

axiomTM



The 30 Year Horizon

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New Foreword

On October 1, 2001 Axiom was withdrawn from the market and ended life as a commercial product. On September 3, 2002 Axiom was released under the Modified BSD license, including this document. On August 27, 2003 Axiom was released as free and open source software available for download from the Free Software Foundation's website, Savannah.

Work on Axiom has had the generous support of the Center for Algorithms and Interactive Scientific Computation (CAISS) at City College of New York. Special thanks go to Dr. Gilbert Baumslag for his support of the long term goal.

The online version of this documentation is roughly 1000 pages. In order to make printed versions we've broken it up into three volumes. The first volume is tutorial in nature. The second volume is for programmers. The third volume is reference material. We've also added a fourth volume for developers. All of these changes represent an experiment in print-on-demand delivery of documentation. Time will tell whether the experiment succeeded.

Axiom has been in existence for over thirty years. It is estimated to contain about three hundred man-years of research and has, as of September 3, 2003, 143 people listed in the credits. All of these people have contributed directly or indirectly to making Axiom available. Axiom is being passed to the next generation. I'm looking forward to future milestones.

With that in mind I've introduced the theme of the "30 year horizon". We must invent the tools that support the Computational Mathematician working 30 years from now. How will research be done when every bit of mathematical knowledge is online and instantly available? What happens when we scale Axiom by a factor of 100, giving us 1.1 million domains? How can we integrate theory with code? How will we integrate theorems and proofs of the mathematics with space-time complexity proofs and running code? What visualization tools are needed? How do we support the conceptual structures and semantics of mathematics in effective ways? How do we support results from the sciences? How do we teach the next generation to be effective Computational Mathematicians?

The "30 year horizon" is much nearer than it appears.

Tim Daly
CAISS, City College of New York
November 10, 2003 ((iHy))

Chapter 1

The Interpreter

The Axiom interpreter is a large common lisp program. It has several forms of interaction and run from terminal in a standalone fashion, run under the control of a session handler program, run as a web server, or run in a unix pipe.

Chapter 2

The Fundamental Data Structures

Axiom currently depends on a lot of global variables. These are generally listed here along with explanations.

2.1 The global variables

Credits

Axiom has a very long history and many people have contributed to the effort, some in large ways and some in small ways. Any and all effort deserves recognition. There is no other criteria than contribution of effort. We would like to acknowledge and thank the following people:

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— initvars —

```
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"Bruno Zuercher	Dan Zwillingner"	

))

The `$current-directory` variable is set to the current directory at startup. This is used by the `)cd` function and some of the compile routines. This is the result of the (p34) `get-current-directory` function. This variable is used to set `*default-pathname-defaults*`. The (p38) `reroot` function resets it to `$spadroot`.

An example of a runtime value is:

```
$current-directory = "/research/test/"
```

```
defvar $current-directory
```

— initvars —

```
(defvar $current-directory nil)
```

The `$defaultMsgDatabaseName` variable contains the location of the international message database. This can be changed to use a translated version of the messages. It defaults to the United States English version. The relative pathname used as the default is hardcoded in the (p38) `reroot` function. This value is prefixed with the `$spadroot` to make the path absolute.

In general, all Axiom message text should be stored in this file to enable internationalization of messages.

An example of a runtime value is:

```
|$defaultMsgDatabaseName| =
  #p"/research/test/mnt/ubuntu/doc/messages/s2-us.messages"
```

defvar \$defaultMsgDatabaseName

— initvars —

```
(defvar |$defaultMsgDatabaseName| nil)
```

The `$directory-list` is a runtime list of absolute pathnames. This list is generated by (p38) `reroot` from the list of relative paths held in the variable `$relative-directory-list`. Each entry will be prefixed by `$spadroot`.

An example of a runtime value is:

```
$directory-list =
  ("/research/test/mnt/ubuntu/../../src/input/"
   "/research/test/mnt/ubuntu/doc/messages/"
   "/research/test/mnt/ubuntu/../../src/algebra/"
   "/research/test/mnt/ubuntu/../../src/interp/"
   "/research/test/mnt/ubuntu/doc/spadhelp/")
```

defvar \$directory-list

— initvars —

```
(defvar $directory-list nil)
```

The `$InitialModemapFrame` is used as the initial value.
 See the function “makeInitialModemapFrame” (4.3 p 35).
 An example of a runtime value is:

```
$InitialModemapFrame = '((nil))
```

defvar `$InitialModemapFrame`

— initvars —

```
(defvar |$InitialModemapFrame| '((nil)))
```

The `$library-directory-list` variable is the system-wide search path for library files. (p38)
 reroot prepends the `$spadroot` variable to the `$relative-library-directory-list` variable.
 An example of a runtime value is:

```
$library-directory-list = ("/research/test/mnt/ubuntu/algebra/")
```

defvar `$library-directory-list`

— initvars —

```
(defvar $library-directory-list '("/algebra/"))
```

The `$msgDatabaseName` is a locally shared variable among the message database routines.
 An example of a runtime value is:

```
|$msgDatabaseName| = nil
```

defvar `$msgDatabaseName`

— initvars —


```
(defvar |$msgDatabaseName| nil)
```

The `$openServerIfTrue` It appears to control whether the interpreter will be used as an open server, probably for OpenMath use.

If an open server is not requested then this variable to NIL

See the function “openserver” ([63 p 987](#)).

An example of a runtime value is:

```
$openServerIfTrue = nil
```

defvar \$openServerIfTrue

— initvars —

```
(defvar $openServerIfTrue nil)
```

The `$relative-directory-list` variable contains a hand-generated list of directories used in the Axiom system. The relative directory list specifies a search path for files for the current directory structure. It has been changed from the NAG distribution back to the original form.

This list is used by the ([p38](#)) reroot function to generate the absolute list of paths held in the variable `$directory-list`. Each entry will be prefixed by `$spadroot`.

An example of a runtime value is:

```
$relative-directory-list =
  ("../../../../src/input/"
   "/doc/messages/"
   "../../../../src/algebra/"
   "../../../../src/interp/"
   "/doc/spadhelp/")
```

defvar \$relative-directory-list

— initvars —

```
(defvar $relative-directory-list
```

```
'("../.../src/input/"
  "/doc/msgs/"
  "../.../src/algebra/"
  "../.../src/interp/" ; for lisp files (helps fd)
  "/doc/spadhelp/" ))
```

The `$relative-library-directory-list` is a hand-generated list of directories containing algebra. The (p38) `reroot` function will prefix every path in this list with the value of the `$spadroot` variable to construct the `$library-directory-list` variable.

An example of a runtime value is:

```
$relative-library-directory-list = ("/algebra/")
```

defvar \$relative-library-directory-list

— initvars —

```
(defvar $relative-library-directory-list '("/algebra/"))
```

The `$spadroot` variable is the internal name for the AXIOM shell variable. It is set in `reroot` to the value of the argument. The value is expected to be a directory name. The (p33) `initroot` function uses this variable if the AXIOM shell variable is not set. The (p35) `make-absolute-filename` function uses this path as a prefix to all of the relative filenames to make them absolute.

An example of a runtime value is:

```
$spadroot = "/research/test/mnt/ubuntu"
```

defvar \$spadroot

— initvars —

```
(defvar $spadroot nil)
```

The `$SpadServer` determines whether Axiom acts as a remote server.

See the function “openserver” ([63 p 987](#)).

An example of a runtime value is:

```
$SpadServer = nil
```

defvar \$SpadServer

— initvars —

```
(defvar $SpadServer nil "t means Axiom acts as a remote server")
```

—————

The `$SpadServerName` defines the name of the spad server socket. In unix these exist in the tmp directory as names.

See the function “openserver” ([63 p 987](#)).

An example of a runtime value is:

```
$SpadServerName = "/tmp/.d"
```

defvar \$SpadServerName

— initvars —

```
(defvar $SpadServerName "/tmp/.d" "the name of the spad server socket")
```

—————

The `$IOindex` variable is the number associated with the input prompt. Every successful expression evaluated increments this number until a `)clear all` resets it. Here we set it to the initial value.

An example of a runtime value is:

```
$IOindex = 1
```

defvar \$IOindex

— initvars —

```
(defvar $I0index 1 "The current Axiom prompt number")
```

Chapter 3

Starting Axiom

Axiom starts by invoking a function value of the lisp symbol `*top-level-hook*`. The function invocation path to from this point until the prompt is approximates (skipping initializations):

```
lisp -> restart
      -> |spad|
      -> |runspad|
      -> |ncTopLevel|
      -> |ncIntLoop|
      -> |intloop|
      -> |SpadInterpretStream|
      -> |intloopReadConsole|
```

The `—intloopReadConsole—` function does tail-recursive calls to itself (don't break this) and never exits.

3.1 Variables Used

3.2 Data Structures

3.3 Functions

Set the restart hook

When a lisp image containing code is reloaded there is a hook to allow a function to be called. In our case it is the restart function which is the entry to the Axiom interpreter.

— **defun set-restart-hook 0** —

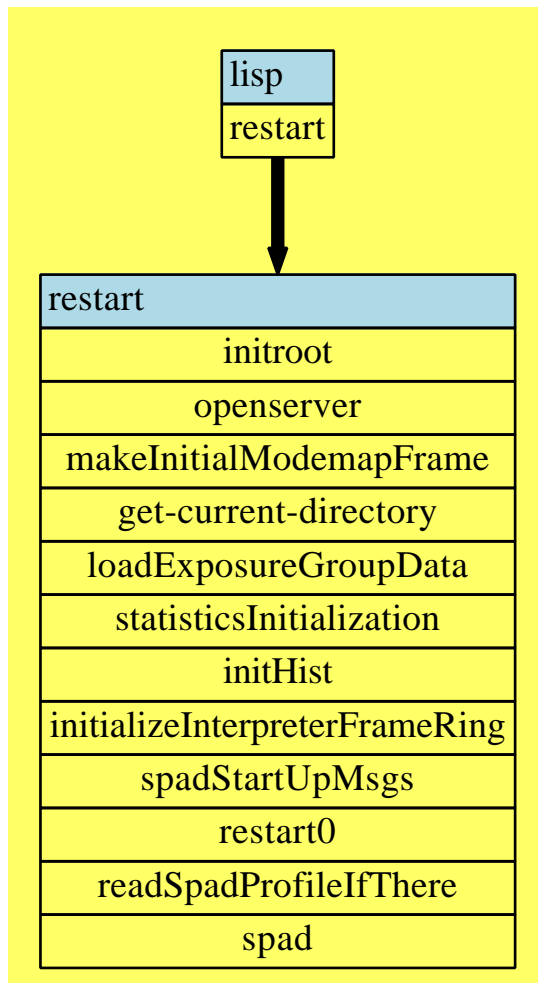
```
(defun set-restart-hook ())
```

```

"Set the restart hook"
#+KCL (setq system::*top-level-hook* 'restart)
#+Lucid (setq boot::restart-hook 'restart)
'restart
)

```

restart function (The restart function)



The restart function is the real root of the world. It sets up memory if we are working in a GCL/akcl version of the system.

The `compiler::*compile-verbose*` flag has been set to nil globally. We do not want to know about the microsteps of GCL's compile facility.

The `compiler::*suppress-compiler-warnings*` flag has been set to t. We do not care that certain generated variables are not used.

The `compiler::*suppress-compiler-notes*` flag has been set to t. We do not care that tail recursion occurs.

It sets the current package to be the "BOOT" package which is the standard package in which the interpreter runs.

The "initroot" (4.3 p 33) function sets global variables that depend on the AXIOM shell variable. These are needed to find basic files like s2-us.msgs, which contains the error message text.

The "openserver" (63 p 987) function tried to set up the socket connection used for things like hyperdoc. The `$openServerIfTrue` variable starts true, which implies trying to start a server.

Axiom has multiple frames that contain independent information about a computation. There can be several frames at any one time and you can shift back and forth between the frames. By default, the system starts in "frame0" (try the `)frame names` command). See the Frame Mechanism chapter (32.3 page 552).

The `$InteractiveFrame` variable contains the state information related to the current frame, which includes things like the last value, the value of all of the variables, etc.

The "printLoadMsgs" (45.29 p 736) variable controls whether load messages will be output as library routines are loaded. We disable this by default. It can be changed by using `)set message autoload`.

The "current-directory" (2.1 p 5) variable is set to the current directory. This is used by the `)cd` function and some of the compile routines.

The "statisticsInitialization" (67 p 1035) function initializes variables used to collect statistics. Currently, only the garbage collector information is initialized.

[init-memory-config p32]
 [initroot p33]
 [openserver p987]
 [makeInitialModemapFrame p35]
 [get-current-directory p34]
 [statisticsInitialization p1035]
 [initHist p581]
 [initializeInterpreterFrameRing p555]
 [spadStartUpMsgs p17]
 [restart0 p16]
 [readSpadProfileIfThere p961]
 [spad p18]
 [\$openServerIfTrue p8]
 [\$SpadServerName p10]
 [\$SpadServer p10]


```

[\$IOindex p10]
[\$InteractiveFrame p??]
[\$printLoadMsgs p736]
[\$current-directory p5]
[\$displayStartMsgs p749]
[\$currentLine p??]

```

— **defun restart** —

```

(defun restart ()
  (declare (special $openServerIfTrue $SpadServerName |$SpadServer|
    |$IOindex| |$InteractiveFrame| |$printLoadMsgs| $current-directory
    |$displayStartMsgs| |$currentLine|))
  #+:akcl
    (init-memory-config :cons 1024 :fixnum 200 :symbol 500 :package 8
      :array 800 :string 1024 :cfun 200 :cpages 6000 :rpages 2000 :hole 4000)
  #+:akcl (setq compiler::*compile-verbose* nil)
  #+:akcl (setq compiler::*suppress-compiler-warnings* t)
  #+:akcl (setq compiler::*suppress-compiler-notes* t)
  #+:akcl (setq si::*system-directory* "")
    (in-package "BOOT")
    (initroot)
  #+:akcl
    (when (and $openServerIfTrue (zerop (openserver $SpadServerName)))
      (setq $openServerIfTrue nil)
      (setq |$SpadServer| t))
    (setq |$IOindex| 1)
    (setq |$InteractiveFrame| (|makeInitialModemapFrame|))
    (setq |$printLoadMsgs| nil)
    (setq $current-directory (get-current-directory))
    (setq *default-pathname-defaults* (pathname $current-directory))
    (|statisticsInitialization|)
    (|initHist|)
    (|initializeInterpreterFrameRing|)
    (when |$displayStartMsgs| (|spadStartUpMsgs|))
    (setq |$currentLine| nil)
    (restart0)
    (|readSpadProfileIfThere|)
    (|spad|))

```

defun Non-interactive restarts

```

[interopen p??]
[operationopen p??]
[categoryopen p??]

```

```
[browseopen p??]
[getEnv p??]
```

— defun restart0 —

```
(defun restart0 ()
  (interpopen)      ;; open up the interpreter database
  (operationopen)    ;; all of the operations known to the system
  (categoryopen)     ;; answer hasCategory question
  (browseopen))
```

defun The startup banner messages

```
[fillerSpaces p18]
[specialChar p980]
[sayKeyedMsg p329]
[sayMSG p331]
[msgAlist p326]
[opSysName p??]
[linelength p774]
[*yearweek* p??]
[*build-version* p??]
```

— defun spadStartUpMsgs —

```
(defun |spadStartUpMsgs| ()
  (let (bar)
    (declare (special |msgAlist| |opSysName| $linelength *yearweek*
                      *build-version*))
    (when (> $linelength 60)
      (setq bar (|fillerSpaces| $linelength (|specialChar| '|hbar|)))
      (|sayKeyedMsg| 'S2GL0001 (list *build-version* *yearweek*))
      (|sayMSG| bar)
      (|sayKeyedMsg| 'S2GL0018C nil)
      (|sayKeyedMsg| 'S2GL0018D nil)
      (|sayKeyedMsg| 'S2GL0003B (list |opSysName|))
      (say " Visit http://axiom-developer.org for more information")
      (|sayMSG| bar)
      (setq |msgAlist| nil)
      (|sayMSG| '| |))))
```

defun Make a vector of filler characters

```
[ifcar p??]
```

— defun fillerSpaces —

```
(defun |fillerSpaces| (&rest arglist &aux charPart n)
  (setq n (car arglist))
  (setq charPart (cdr arglist))
  (if (<= n 0)
      ""
      (make-string n :initial-element (character (or (ifcar charPart) " "))))
```

Starts the interpreter but do not read in profiles

```
[setOutputAlgebra p763]
[runspad p19]
[$PrintCompilerMessageIfTrue p??]
```

— defun spad —

```
(defun |spad| ()
  "Starts the interpreter but do not read in profiles"
  (let (|$PrintCompilerMessageIfTrue|)
    (declare (special |$PrintCompilerMessageIfTrue|))
    (setq |$PrintCompilerMessageIfTrue| nil)
    (|setOutputAlgebra| '|%initialize%|)
    (|runspad|)
    '|EndOfSpad|))
```

defvar \$quitTag

— initvars —

```
(defvar |$quitTag| system::*quit-tag*)
```

defun runspad

```
[quitTag p18]
[coerceFailure p??]
[top-level p??]
[seq p??]
[exit p??]
[resetStackLimits p19]
[ncTopLevel p23]
[$quitTag p18]
```

— defun runspad —

```
(defun |runspad| ()
  (prog (mode)
    (declare (special |$quitTag|))
    (return
      (seq
        (progn
          (setq mode '|restart|)
          (do ()
            ((null (eq mode '|restart|)) nil)
            (seq
              (exit
                (progn
                  (|resetStackLimits|)
                  (catch |$quitTag|
                    (catch '|coerceFailure|
                      (setq mode (catch '|top_level| (|ncTopLevel|))))))))))))))
```

—————

defun Reset the stack limits

```
[reset-stack-limits p??]
```

— defun resetStackLimits 0 —

```
(defun |resetStackLimits| ()
  "Reset the stack limits"
  (system:reset-stack-limits))
```

—————

Chapter 4

Handling Terminal Input

4.1 Streams

defvar \$curinstream

The curinstream variable is set to the value of the ***standard-input*** common lisp variable in ncIntLoop. While not using the “dollar” convention this variable is still “global”.

— **initvars** —

```
(defvar curinstream (make-synonym-stream '*standard-input*))
```

defvar \$curoutstream

The curoutstream variable is set to the value of the ***standard-output*** common lisp variable in ncIntLoop. While not using the “dollar” convention this variable is still “global”.

— **initvars** —

```
(defvar curoutstream (make-synonym-stream '*standard-output*))
```

defvar \$errorinstream

— **initvars** —

```
(defvar errorinstream (make-synonym-stream '*terminal-io*))
```

defvar \$erroroutstream

— initvars —

```
(defvar erroroutstream (make-synonym-stream '*terminal-io*))
```

defvar \$*eof*

— initvars —

```
(defvar *eof* nil)
```

defvar \$*whitespace*

— initvars —

```
(defvar *whitespace*
  '(#\Space #\Newline #\Tab #\Page #\Linefeed #\Return #\Backspace)
  "A list of characters used by string-trim considered as whitespace")
```

defvar \$InteractiveMode

— initvars —

```
(defvar |$InteractiveMode| t)
```

defvar \$boot

— initvars —

```
(defvar $boot nil)
```

—————

Top-level read-parse-eval-print loop

Top-level read-parse-eval-print loop for the interpreter. Uses the Bill Burge's parser. [ncInt-Loop p23]

```
[ $e p?? ]
[ $spad p18 ]
[ $newspad p?? ]
[ $boot p23 ]
[ $InteractiveMode p22 ]
[ $InteractiveFrame p?? ]
[ *eof* p22 ]
[ in-stream p961 ]
```

— defun ncTopLevel —

```
(defun |ncTopLevel| ()
  "Top-level read-parse-eval-print loop"
  (let (|$e| $spad $newspad $boot |$InteractiveMode| *eof* in-stream)
    (declare (special |$e| $spad $newspad $boot |$InteractiveMode| *eof*
                      in-stream |$InteractiveFrame|))
    (setq in-stream curinstream)
    (setq *eof* nil)
    (setq |$InteractiveMode| t)
    (setq $boot nil)
    (setq $newspad t)
    (setq $spad t)
    (setq |$e| |$InteractiveFrame|)
    (|ncIntLoop|)))
```

—————

defun ncIntLoop

```
[intloop p24]
[curinstream p21]
```


[curoutstream p21]

— defun ncIntLoop —

```
(defun |ncIntLoop| ()
  (let ((curinstream *standard-output*)
        (curoutstream *standard-input*))
    (declare (special curinstream curoutstream))
    (|intloop|)))
```

—————

defvar \$intTopLevel

— initvars —

```
(defvar |$intTopLevel| ' |top_level|)
```

—————

defvar \$intRestart

— initvars —

```
(defvar |$intRestart| ' |restart|)
```

—————

defun intloop

Note that the SpadInterpretStream function uses a list of three strings as an argument. The values in the list seem to have no use and can eventually be removed. [intTopLevel p24]

[SpadInterpretStream p25]

[resetStackLimits p19]

[\$intTopLevel p24]

[\$intRestart p24]

— defun intloop —

```
(defun |intloop| ()
```

```

(prog (mode)
  (declare (special |$intTopLevel| |$intRestart|))
  (return
    (progn
      (setq mode |$intRestart|)
      ((lambda ()
        (loop
          (cond
            ((not (equal mode |$intRestart|))
              (return nil))
            (t
              (progn
                (|resetStackLimits|)
                (setq mode
                  (catch |$intTopLevel|
                    (|SpadInterpretStream| 1
                      (list 'tim 'daly '? t))))))))))))))

```

defvar \$ncMsgList

— initvars —

```
(defvar |$ncMsgList| nil)
```

defun SpadInterpretStream

The SpadInterpretStream function takes three arguments

str This is passed as an argument to intloopReadConsole

source This is the name of a source file but appears not to be used. It is set to the list (tim daly ?).

interactive? If this is false then various messages are suppressed and input does not use piles. If this is true then the library loading routines might output messages and piles are expected on input (as from a file).

System commands are handled by the function in the “hook” variable **\$systemCommandFunction** which has the default function **InterpExecuteSpadSystemCommand**. Thus, when a system command is entered this function is called.

The **\$promptMsg** variable is set to the constant S2CTP023. This constant points to a message in src/doc/msgsgs/s2-us.msgsgs. This message does nothing but print the argument value.

defvar \$promptMsg

— initvars —

```
(defvar |$promptMsg| 'S2CTP023)
```

—————

defun GCL cmpnote function

GCL keeps noting the fact that the compiler is performing tail-recursion. Bill Schelter added this as a debugging tool for Axiom and it was never removed. Patching the lisp code in the GCL build fails as the system is actually built from the pre-compiled C code. Thus, we can only step on this message after the fact. The cmpnote function is used nowhere else in GCL so stepping on the function call seems best. We're unhappy with this hack and will try to convince the GCL crowd to fix this.

— defun cmpnote —

```
#+:gcl (defun compiler::cmpnote (&rest x) (declare (ignore x)))
```

—————

defvar \$newcompErrorCount

— initvars —

```
(defvar |$newcompErrorCount| 0)
```

—————

defvar \$nupos

— initvars —

```
(defvar |$nupos| (list '|noposition|))
```

—————

```

[mkprompt p40]
[intloopReadConsole p28]
[intloopInclude p61]
[$promptMsg p26]
[$systemCommandFunction p??]
[$ncMsgList p25]
[$errMsgToss p??]
[$lastPos p??]
[$inclAssertions p??]
[$okToExecuteMachineCode p??]
[$newcompErrorCount p26]
[$libQuiet p??]
[$fn p??]
[$nopus p26]

```

— defun SpadInterpretStream —

```

(defun |SpadInterpretStream| (str source interactive?)
  (let (|$promptMsg| |$systemCommandFunction|
        |$ncMsgList| |$errMsgToss| |$lastPos| |$inclAssertions|
        |$okToExecuteMachineCode| |$newcompErrorCount|
        |$libQuiet| |$fn|)
    (declare (special |$promptMsg|
                      |$systemCommandFunction| |$ncMsgList| |$errMsgToss| |$lastPos|
                      |$inclAssertions| |$okToExecuteMachineCode| |$newcompErrorCount|
                      |$libQuiet| |$fn| |$nopus|))
    (setq |$fn| source)
    (setq |$libQuiet| (null interactive?))
    (setq |$newcompErrorCount| 0)
    (setq |$okToExecuteMachineCode| t)
    (setq |$inclAssertions| (list 'aix '|CommonLisp|))
    (setq |$lastPos| |$nopus|)
    (setq |$errMsgToss| nil)
    (setq |$ncMsgList| nil)
    (setq |$systemCommandFunction| #'|InterpExecuteSpadSystemCommand|)
    (setq |$promptMsg| 's2ctp023)
    (if interactive?
        (progn
          (princ (mkprompt))
          (|intloopReadConsole| "" str))
        (|intloopInclude| source 0))))

```

—————

4.2 The Read-Eval-Print Loop

defun intloopReadConsole

Note that this function relies on the fact that lisp can do tail-recursion. The function recursively invokes itself.

The serverReadLine function is a special readline function that handles communication with the session manager code, which is a separate process running in parallel.

We read a line from standard input.

- If it is a null line then we exit Axiom.
- If it is a zero length line we prompt and recurse
- If \$dalymode and open-paren we execute lisp code, prompt and recurse The \$dalymode will interpret any input that begins with an open-paren as a lisp expression rather than Axiom input. This is useful for debugging purposes when most of the input lines will be lisp. Setting \$dalymode non-nil will certainly break user expectations and is to be used with caution.
- If it is “)fi” or “)fin” we drop into lisp. Use the (restart) function to return to the interpreter loop.
- If it starts with “)” we process the command, prompt, and recurse
- If it is a command then we remember the current line, process the command, prompt, and recurse.
- If the input has a trailing underscore (Axiom line-continuation) then we cut off the continuation character and pass the truncated string to ourselves, prompt, and recurse
- otherwise we process the input, prompt, and recurse.

Notice that all but two paths (a null input or a “)fi” or a “)fin”) will end up as a recursive call to ourselves. [top-level p??]

[serverReadLine p42]
 [leaveScratchpad p639]
 [mkprompt p40]
 [intloopReadConsole p28]
 [intloopPrefix? p34]
 [intnplisp p34]
 [setCurrentLine p40]
 [ncloopCommand p478]
 [concat p1047]
 [ncloopEscaped p35]
 [intloopProcessString p36]
 [\$dalymode p663]

— defun intloopReadConsole —

```
(defun |intloopReadConsole| (b n)
  (declare (special $dalymode))
  (let (c d pfx input)
    (setq input (|serverReadLine| *standard-input*))
    (when (null (stringp input)) (|leaveScratchpad|))
    (when (eql (length input) 0)
      (princ (mkprompt))
      (|intloopReadConsole| "" n))
    (when (and $dalymode (|intloopPrefix?| "(" input))
      (|intnplisp| input)
      (princ (mkprompt))
      (|intloopReadConsole| "" n))
    (setq pfx (|intloopPrefix?| ")fi" input))
    (when (and pfx (or (string= pfx ")fi") (string= pfx ")fin")))
      (throw '|top_level| nil))
    (when (and (equal b "") (setq d (|intloopPrefix?| ")" input)))
      (|setCurrentLine| d)
      (setq c (|ncloopCommand| d n))
      (princ (mkprompt))
      (|intloopReadConsole| "" c))
    (setq input (concat b input))
    (when (|ncloopEscaped| input)
      (|intloopReadConsole| (subseq input 0 (- (length input) 1)) n))
    (setq c (|intloopProcessString| input n))
    (princ (mkprompt))
    (|intloopReadConsole| "" c)))
```

—————

4.3 Helper Functions

Get the value of an environment variable

[getenv p??]

— defun getenviron 0 —

```
(defun getenviron (var)
  "Get the value of an environment variable"
  #+allegro (sys::getenv (string var))
  #+clisp (ext:getenv (string var))
  #+(or cmu scl)
  (cdr
```

```

    (assoc (string var) ext:*environment-list* :test #'equalp :key #'string))
  #+(or kcl akcl gcl) (si::getenv (string var))
  #+lispworks (lw:environment-variable (string var))
  #+lucid (lcl:environment-variable (string var))
  #+mcl (ccl::getenv var)
  #+sbcl (sb-ext:posix-getenv var)
)

```

defvar \$intCoerceFailure

— initvars —

```
(defvar |$intCoerceFailure| '|coerceFailure|)
```

defvar \$intSpadReader

— initvars —

```
(defvar |$intSpadReader| 'SPAD_READER)
```

defun InterpExecuteSpadSystemCommand

```

[intCoerceFailure p30]
[intSpadReader p30]
[ExecuteInterpSystemCommand p31]
[$intSpadReader p30]
[$intCoerceFailure p30]

```

— defun InterpExecuteSpadSystemCommand —

```

(defun |InterpExecuteSpadSystemCommand| (string)
  (declare (special |$intSpadReader| |$intCoerceFailure|))
  (catch |$intCoerceFailure|
    (catch |$intSpadReader|
      (|ExecuteInterpSystemCommand| string))))

```

defun ExecuteInterpSystemCommand

```
[intProcessSynonyms p31]
[substring p??]
[doSystemCommand p446]
[$currentLine p??]
```

— defun ExecuteInterpSystemCommand —

```
(defun |ExecuteInterpSystemCommand| (string)
  (let (|$currentLine|)
    (declare (special |$currentLine|))
    (setq string (|intProcessSynonyms| string))
    (setq |$currentLine| string)
    (setq string (substring string 1 nil))
    (unless (equal string "") (|doSystemCommand| string))))
```

defun Handle Synonyms

```
[processSynonyms p31]
[line p??]
```

— defun intProcessSynonyms —

```
(defun |intProcessSynonyms| (str)
  (let ((line str))
    (declare (special line))
    (|processSynonyms|)
    line))
```

defun Synonym File Reader

```
[strpos p1045]
[substring p??]
[string2id-n p??]
[lassoc p??]
[strconc p??]
```



```
[size p1045]
[concat p1047]
[rplacstr p??]
[processSynonyms p31]
[$CommandSynonymAlist p478]
[line p??]
```

— defun processSynonyms —

```
(defun |processSynonyms| ()
  (let (fill p aline synstr syn to opt fun cl chr)
    (declare (special |$CommandSynonymAlist| line))
    (setq p (strpos ")" line 0 nil))
    (setq fill "")
    (cond
      (p
        (setq aline (substring line p nil))
        (when (> p 0) (setq fill (substring line 0 p))))
      (t
        (setq p 0)
        (setq aline line)))
    (setq to (strpos " " aline 1 nil))
    (cond (to (setq to (1- to))))
    (setq synstr (substring aline 1 to))
    (setq syn (string2id-n synstr 1))
    (when (setq fun (lassoc syn |$CommandSynonymAlist|))
      (setq to (strpos ")" fun 1 nil))
      (cond
        ((and to (not (eql to (1- (size fun))))))
          (setq opt (strconc " " (substring fun to nil)))
          (setq fun (substring fun 0 (1- to))))
        (t (setq opt " ")))
      (when (> (size synstr) (size fun))
        (do ((G167173 (size synstr)) (i (size fun) (1+ i)))
            ((> i G167173) nil)
          (setq fun (concat fun " "))))
      (setq cl (strconc fill (rplacstr aline 1 (size synstr) fun) opt))
      (setq line cl)
      (setq chr (elt line (1+ p)))
      (|processSynonyms|))))
```

defun init-memory-config

Austin-Kyoto Common Lisp (AKCL), now known as Gnu Common Lisp (GCL) requires some changes to the default memory setup to run Axiom efficiently. This function performs

those setup commands. [allocate p??]
 [allocate-contiguous-pages p??]
 [allocate-relocatable-pages p??]
 [set-hole-size p??]

— defun init-memory-config 0 —

```
(defun init-memory-config (&key
                          (cons 500)
                          (fixnum 200)
                          (symbol 500)
                          (package 8)
                          (array 400)
                          (string 500)
                          (cfun 100)
                          (cpages 3000)
                          (rpages 1000)
                          (hole 2000) )
  ;; initialize AKCL memory allocation parameters
  #+:AKCL
  (progn
    (system:allocate 'cons cons)
    (system:allocate 'fixnum fixnum)
    (system:allocate 'symbol symbol)
    (system:allocate 'package package)
    (system:allocate 'array array)
    (system:allocate 'string string)
    (system:allocate 'cfun cfun)
    (system:allocate-contiguous-pages cpages)
    (system:allocate-relocatable-pages rpages)
    (system:set-hole-size hole))
  #-:AKCL
  nil)
```

—————

Set spadroot to be the AXIOM shell variable

Sets up the system to use the **AXIOM** shell variable if we can and default to the **\$spadroot** variable (which was the value of the **AXIOM** shell variable at build time) if we can't.

[reroot p38]
 [getenvIRON p29]
 [\$spadroot p9]

— defun initroot —

```
(defun initroot (&optional (newroot (getenvIRON "AXIOM")))
```

```
"Set spadroot to be the AXIOM shell variable"
(declare (special $spadroot))
(reroot (or newroot $spadroot (error "setenv AXIOM or (setq $spadroot)"))))
```

Does the string start with this prefix?

If the prefix string is the same as the whole string initial characters –R(ignoring spaces in the whole string) then we return the whole string minus any leading spaces.

— defun intloopPrefix? 0 —

```
(defun |intloopPrefix?| (prefix whole)
  "Does the string start with this prefix?"
  (let ((newprefix (string-left-trim '(#\space) prefix))
        (newwhole (string-left-trim '(#\space) whole)))
    (when (<= (length newprefix) (length newwhole))
      (when (string= newprefix newwhole :end2 (length prefix))
        newwhole))))
```

defun Interpret a line of lisp code

This is used to handle)lisp top level commands [nplisp p472]
[\$currentLine p??]

— defun intnplisp —

```
(defun |intnplisp| (s)
  (declare (special |$currentLine|))
  (setq |$currentLine| s)
  (|nplisp| |$currentLine|))
```

Get the current directory

— defun get-current-directory 0 —

```
(defun get-current-directory ()
  "Get the current directory"
```

```
(namestring (truename "")))
```

Prepend the absolute path to a filename

Prefix a filename with the **AXIOM** shell variable. [[\\$spadroot p9](#)]

— **defun make-absolute-filename 0** —

```
(defun make-absolute-filename (name)
  "Prepend the absolute path to a filename"
  (declare (special $spadroot))
  (concatenate 'string $spadroot name))
```

Make the initial modemap frame

[[copy p??](#)]

[[\\$InitialModemapFrame p7](#)]

— **defun makeInitialModemapFrame 0** —

```
(defun |makeInitialModemapFrame| ()
  "Make the initial modemap frame"
  (declare (special |$InitialModemapFrame|))
  (copy |$InitialModemapFrame|))
```

defun ncloopEscaped

The ncloopEscaped function will return true if the last non-blank character of a line is an underscore, the Axiom line-continuation character. Otherwise, it returns nil.

— **defun ncloopEscaped 0** —

```
(defun |ncloopEscaped| (x)
  (let ((l (length x)))
    (dotimes (i l)
      (when (char= (char x (- l i 1)) #\_) (return t))
      (unless (char= (char x (- l i 1)) #\space) (return nil))))))
```

defun intloopProcessString

```
[setCurrentLine p40]
[intloopProcess p62]
[next p36]
[incString p37]
```

— defun intloopProcessString —

```
(defun |intloopProcessString| (s n)
  (|setCurrentLine| s)
  (|intloopProcess| n t
    (|next| #'|ncloopParse|
      (|next| #'|lineoftoks| (|incString| s)))))
```

defun ncloopParse

```
[ncloopDQlines p70]
[npParse p141]
[dqToList p344]
```

— defun ncloopParse —

```
(defun |ncloopParse| (s)
  (let (cudr lines stream dq t1)
    (setq t1 (car s))
    (setq dq (car t1))
    (setq stream (cadr t1))
    (setq t1 (|ncloopDQlines| dq stream))
    (setq lines (car t1))
    (setq cudr (cadr t1))
    (cons (list (list lines (|npParse| (|dqToList| dq)))) (cdr s))))
```

defun next

```
[Delay p102]
[next1 p37]
```

— defun next —

```
(defun |next| (f s)
  (|Delay| #'|next1| (list f s)))
```

defun next1

[StreamNull p333]
 [incAppend p85]
 [next p36]

— defun next1 —

```
(defun |next1| (&rest z)
  (let (h s f)
    (setq f (car z))
    (setq s (cadr z))
    (cond
      ((|StreamNull| s) |StreamNil|)
      (t
       (setq h (apply f (list s)))
       (|incAppend| (car h) (|next| f (cdr h)))))))
```

defun incString

[incRenumber p72]
 [incLude p75]
 [Top p75]

— defun incString —

```
(defun |incString| (s)
  (declare (special |Top|))
  (|incRenumber| (|incLude| 0 (list s) 0 (list "strings") (list |Top|))))
```

Call the garbage collector

Call the garbage collector on various platforms.

— defun reclaim 0 —

```

#+abcl
(defun reclaim () "Call the garbage collector" (ext::gc))
#+:allegro
(defun reclaim () "Call the garbage collector" (excl::gc t))
#+:CCL
(defun reclaim () "Call the garbage collector" (gc))
#+clisp
(defun reclaim ()
  "Call the garbage collector"
  (#+lisp=cl ext::gc #-lisp=cl lisp::gc))
#+(or :cmulisp :cmu)
(defun reclaim () "Call the garbage collector" (ext:gc))
#+cormanlisp
(defun reclaim () "Call the garbage collector" (cl::gc))
#+(OR IBCL KCL GCL)
(defun reclaim () "Call the garbage collector" (si::gbc t))
#+lispworks
(defun reclaim () "Call the garbage collector" (hcl::normal-gc))
#+Lucid
(defun reclaim () "Call the garbage collector" (lcl::gc))
#+sbcl
(defun reclaim () "Call the garbage collector" (sb-ext::gc))

```

defun reroot

The `reroot` function is used to reset the important variables used by the system. In particular, these variables are sensitive to the **AXIOM** shell variable. That variable is renamed internally to be **\$spadroot**. The **reroot** function will change the system to use a new root directory and will have the same effect as changing the **AXIOM** shell variable and rerunning the system from scratch. Note that we have changed from the NAG distribution back to the original form. If you need the NAG version you can push **:tpd** on the ***features*** variable before compiling this file. A correct call looks like:

```

(in-package "BOOT")
(reroot "/spad/mnt/${SYS}")

```

where the `${SYS}` variable is the same one set at build time.

For the example call:

```

(REROOT "/research/test/mnt/ubuntu")

```

the variables are set as:

```

$spadroot = "/research/test/mnt/ubuntu"

```

```

$relative-directory-list =
  ("../../../../src/input/"
   "/doc/messages/"
   "../../../../src/algebra/"
   "../../../../src/interp/"
   "/doc/spadhelp/")

$directory-list =
  ("/research/test/mnt/ubuntu/../../../../src/input/"
   "/research/test/mnt/ubuntu/doc/messages/"
   "/research/test/mnt/ubuntu/../../../../src/algebra/"
   "/research/test/mnt/ubuntu/../../../../src/interp/"
   "/research/test/mnt/ubuntu/doc/spadhelp/")

$relative-library-directory-list = ("/algebra/")

$library-directory-list = ("/research/test/mnt/ubuntu/algebra/")

|$defaultMsgDatabaseName| = #p"/research/test/mnt/ubuntu/doc/messages/s2-us.messages"

|$msgDatabaseName| = nil

$current-directory = "/research/test/"

[make-absolute-filename p35]
[$spadroot p9]
[$directory-list p6]
[$relative-directory-list p8]
[$library-directory-list p7]
[$relative-library-directory-list p9]
|$defaultMsgDatabaseName| p6]
|$msgDatabaseName| p7]
[$current-directory p5]

```

— defun reroot —

```

(defun reroot (dir)
  (declare (special $spadroot $directory-list $relative-directory-list
    $library-directory-list $relative-library-directory-list
    |$defaultMsgDatabaseName| |$msgDatabaseName| $current-directory))
  (setq $spadroot dir)
  (setq $directory-list
    (mapcar #'make-absolute-filename $relative-directory-list))
  (setq $library-directory-list
    (mapcar #'make-absolute-filename $relative-library-directory-list))
  (setq |$defaultMsgDatabaseName|
    (pathname (make-absolute-filename "/doc/messages/s2-us.messages")))
  (setq |$msgDatabaseName| ()))

```



```
(setq $current-directory $spadroot))
```

defun setCurrentLine

Remember the current line. The cases are:

- If there is no \$currentLine set it to the input
- Is the current line a string and the input a string? Make them into a list
- Is \$currentLine not a cons cell? Make it one.
- Is the input a string? Cons it on the end of the list.
- Otherwise stick it on the end of the list

Note I suspect the last two cases do not occur in practice since they result in a dotted pair if the input is not a cons. However, this is what the current code does so I won't change it.
[\$currentLine p??]

— defun setCurrentLine 0 —

```
(defun |setCurrentLine| (s)
  (declare (special |$currentLine|))
  (cond
    ((null |$currentLine|) (setq |$currentLine| s))
    ((and (stringp |$currentLine|) (stringp s))
     (setq |$currentLine| (list |$currentLine| s)))
    ((not (consp |$currentLine|)) (setq |$currentLine| (cons |$currentLine| s)))
    ((stringp s) (rplacd (last |$currentLine|) (cons s nil)))
    (t (rplacd (last |$currentLine|) s)))
  |$currentLine|)
```

Show the Axiom prompt

```
[concat p1047]
[substring p??]
[currenttime p??]
[$inputPromptType p746]
[$IOindex p10]
[$interpreterFrameName p??]
```

— defun mkprompt —

```
(defun mkprompt ()
  "Show the Axiom prompt"
  (declare (special |$inputPromptType| |$IOindex| |$interpreterFrameName|))
  (case |$inputPromptType|
    (|none| "")
    (|plain| "-> ")
    (|step| (concat "(" (princ-to-string |$IOindex|) ") -> "))
    (|frame|
      (concat (princ-to-string |$interpreterFrameName|) " ("
        (princ-to-string |$IOindex|) ") -> "))
    (t (concat (princ-to-string |$interpreterFrameName|) " ["
      (substring (currenttime) 8 nil) "]" ["
        (princ-to-string |$IOindex|) "]" -> "))))))
```

defvar \$frameAlist

— initvars —

```
(defvar |$frameAlist| nil)
```

defvar \$frameNumber

— initvars —

```
(defvar |$frameNumber| 0)
```

defvar \$currentFrameNum

— initvars —

```
(defvar |$currentFrameNum| 0)
```

defvar \$EndServerSession

— initvars —

```
(defvar |$EndServerSession| nil)
```

—————

defvar \$NeedToSignalSessionManager

— initvars —

```
(defvar |$NeedToSignalSessionManager| nil)
```

—————

defvar \$sockBufferLength

— initvars —

```
(defvar |$sockBufferLength| 9217)
```

—————

READ-LINE in an Axiom server system

```
[coerceFailure p??]
[top-level p??]
[spad-reader p??]
[read-line p??]
[addNewInterpreterFrame p561]
[sockSendInt p??]
[sockSendString p??]
[mkprompt p40]
[sockGetInt p??]
[lassoc p??]
[changeToNamedInterpreterFrame p560]
[sockGetString p??]
[unescapeStringsInForm p61]
```

[\[protectedEVAL p45\]](#)
[\[executeQuietCommand p45\]](#)
[\[parseAndInterpret p46\]](#)
[\[serverReadLine is-console \(vol9\)\]](#)
[\[serverSwitch p??\]](#)
[\[\\$KillLispSystem p??\]](#)
[\[\\$NonSmanSession p??\]](#)
[\[\\$SpadCommand p??\]](#)
[\[\\$QuietSpadCommand p??\]](#)
[\[\\$MenuServer p??\]](#)
[\[\\$sockBufferLength p42\]](#)
[\[\\$LispCommand p??\]](#)
[\[\\$EndServerSession p42\]](#)
[\[\\$EndSession p??\]](#)
[\[\\$SwitchFrames p??\]](#)
[\[\\$CreateFrameAnswer p??\]](#)
[\[\\$currentFrameNum p41\]](#)
[\[\\$frameNumber p41\]](#)
[\[\\$frameAlist p41\]](#)
[\[\\$CreateFrame p??\]](#)
[\[\\$CallInterp p??\]](#)
[\[\\$EndOfOutput p??\]](#)
[\[\\$SessionManager p??\]](#)
[\[\\$NeedToSignalSessionManager p42\]](#)
[\[\\$EndServerSession p42\]](#)
[\[\\$SpadServer p10\]](#)
[\[*eof* p22\]](#)
[\[in-stream p961\]](#)

— defun serverReadLine —

```

(defun |serverReadLine| (stream)
  "used in place of READ-LINE in a Axiom server system."
  (let (in-stream *eof* 1 frameName currentFrame form stringBuffer line action)
    (declare (special in-stream *eof* |$SpadServer| |$EndServerSession|
      |$NeedToSignalSessionManager| |$SessionManager| |$EndOfOutput| | |
      |$CallInterp| |$CreateFrame| |$frameAlist| |$frameNumber|
      |$currentFrameNum| |$CreateFrameAnswer| |$SwitchFrames| |$EndSession|
      |$EndServerSession| |$LispCommand| |$sockBufferLength| |$MenuServer|
      |$QuietSpadCommand| |$SpadCommand| |$NonSmanSession| |$KillLispSystem|))
    (force-output)
    (if (or (null |$SpadServer|) (null (is-console stream)))
      (|read-line| stream)
      (progn
        (setq in-stream stream)
        (setq *eof* nil)
        (setq line

```

```

(do ()
  ((null (and (null |$EndServerSession|) (null *eof*))) nil)
  (when |$NeedToSignalSessionManager|
    (|sockSendInt| |$SessionManager| |$EndOfOutput|))
  (setq |$NeedToSignalSessionManager| nil)
  (setq action (|serverSwitch|))
  (cond
    ((= action |$CallInterp|)
     (setq l (|read-line| stream))
     (setq |$NeedToSignalSessionManager| t)
     (return l))
    ((= action |$CreateFrame|)
     (setq framename (gentemp "frame"))
     (|addNewInterpreterFrame| framename)
     (setq |$frameAlist|
      (cons (cons |$frameNumber| framename) |$frameAlist|))
     (setq |$currentFrameNum| |$frameNumber|)
     (|sockSendInt| |$SessionManager| |$CreateFrameAnswer|)
     (|sockSendInt| |$SessionManager| |$frameNumber|)
     (setq |$frameNumber| (1+ |$frameNumber|))
     (|sockSendString| |$SessionManager| (mkprompt)))
    ((= action |$SwitchFrames|)
     (setq |$currentFrameNum| (|sockGetInt| |$SessionManager|))
     (setq currentframe (lassoc |$currentFrameNum| |$frameAlist|))
     (|changeToNamedInterpreterFrame| currentframe))
    ((= action |$EndSession|)
     (setq |$EndServerSession| t))
    ((= action |$LispCommand|)
     (setq |$NeedToSignalSessionManager| t)
     (setq stringbuf (make-string |$sockBufferLength|))
     (|sockGetString| |$MenuServer| stringbuf |$sockBufferLength|)
     (setq form (|unescapeStringsInForm| (read-from-string stringbuf)))
     (|protectedEVAL| form))
    ((= action |$QuietSpadCommand|)
     (setq |$NeedToSignalSessionManager| t)
     (|executeQuietCommand|))
    ((= action |$SpadCommand|)
     (setq |$NeedToSignalSessionManager| t)
     (setq stringbuf (make-string 512))
     (|sockGetString| |$MenuServer| stringbuf 512)
     (catch '|coerceFailure|
      (catch '|top_level|
       (catch '|spad_reader|
        (|parseAndInterpret| stringbuf))))
     (princ (mkprompt))
     (finish-output))
    ((= action |$NonSmanSession|) (setq |$SpadServer| nil))
    ((= action |$KillLispSystem|) (bye))
    (t nil)))
(cond

```

```
(line line)
(t '||))))))
```

defun protectedEVAL

```
[resetStackLimits p19]
[sendHTErrorSignal p??]
```

— defun protectedEVAL —

```
(defun |protectedEVAL| (x)
  (let (val (error t))
    (unwind-protect
      (progn
        (setq val (eval x))
        (setq error nil))
      (when error
        (|resetStackLimits|)
        (|sendHTErrorSignal|))))
    (unless error val)))
```

defvar \$QuietCommand

— initvars —

```
(defvar |$QuietCommand| nil "If true, produce no top level output")
```

defun executeQuietCommand

When \$QuietCommand is true Spad will not produce any output from a top level command

```
[spad-reader p??]
[coerceFailure p??]
[toplevel p??]
[spadreader p??]
[make-string p??]
```

```
[sockGetString p??]
[parseAndInterpret p46]
[$MenuServer p??]
[$QuietCommand p45]
```

— **defun executeQuietCommand** —

```
(defun |executeQuietCommand| ()
  (let (|$QuietCommand| stringBuffer)
    (declare (special |$QuietCommand| |$MenuServer|))
    (setq |$QuietCommand| t)
    (setq stringBuffer (make-string 512))
    (|sockGetString| |$MenuServer| stringBuffer 512)
    (catch '|coerceFailure|
      (catch '|top_level|
        (catch '|spad_reader| (|parseAndInterpret| stringBuffer))))))
```

defun parseAndInterpret

```
[$InteractiveMode p22]
[$boot p23]
[$spad p18]
[$e p??]
[$InteractiveFrame p??]
```

— **defun parseAndInterpret** —

```
(defun |parseAndInterpret| (str)
  (let (|$InteractiveMode| $boot $spad |$e|)
    (declare (special |$InteractiveMode| $boot $spad |$e|
                      |$InteractiveFrame|))
    (setq |$InteractiveMode| t)
    (setq $boot nil)
    (setq $spad t)
    (setq |$e| |$InteractiveFrame|)
    (|processInteractive| (|parseFromString| str) nil)))
```

defun parseFromString

```
[next p36]
[ncloopParse p36]
```

[lineoftoks p111]
 [incString p37]
 [StreamNull p333]
 [pf2Sex p299]
 [macroExpanded p222]

— defun parseFromString —

```
(defun |parseFromString| (s)
  (setq s (|next| #'|ncloopParse| (|next| #'|lineoftoks| (|incString| s))))
  (unless (|StreamNull| s) (|pf2Sex| (|macroExpanded| (cadar s)))))
```

—————

defvar \$interpOnly

— initvars —

```
(defvar |$interpOnly| nil)
```

—————

defvar \$minivectorNames

— initvars —

```
(defvar |$minivectorNames| nil)
```

—————

defvar \$domPvar

— initvars —

```
(defvar |$domPvar| nil)
```

—————

defun processInteractive

Parser Output --> Interpreter

Top-level dispatcher for the interpreter. It sets local variables and then calls processInteractive1 to do most of the work. This function receives the output from the parser. [initialize-TimedNames p??]

```
[qcar p??]
[processInteractive1 p50]
[reportInstantiations p742]
[clrhash p??]
[writeHistModesAndValues p603]
[updateHist p589]
[$op p??]
[$Coerce p??]
[$compErrorMessageStack p??]
[$freeVars p??]
[$mapList p??]
[$compilingMap p??]
[$compilingLoop p??]
[$interpOnly p47]
[$whereCacheList p??]
[$timeGlobalName p??]
[$StreamFrame p??]
[$declaredMode p??]
[$localVars p??]
[$analyzingMapList p??]
[$lastLineInSEQ p??]
[$instantCoerceCount p??]
[$instantCanCoerceCount p??]
[$instantMmCondCount p??]
[$fortVar p??]
[$minivector p??]
[$minivectorCode p??]
[$minivectorNames p47]
[$domPvar p47]
[$inRetract p??]
[$instantRecord p??]
[$reportInstantiations p742]
[$ProcessInteractiveValue p50]
[$defaultFortVar p??]
[$interpreterTimedNames p??]
[$interpreterTimedClasses p??]
```

— defun processInteractive —

```
(defun |processInteractive| (form posnForm)
```

```

(let (|$op| |$Coerce| |$compErrorMessageStack| |$freeVars|
      |$mapList| |$compilingMap| |$compilingLoop|
      |$interpOnly| |$whereCacheList| |$timeGlobalName|
      |$StreamFrame| |$declaredMode| |$localVars|
      |$analyzingMapList| |$lastLineInSEQ|
      |$instantCoerceCount| |$instantCanCoerceCount|
      |$instantMmCondCount| |$fortVar| |$minivector|
      |$minivectorCode| |$minivectorNames| |$domPvar|
      |$inRetract| object)
(declare (special |$op| |$Coerce| |$compErrorMessageStack|
                  |$freeVars| |$mapList| |$compilingMap|
                  |$compilingLoop| |$interpOnly| |$whereCacheList|
                  |$timeGlobalName| |$StreamFrame| |$declaredMode|
                  |$localVars| |$analyzingMapList| |$lastLineInSEQ|
                  |$instantCoerceCount| |$instantCanCoerceCount|
                  |$instantMmCondCount| |$fortVar| |$minivector|
                  |$minivectorCode| |$minivectorNames| |$domPvar|
                  |$inRetract| |$instantRecord| |$reportInstantiations|
                  |$ProcessInteractiveValue| |$defaultFortVar|
                  |$interpreterTimedNames| |$interpreterTimedClasses|))
(|initializeTimedNames| |$interpreterTimedNames| |$interpreterTimedClasses|)
(if (consp form)                                ; compute name of operator
    (setq |$op| (qcar form))
    (setq |$op| form))
(setq |$Coerce| nil)
(setq |$compErrorMessageStack| nil)
(setq |$freeVars| nil)
(setq |$mapList| nil)                          ; list of maps being type analyzed
(setq |$compilingMap| nil)                     ; true when compiling a map
(setq |$compilingLoop| nil)                   ; true when compiling a loop body
(setq |$interpOnly| nil)                      ; true when in interp only mode
(setq |$whereCacheList| nil)                  ; maps compiled because of where
(setq |$timeGlobalName| '$compTimeSum|); see incrementTimeSum
(setq |$StreamFrame| nil)                     ; used in printing streams
(setq |$declaredMode| nil)                    ; weak type propagation for symbols
(setq |$localVars| nil)                       ; list of local variables in function
(setq |$analyzingMapList| nil)                ; names of maps currently being analyzed
(setq |$lastLineInSEQ| t)                     ; see evalIF and friends
(setq |$instantCoerceCount| 0)
(setq |$instantCanCoerceCount| 0)
(setq |$instantMmCondCount| 0)
(setq |$defaultFortVar| 'x)                   ; default FORTRAN variable name
(setq |$fortVar| |$defaultFortVar|)           ; variable name for FORTRAN output
(setq |$minivector| nil)
(setq |$minivectorCode| nil)
(setq |$minivectorNames| nil)
(setq |$domPvar| nil)
(setq |$inRetract| nil)
(setq object (|processInteractive1| form posnForm))
(unless |$ProcessInteractiveValue|

```

```
(when |$reportInstantiations|
  (|reportInstantiations|)
  (clrhash |$instantRecord|))
(|writeHistModesAndValues|)
(|updateHist|))
object))
```

defvar \$ProcessInteractiveValue

— initvars —

```
(defvar |$ProcessInteractiveValue| nil "If true, no output or record")
```

defvar \$HTCompanionWindowID

— initvars —

```
(defvar |$HTCompanionWindowID| nil)
```

defun processInteractive1

This calls the analysis and output printing routines [recordFrame p923]

```
[startTimingProcess p??]
[interpretTopLevel p51]
[stopTimingProcess p??]
[recordAndPrint p54]
[objValUnwrap p??]
[objMode p??]
[$e p??]
[$ProcessInteractiveValue p50]
[$InteractiveFrame p??]
```

— defun processInteractive1 —

```
(defun |processInteractive1| (form posnForm)
  (let (|$e| object)
    (declare (special |$e| |$ProcessInteractiveValue| |$InteractiveFrame|))
    (setq |$e| |$InteractiveFrame|)
    (|recordFrame| '|system|)
    (|startTimingProcess| '|analysis|)
    (setq object (|interpretTopLevel| form posnForm))
    (|stopTimingProcess| '|analysis|)
    (|startTimingProcess| '|print|)
    (unless |$ProcessInteractiveValue|
      (|recordAndPrint| (|objValUnwrap| object) (|objMode| object)))
    (|recordFrame| '|normal|)
    (|stopTimingProcess| '|print|)
    object))
```

defun interpretTopLevel

```
[interpreter p??]
[interpret p52]
[stopTimingProcess p??]
[peekTimedName p??]
[interpretTopLevel p51]
[$timedNameStack p??]
```

— defun interpretTopLevel —

```
(defun |interpretTopLevel| (x posnForm)
  (let (savedTimerStack c)
    (declare (special |$timedNameStack|))
    (setq savedTimerStack (copy |$timedNameStack|))
    (setq c (catch '|interpreter| (|interpret| x posnForm)))
    (do ()
      ((equal savedTimerStack |$timedNameStack|) nil)
      (|stopTimingProcess| (|peekTimedName|)))
    (if (eq c '|tryAgain|)
      (|interpretTopLevel| x posnForm)
      c)))
```

defvar \$genValue

If the `$genValue` variable is true then evaluate generated code, otherwise leave code unevaluated. If `$genValue` is false then we are compiling. This variable is only defined and used

locally.

— **initvars** —

```
(defvar |$genValue| nil "evaluate generated code if true")
```

—————

defun Type analyzes and evaluates expression x, returns object

```
[interpret1 p52]
|$env p??]
|$eval p??]
|$genValue p51]
```

— **defun interpret** —

```
(defun |interpret| (&rest arg &aux restargs x)
  (let (|$env| |$eval| |$genValue| posnForm)
    (declare (special |$env| |$eval| |$genValue|))
    (setq x (car arg))
    (setq restargs (cdr arg))
    (if (consp restargs)
        (setq posnForm (car restargs))
        (setq posnForm restargs))
    (setq |$env| (list (list nil)))
    (setq |$eval| t) ; generate code -- don't just type analyze
    (setq |$genValue| t) ; evaluate all generated code
    (|interpret1| x nil posnForm)))
```

—————

defun Dispatcher for the type analysis routines

This is the dispatcher for the type analysis routines. It type analyzes and evaluates the expression x in the rootMode (if non-nil) which may be \$EmptyMode. It returns an object if evaluating, and a modeset otherwise. It creates the attributed tree. [mkAtreeWithSrcPos p??]

```
[putTarget p??]
[bottomUp p??]
[getArgValue p??]
[objNew p??]
[getValue p??]
[interpret2 p53]
[keyedSystemError p??]
```

```
[$genValue p51]
[$eval p??]
```

— defun interpret1 —

```
(defun |interpret1| (x rootMode posnForm)
  (let (node modeSet newRootMode argVal val)
    (declare (special |$genValue| |$eval|))
    (setq node (|mkAtreeWithSrcPos| x posnForm))
    (when rootMode (|putTarget| node rootMode))
    (setq modeSet (|bottomUp| node))
    (if (null |$eval|)
        modeSet
        (progn
         (if (null rootMode)
             (setq newRootMode (car modeSet))
             (setq newRootMode rootMode))
         (setq argVal (|getArgValue| node newRootMode))
         (cond
          ((and argVal (null |$genValue|))
           (|objNew| argVal newRootMode))
          ((and argVal (setq val (|getValue| node)))
           (|interpret2| val newRootMode posnForm)))
         (t
          (|keyedSystemError| 'S2IS0053 (list x)))))))
```

—————

defun interpret2

This is the late interpretCoerce. I removed the call to coerceInteractive, so it only does the JENKS cases ALBI [objVal p??]

```
[objMode p??]
[member p1048]
[objNew p??]
[systemErrorHere p??]
[coerceInteractive p??]
[throwKeyedMsgCannotCoerceWithValue p??]
[$EmptyMode p??]
[$ThrowAwayMode p??]
```

— defun interpret2 —

```
(defun |interpret2| (object m1 posnForm)
  (declare (ignore posnForm))
  (let (x m op ans)
```

```

(declare (special |$EmptyMode| |$ThrowAwayMode|))
(cond
  ((equal m1 |$ThrowAwayMode|) object)
  (t
    (setq x (|objVal| object))
    (setq m (|objMode| object))
    (cond
      ((equal m |$EmptyMode|)
        (cond
          ((and (consp x)
                (progn (setq op (qcar x)) t)
                (|member| op '(map stream)))
            (|objNew| x m1))
          ((equal m1 |$EmptyMode|)
            (|objNew| x m))
          (t
            (|systemErrorHere| "interpret2")))))
      (m1
        (if (setq ans (|coerceInteractive| object m1))
          ans
          (|throwKeyedMsgCannotCoerceWithValue| x m m1)))
      (t object))))))

```

defun Result Output Printing

Prints out the value x which is of type m, and records the changes in environment \$e into \$InteractiveFrame \$printAnyIfTrue is documented in setvar.boot. It is controlled with the)se me any command. [output p??]

```

[putHist p590]
[objNewWrap p??]
[printTypeAndTime p56]
[printStorage p56]
[printStatisticsSummary p56]
[mkCompanionPage p??]
[recordAndPrintTest p??]
[$outputMode p??]
[$mkTestOutputType p??]
[$runTestFlag p??]
[$e p??]
[$mkTestFlag p??]
[$HTCompanionWindowID p50]
[$QuietCommand p45]
[$printStatisticsSummaryIfTrue p749]
[$printTypeIfTrue p752]

```

```

[$printStorageIfTrue p??]
[$printTimeIfTrue p751]
[$Void p??]
[$algebraOutputStream p762]
[$collectOutput p??]
[$EmptyMode p??]
[$printVoidIfTrue p753]
[$outputMode p??]
[$printAnyIfTrue p735]

```

— defun recordAndPrint —

```

(defun |recordAndPrint| (x md)
  (let (|$outputMode| xp mdp mode)
    (declare (special |$mkTestOutputType| |$runTestFlag| |$e|
                      |$mkTestFlag| |$HTCompanionWindowID| |$QuietCommand|
                      |$printStatisticsSummaryIfTrue| |$printTypeIfTrue|
                      |$printStorageIfTrue| |$printTimeIfTrue| |$Void|
                      |$algebraOutputStream| |$collectOutput| |$EmptyMode|
                      |$printVoidIfTrue| |$outputMode| |$printAnyIfTrue|))
      (cond
        ((and (equal md '(|Any|)) |$printAnyIfTrue|)
         (setq mdp (car x))
         (setq xp (cdr x)))
        (t
         (setq mdp md)
         (setq xp x)))
      (setq |$outputMode| md)
      (if (equal md |$EmptyMode|)
          (setq mode (|quadSch|))
          (setq mode md))
      (when (or (not (equal md |$Void|)) |$printVoidIfTrue|)
        (unless |$collectOutput| (terpri |$algebraOutputStream|))
        (unless |$QuietCommand| (|output| xp mdp)))
      (|putHist| '% '|value| (|objNewWrap| x md) |$e|)
      (when (or |$printTimeIfTrue| |$printTypeIfTrue|)
        (|printTypeAndTime| xp mdp))
      (when |$printStorageIfTrue| (|printStorage|))
      (when |$printStatisticsSummaryIfTrue| (|printStatisticsSummary|))
      (when (integerp |$HTCompanionWindowID|) (|mkCompanionPage| md))
      (cond
        (|$mkTestFlag| (|recordAndPrintTest| md))
        (|$runTestFlag|
         (setq |$mkTestOutputType| md)
         '|done|)
        (t '|done|))))

```

defun printStatisticsSummary

```
[sayKeyedMsg p329]
[statisticsSummary p??]
[$collectOutput p??]
```

— defun printStatisticsSummary —

```
(defun |printStatisticsSummary| ()
  (declare (special |$collectOutput|))
  (unless |$collectOutput|
    (|sayKeyedMsg| 'S2GL0017 (list (|statisticsSummary|)))))
```

—————

defun printStorage

```
[makeLongSpaceString p??]
[$interpreterTimedClasses p??]
[$collectOutput p??]
[$interpreterTimedNames p??]
```

— defun printStorage —

```
(defun |printStorage| ()
  (declare (special |$interpreterTimedClasses| |$collectOutput|
                    |$interpreterTimedNames|))
  (unless |$collectOutput|
    (|sayKeyedMsg| 'S2GL0016
      (list
        (|makeLongSpaceString|
          |$interpreterTimedNames|
          |$interpreterTimedClasses|))))))
```

—————

defun printTypeAndTime

```
[printTypeAndTimeSaturn p58]
[printTypeAndTimeNormal p57]
[$saturn p??]
```

— defun printTypeAndTime —

```
(defun |printTypeAndTime| (x m)
  (declare (special |$saturn|))
  (if |$saturn|
    (|printTypeAndTimeSaturn| x m)
    (|printTypeAndTimeNormal| x m)))
```

defun printTypeAndTimeNormal

```
[retract p1064]
[qcar p??]
[retract p1064]
[objNewWrap p??]
[objMode p??]
[sameUnionBranch p59]
[makeLongTimeString p??]
[msgText p60]
[sayKeyedMsg p329]
[justifyMyType p60]
[$outputLines p??]
[$collectOutput p??]
[$printTypeIfTrue p752]
[$printTimeIfTrue p751]
[$outputLines p??]
[$interpreterTimedNames p??]
[$interpreterTimedClasses p??]
```

— defun printTypeAndTimeNormal —

```
(defun |printTypeAndTimeNormal| (x m)
  (let (xp mp timeString result)
    (declare (special |$outputLines| |$collectOutput| |$printTypeIfTrue|
                      |$printTimeIfTrue| |$outputLines|
                      |$interpreterTimedNames| |$interpreterTimedClasses|))
    (cond
      ((and (consp m) (eq (qcar m) '|Union|))
       (setq xp (|retract| (|objNewWrap| x m)))
       (setq mp (|objMode| xp))
       (setq m
        (cons '|Union|
              (append
               (dolist (arg (qcdr m) (nreverse result))
                 (when (|sameUnionBranch| arg mp) (push arg result)))
               (list "...")))))
      (when |$printTimeIfTrue|
```

```

(setq timeString
  (|makeLongTimeString|
   |$interpreterTimedNames|
   |$interpreterTimedClasses|)))
(cond
  ((and |$printTimeIfTrue| |$printTypeIfTrue|)
   (if |$collectOutput|
       (push (|msgText| 'S2GL0012 (list m)) |$outputLines|)
       (|sayKeyedMsg| 'S2GL0014 (list m timeString ))))
   (|$printTimeIfTrue|
    (unless |$collectOutput| (|sayKeyedMsg| 'S2GL0013 (list timeString))))
   (|$printTypeIfTrue|
    (if |$collectOutput|
        (push (|justifyMyType| (|msgText| 'S2GL0012 (list m)) |$outputLines|)
              (|sayKeyedMsg| 'S2GL0012 (list m)))))))

```

defun printTypeAndTimeSaturn

```

[makeLongTimeString p??]
[form2StringAsTeX p??]
[devaluate p??]
[printAsTeX p59]
[$printTimeIfTrue p751]
[$printTypeIfTrue p752]
[$interpreterTimedClasses p??]
[$interpreterTimedNames p??]

```

— defun printTypeAndTimeSaturn —

```

(defun |printTypeAndTimeSaturn| (x m)
  (declare (ignore x))
  (let (timeString typeString)
    (declare (special |$printTimeIfTrue| |$printTypeIfTrue|
                      |$interpreterTimedClasses| |$interpreterTimedNames|))
    (if |$printTimeIfTrue|
        (setq timeString
              (|makeLongTimeString|
               |$interpreterTimedNames|
               |$interpreterTimedClasses|))
        (setq timeString ""))
    (if |$printTypeIfTrue|
        (setq typeString (|form2StringAsTeX| (|devaluate| m)))
        (setq typeString ""))
    (when |$printTypeIfTrue|
      (|printAsTeX| "\\axPrintType{")

```

[\$texOutputStream p??]

[illegible]

```
(equal t3 m))
(t (equal uArg m))))))
```

defun msgText

```
[segmentKeyedMsg p330]
[getKeyedMsg p329]
[substituteSegmentedMsg p??]
[flowSegmentedMsg p??]
[$linelength p774]
[$margin p774]
```

— defun msgText —

```
(defun |msgText| (key args)
  (let (msg)
    (declare (special $linelength $margin))
    (setq msg (|segmentKeyedMsg| (|getKeyedMsg| key)))
    (setq msg (|substituteSegmentedMsg| msg args))
    (setq msg (|flowSegmentedMsg| msg $linelength $margin))
    (apply #'concat (mapcar #'princ-to-string (cdar msg)))))
```

defun Right-justify the Type output

```
[fillerSpaces p18]
[$linelength p774]
```

— defun justifyMyType —

```
(defun |justifyMyType| (arg)
  (let (len)
    (declare (special $linelength))
    (setq len (|#| arg))
    (if (> len $linelength)
      arg
      (concat (|fillerSpaces| (- $linelength len)) arg))))
```

defun Destructively fix quotes in strings

[unescapeStringsInForm p61]
 [\$funnyBacks p1297]
 [\$funnyQuote p1297]

— defun unescapeStringsInForm —

```
(defun |unescapeStringsInForm| (form)
  (let (str)
    (declare (special |$funnyBacks| |$funnyQuote|))
    (cond
      ((stringp form)
       (setq str (nsubstitute #" |$funnyQuote| form))
       (nsubstitute #\\ |$funnyBacks| str))
      ((cons p form)
       (|unescapeStringsInForm| (car form))
       (|unescapeStringsInForm| (cdr form))
       form)
      (t form))))
```

—————

Include a file into the stream

[ST p??]
 [intloopInclude0 p61]

— defun intloopInclude —

```
(defun |intloopInclude| (name n)
  "Include a file into the stream"
  (with-open-file (st name) (|intloopInclude0| st name n)))
```

—————

defun intloopInclude0

[incStream p71]
 [intloopProcess p62]
 [next p36]
 [intloopEchoParse p67]
 [insertpile p335]
 [lineoftoks p111]

[[\\$lines p??](#)]

— **defun intloopInclude0** —

```
(defun |intloopInclude0| (|st| |name| |n|)
  (let (|$lines|)
    (declare (special |$lines|))
    (setq |$lines| (|incStream| |st| |name|))
    (|intloopProcess| |n| NIL
      (|next| #'|intloopEchoParse|
        (|next| #'|insertpile|
          (|next| #'|lineoftoks|
            |$lines|))))))
```

defun intloopProcess

[[StreamNull p333](#)]
 [[pfAbSynOp? p412](#)]
 [[setCurrentLine p40](#)]
 [[tokPart p413](#)]
 [[intloopProcess p62](#)]
 [[intloopSpadProcess p63](#)]
 [[\\$systemCommandFunction p??](#)]
 [[\\$systemCommandFunction p??](#)]

— **defun intloopProcess** —

```
(defun |intloopProcess| (n interactive s)
  (let (ptree lines t1)
    (declare (special |$systemCommandFunction|))
    (cond
      ((|StreamNull| s) n)
      (t
        (setq t1 (car s))
        (setq lines (car t1))
        (setq ptree (cadr t1))
        (cond
          ((|pfAbSynOp?| ptree '|command|)
            (when interactive (|setCurrentLine| (|tokPart| ptree)))
            (funcall |$systemCommandFunction| (|tokPart| ptree))
            (|intloopProcess| n interactive (cdr s)))
          (t
            (|intloopProcess|
              (|intloopSpadProcess| n lines ptree interactive)
              interactive (cdr s))))))))
```

defun intloopSpadProcess

```

[flung p??]
[SpadCompileItem p??]
[intCoerceFailure p30]
[intSpadReader p30]
[ncPutQ p416]
[CatchAsCan p??]
[Catch p??]
[intloopSpadProcess,interp p64]
[$currentCarrier p??]
[$ncMsgList p25]
[$intCoerceFailure p30]
[$intSpadReader p30]
[$prevCarrier p??]
[$stepNo p??]
[$NeedToSignalSessionManager p42]
[flung p??]

```

— defun intloopSpadProcess —

```

(defun |intloopSpadProcess| (stepNo lines ptree interactive?)
  (let (|$stepNo| result cc)
    (declare (special |$stepNo| |$prevCarrier| |$intSpadReader| |flung|
                      |$intCoerceFailure| |$ncMsgList| |$currentCarrier|
                      |$NeedToSignalSessionManager|))
    (setq |$stepNo| stepNo)
    (setq |$currentCarrier| (setq cc (list '|carrier|)))
    (|ncPutQ| cc '|stepNumber| stepNo)
    (|ncPutQ| cc '|messages| |$ncMsgList|)
    (|ncPutQ| cc '|lines| lines)
    (setq |$ncMsgList| nil)
    (setq result
      (catch '|SpadCompileItem|
        (catch |$intCoerceFailure|
          (catch |$intSpadReader|
            (|intloopSpadProcess,interp| cc ptree interactive?))))))
    (setq |$NeedToSignalSessionManager| t)
    (setq |$prevCarrier| |$currentCarrier|)
    (cond
      ((eq result '|ncEnd|) stepNo)
      ((eq result '|ncError|) stepNo)
      ((eq result '|ncEndItem|) stepNo)

```



```
(t (1+ stepNo))))))
```

defun intloopSpadProcess,interp

```
[ncConversationPhase p66]
[ncEltQ p416]
[ncError p67]
```

— defun intloopSpadProcess,interp —

```
(defun |intloopSpadProcess,interp| (cc ptree interactive?)
  (|ncConversationPhase| #'|phParse| (list cc ptree))
  (|ncConversationPhase| #'|phMacro| (list cc))
  (|ncConversationPhase| #'|phIntReportMsgs| (list cc interactive?))
  (|ncConversationPhase| #'|phInterpret| (list cc))
  (unless (eql (length (|ncEltQ| cc '|messages|)) 0) (|ncError|)))
```

defun phParse

TPDHERE: The pform function has a leading percent sign

```
phParse: carrier[tokens,...] -> carrier[ptree, tokens,...]
```

```
[ncPutQ p416]
```

— defun phParse —

```
(defun |phParse| (carrier ptree)
  (|ncPutQ| carrier '|ptree| ptree)
  'ok)
```

defun phIntReportMsgs

```
carrier[lines,messages,...]-> carrier[lines,messages,...]
```

```
[ncEltQ p416]
[ncPutQ p416]
```

[processMsgList p369]
 [\$erMsgToss p??]

— defun phIntReportMsgs —

```
(defun |phIntReportMsgs| (carrier interactive?)
  (declare (ignore interactive?))
  (let (nerr msgs lines)
    (declare (special |$erMsgToss|))
    (cond
      (|$erMsgToss| 'ok)
      (t
       (setq lines (|ncEltQ| carrier '|lines|))
       (setq msgs (|ncEltQ| carrier '|messages|))
       (setq nerr (length msgs))
       (|ncPutQ| carrier '|ok?'| (eq1 nerr 0))
       (cond
         ((eq1 nerr 0) 'ok)
         (t
          (|processMsgList| msgs lines)
          (|sayKeyedMsg| 'S2CTP010 (list nerr))
          'ok))))))
```

—————

defun phInterpret

[ncEltQ p416]
 [intInterpretPform p65]
 [ncPutQ p416]

— defun phInterpret —

```
(defun |phInterpret| (carrier)
  (let (val ptree)
    (setq ptree (|ncEltQ| carrier '|ptree|))
    (setq val (|intInterpretPform| ptree))
    (|ncPutQ| carrier '|value| val)))
```

—————

defun intInterpretPform

[processInteractive p48]
 [zeroOneTran p66]

[pf2Sex p299]

— defun intInterpretPform —

```
(defun |intInterpretPform| (pf)
  (|processInteractive| (|zeroOneTran| (|pf2Sex| pf)) pf))
```

—————

defun zeroOneTran

[nsubst p??]

— defun zeroOneTran 0 —

```
(defun |zeroOneTran| (sex)
  (nsubst '|$EmptyMode| '? sex))
```

—————

defun ncConversationPhase

[ncConversationPhase,wrapup p66]
[ncMsgList p25]

— defun ncConversationPhase —

```
(defun |ncConversationPhase| (fn args)
  (let (|ncMsgList| carrier)
    (declare (special |ncMsgList|))
    (setq carrier (car args))
    (setq |ncMsgList| nil)
    (unwind-protect
      (apply fn args)
      (|ncConversationPhase,wrapup| carrier))))
```

—————

defun ncConversationPhase,wrapup

[ncMsgList p25]

— defun ncConversationPhase,wrapup —

```
(defun |ncConversationPhase,wrapup| (carrier)
  (declare (special |$ncMsgList|))
  ((lambda (Var5 m)
    (loop
      (cond
        ((or (atom Var5) (progn (setq m (car Var5)) nil))
          (return nil))
        (t
          (|ncPutQ| carrier '|messages| (cons m (|ncEltQ| carrier '|messages|))))
        (setq Var5 (cdr Var5))))
    |$ncMsgList| nil))
```

defun ncError

[SpadCompileItem p??]

— defun ncError 0 —

```
(defun |ncError| ()
  (throw '|SpadCompileItem| '|ncError|))
```

defun intloopEchoParse

[ncloopDQlines p70]
 [setCurrentLine p40]
 [mkLineList p68]
 [ncloopPrintLines p68]
 [npParse p141]
 [dqToList p344]
 [\$EchoLines p??]
 [\$lines p??]

— defun intloopEchoParse —

```
(defun |intloopEchoParse| (s)
  (let (cudr lines stream dq t1)
    (declare (special |$EchoLines| |$lines|))
    (setq t1 (car s))
    (setq dq (car t1))
    (setq stream (cadr t1))
```

```

(setq t1 (|ncloopDQlines| dq |$lines|))
(setq lines (car t1))
(setq cudr (cadr t1))
(|setCurrentLine| (|mkLineList| lines))
(when |$EchoLines| (|ncloopPrintLines| lines))
(setq |$lines| cudr)
(cons (list (list lines (|npParse| (|dqToList| dq)))) (cdr s))))

```

defun ncloopPrintLines

```

;ncloopPrintLines lines ==
;      for line in lines repeat WRITE_-LINE CDR line
;      WRITE_-LINE ' " "

```

— defun ncloopPrintLines 0 —

```

(defun |ncloopPrintLines| (lines)
  ((lambda (Var4 line)
    (loop
      (cond
        ((or (atom Var4) (progn (setq line (car Var4)) nil))
         (return nil))
        (t (write-line (cdr line))))
      (setq Var4 (cdr Var4))))
    lines nil)
  (write-line " "))

```

defun mkLineList

```

;mkLineList lines ==
;  l := [CDR line for line in lines | nonBlank CDR line]
;  #l = 1 => CAR l
;  l

```

— defun mkLineList —

```

(defun |mkLineList| (lines)
  (let (l)
    (setq l

```

```

(lambda (Var2 Var1 line)
  (loop
    (cond
      ((or (atom Var1) (progn (setq line (car Var1)) nil))
        (return (nreverse Var2)))
      (t
        (and (|nonBlank| (cdr line))
              (setq Var2 (cons (cdr line) Var2))))
      (setq Var1 (cdr Var1))))
    nil lines nil))
(cond
  ((eq1 (length l) 1) (car l))
  (t l)))

```

defun nonBlank

```

;nonBlank str ==
; value := false
; for i in 0..MAXINDEX str repeat
;   str.i ^= char " " =>
;     value := true
;   return value
; value

```

— defun nonBlank 0 —

```

(defun |nonBlank| (str)
  (let (value)
    ((lambda (Var3 i)
      (loop
        (cond
          ((> i Var3) (return nil))
          (t
            (cond
              ((not (equal (elt str i) #\Space))
                (identity (progn (setq value t) (return value))))))
            (setq i (+ i 1))))
      (maxindex str) 0)
    value))

```

defun ncloopDQlines

[StreamNull p333]
 [poGlobalLinePosn p70]
 [tokPosn p413]
 [streamChop p70]

— defun ncloopDQlines —

```
(defun |ncloopDQlines| (dq stream)
  (let (b a)
    (|StreamNull| stream)
    (setq a (|poGlobalLinePosn| (|tokPosn| (cadr dq))))
    (setq b (|poGlobalLinePosn| (caar stream)))
    (|streamChop| (+ (- a b) 1) stream)))
```

defun poGlobalLinePosn

[lnGlobalNum p346]
 [poGetLineObject p361]
 [ncBug p368]

— defun poGlobalLinePosn —

```
(defun |poGlobalLinePosn| (posn)
  (if posn
    (|lnGlobalNum| (|poGetLineObject| posn))
    (|ncBug| "old style pos objects have no global positions" nil)))
```

defun streamChop

Note that changing the name “lyne” to “line” will break the system. I do not know why. The symptom shows up when there is a file with a large contiguous comment spanning enough lines to overflow the stack. [StreamNull p333]

[streamChop p70]
 [ncloopPrefix? p479]

— defun streamChop —

```
(defun |streamChop| (n s)
```

```
(let (d c lyne b a tmp1)
  (cond
    ((|StreamNull| s) (list nil nil))
    ((eq1 n 0) (list nil s))
    (t
     (setq tmp1 (|streamChop| (- n 1) (cdr s)))
     (setq a (car tmp1))
     (setq b (cadr tmp1))
     (setq lyne (car s))
     (setq c (|incloopPrefix?| ")command" (cdr lyne)))
     (setq d (cons (car lyne) (cond (c c) (t (cdr lyne)))))
     (list (cons d a) b)))))
```

defun ncloopInclude0

```
[incStream p71]
[ncloopProcess p??]
[next p36]
[ncloopEchoParse p??]
[insertpile p335]
[lineoftoks p111]
[$lines p??]
```

— defun ncloopInclude0 —

```
(defun |ncloopInclude0| (st name n)
  (let (|$lines|)
    (declare (special |$lines|))
    (setq |$lines| (|incStream| st name))
    (|ncloopProcess| n nil
      (|next| #'|ncloopEchoParse|
        (|next| #'|insertpile|
          (|next| #'|lineoftoks|
            |$lines|))))))
```

defun incStream

```
[incRenumber p72]
[incLude p75]
[incRgen p101]
[Top p75]
```


— defun incStream —

```
(defun |incStream| (st fn)
  (declare (special |Top|))
  (|incRenum| (|incLude| 0 (|incRgen| st) 0 (list fn) (list |Top|))))
```

—————

defun incRenum

[incZip p72]
[incIgen p73]

— defun incRenum —

```
(defun |incRenum| (ssx)
  (|incZip| #'|incRenumLine| ssx (|incIgen| 0)))
```

—————

defun incZip

[Delay p102]
[incZip1 p72]

— defun incZip —

```
(defun |incZip| (g f1 f2)
  (|Delay| #'|incZip1| (list g f1 f2)))
```

—————

defun incZip1

[StreamNull p333]
[incZip p72]

— defun incZip1 —

```
(defun |incZip1| (&rest z)
  (let (f2 f1 g)
```

```

(setq g (car z))
(setq f1 (cadr z))
(setq f2 (caddr z))
(cond
  ((|StreamNull| f1) |StreamNil|)
  ((|StreamNull| f2) |StreamNil|)
  (t
   (cons
    (funcall g (car f1) (car f2))
    (|incZip| g (cdr f1) (cdr f2))))))

```

defun incIgen

[Delay p102]
[incIgen1 p73]

— defun incIgen —

```

(defun |incIgen| (n)
  (|Delay| #'|incIgen1| (list n)))

```

defun incIgen1

[incIgen p73]

— defun incIgen1 —

```

(defun |incIgen1| (&rest z)
  (let (n)
    (setq n (car z))
    (setq n (+ n 1))
    (cons n (|incIgen| n))))

```

defun incRenumberLine

[incRenumberItem p74]
[incHandleMessage p74]

— defun incRenumberLine —

```
(defun |incRenumberLine| (xl gno)
  (let (l)
    (setq l (|incRenumberItem| (elt xl 0) gno))
    (|incHandleMessage| xl)
    l))
```

—————

defun incRenumberItem

[lnSetGlobalNum p346]

— defun incRenumberItem —

```
(defun |incRenumberItem| (f i)
  (let (l)
    (setq l (caar f))
    (|lnSetGlobalNum| l i) f))
```

—————

defun incHandleMessage

[ncSoftError p351]

[ncBug p368]

— defun incHandleMessage 0 —

```
(defun |incHandleMessage| (x)
  "Message handling for the source includer"
  (let ((msgtype (elt (elt x 1) 1))
        (pos (car (elt x 0)))
        (key (car (elt (elt x 1) 0)))
        (args (cadr (elt (elt x 1) 0))))
    (cond
      ((eq msgtype '|none|) 0)
      ((eq msgtype '|error|) (|ncSoftError| pos key args))
      ((eq msgtype '|warning|) (|ncSoftError| pos key args))
      ((eq msgtype '|say|) (|ncSoftError| pos key args))
      (t (|ncBug| key args)))))
```

defun incLude

[Delay p102]
[incLude1 p79]

— defun incLude —

```
(defun |incLude| (eb ss ln ufos states)
  (|Delay| #'|incLude1| (list eb ss ln ufos states)))
```

defmacro Rest

— defmacro Rest —

```
(defmacro |Rest| ()
  "used in incLude1 for parsing; s is not used."
  '(|incLude| eb (cdr ss) lno ufos states))
```

defvar \$Top

— initvars —

```
(defvar |Top| 1 "used in incLude1 for parsing")
```

defvar \$IfSkipToEnd

— initvars —

```
(defvar |IfSkipToEnd| 10 "used in incLude1 for parsing")
```

defvar \$IfKeepPart

— initvars —

```
(defvar |IfKeepPart| 11 "used in include1 for parsing")
```

—————

defvar \$IfSkipPart

— initvars —

```
(defvar |IfSkipPart| 12 "used in include1 for parsing")
```

—————

defvar \$ElseifSkipToEnd

— initvars —

```
(defvar |ElseifSkipToEnd| 20 "used in include1 for parsing")
```

—————

defvar \$ElseifKeepPart

— initvars —

```
(defvar |ElseifKeepPart| 21 "used in include1 for parsing")
```

—————

defvar \$ElseifSkipPart

— initvars —

```
(defvar |ElseifSkipPart| 22 "used in include1 for parsing")
```

defvar \$ElseSkipToEnd

— initvars —

```
(defvar |ElseSkipToEnd| 30 "used in include1 for parsing")
```

defvar \$ElseKeepPart

— initvars —

```
(defvar |ElseKeepPart| 31 "used in include1 for parsing")
```

defvar \$Top?

[quotient p??]

— defun Top? 0 —

```
(defun |Top?| (|st|)
  "used in include1 for parsing"
  (eq1 (quotient |st| 10) 0))
```

defvar \$If?

[quotient p??]

— defun If? —

```
(defun |If?| (|st|)
  "used in include1 for parsing"
  (eq1 (quotient |st| 10) 1))
```

defvar \$Elseif?

[QUOTIENT p??]

— defun Elseif? —

```
(defun |Elseif?| (|st|)
  "used in include1 for parsing"
  (eq1 (quotient |st| 10) 2))
```

defvar \$Else?

[QUOTIENT p??]

— defun Else? —

```
(defun |Else?| (|st|)
  "used in include1 for parsing"
  (eq1 (quotient |st| 10) 3))
```

defvar \$SkipEnd?

[remainder p??]

— defun SkipEnd? —

```
(defun |SkipEnd?| (|st|)
  "used in include1 for parsing"
  (eq1 (remainder |st| 10) 0))
```

defvar \$KeepPart?

[remainder p??]

— defun KeepPart? —

```
(defun |KeepPart?| (|st|)
  "used in include1 for parsing"
  (eq1 (remainder |st| 10) 1))
```

—————

defvar \$SkipPart?

[remainder p??]

— defun SkipPart? —

```
(defun |SkipPart?| (|st|)
  "used in include1 for parsing"
  (eq1 (remainder |st| 10) 2))
```

—————

defvar \$Skipping?

[KeepPart? p79]

— defun Skipping? —

```
(defun |Skipping?| (|st|)
  "used in include1 for parsing"
  (null (|KeepPart?| |st|)))
```

—————

defun include1

```
[StreamNull p333]
[Top? p77]
[xlPrematureEOF p84]
[Skipping? p79]
```


[xlSkip p87](#)
[Rest p75](#)
[xlOK p84](#)
[xlOK1 p85](#)
[concat p1047](#)
[incCommandTail p99](#)
[xlSay p88](#)
[xlNoSuchFile p89](#)
[xlCannotRead p90](#)
[incActive? p101](#)
[xlFileCycle p90](#)
[incLude p75](#)
[incFileInput p100](#)
[incAppend p85](#)
[inclFname p100](#)
[xlConActive p91](#)
[xlConStill p92](#)
[incConsoleInput p100](#)
[incNConsoles p101](#)
[xlConsole p92](#)
[xlSkippingFin p93](#)
[xlPrematureFin p93](#)
[assertCond p94](#)
[ifCond p87](#)
[If? p77](#)
[Elseif? p78](#)
[xlIfSyntax p94](#)
[SkipEnd? p78](#)
[KeepPart? p79](#)
[SkipPart? p79](#)
[xlIfBug p95](#)
[xlCmdBug p96](#)
[expand-tabs p??](#)
[incClassify p97](#)

— defun incLude1 —

```

(defun |incLude1| (&rest z)
  (let (pred s1 n tail head includee fn1 info str state lno states
        ufos ln ss eb)
    (setq eb (car z))
    (setq ss (cadr . (z)))
    (setq ln (caddr . (z)))
    (setq ufos (caddr . (z)))
    (setq states (car (cddddr . (z))))
    (setq lno (+ ln 1))
    (setq state (elt states 0))

```

```

(cond
  ((|StreamNull| ss)
    (cond
      ((null (|Top?| state))
        (cons (|xlPrematureEOF| eb "--premature end" lno ufos)
          |StreamNil|))
      (t |StreamNil|)))
  (t
    (progn
      (setq str (expand-tabs (car ss)))
      (setq info (|incClassify| str))
      (cond
        ((null (elt info 0))
          (cond
            ((|Skipping?| state)
              (cons (|xlSkip| eb str lno (elt ufos 0)) (|Rest|)))
            (t
              (cons (|xlOK| eb str lno (elt ufos 0)) (|Rest|))))))
        ((equal (elt info 2) "other")
          (cond
            ((|Skipping?| state)
              (cons (|xlSkip| eb str lno (elt ufos 0)) (|Rest|)))
            (t
              (cons
                (|xlOK1| eb str (concat ")command" str) lno (elt ufos 0))
                (|Rest|))))))
        ((equal (elt info 2) "say")
          (cond
            ((|Skipping?| state)
              (cons (|xlSkip| eb str lno (elt ufos 0)) (|Rest|)))
            (t
              (progn
                (setq str (|incCommandTail| str info))
                (cons (|xlSay| eb str lno ufos str)
                  (cons (|xlOK| eb str lno (ELT ufos 0)) (|Rest|)))))))
        ((equal (elt info 2) "include")
          (cond
            ((|Skipping?| state)
              (cons (|xlSkip| eb str lno (elt ufos 0)) (|Rest|)))
            (t
              (progn
                (setq fn1 (|inclFname| str info))
                (cond
                  ((null fn1)
                    (cons (|xlNoSuchFile| eb str lno ufos fn1) (|Rest|)))
                  ((null (probe-file fn1))
                    (cons (|xlCannotRead| eb str lno ufos fn1) (|Rest|)))
                  ((|incActive?| fn1 ufos)
                    (cons (|xlFileCycle| eb str lno ufos fn1) (|Rest|)))
                  (t

```

```

(progn
  (setq includee
    (|incLude| (+ eb (elt info 1))
              (|incFileInput| fn1)
              0
              (cons fn1 ufos)
              (cons |Top| states)))
    (cons (|xlOK| eb str lno (elt ufos 0))
          (|incAppend| includee (|Rest|))))))
((equal (elt info 2) "console")
 (cond
  ((|Skipping?| state)
   (cons (|xlSkip| eb str lno (elt ufos 0)) (|Rest|)))
  (t
   (progn
    (setq head
      (|incLude| (+ eb (elt info 1))
                (|incConsoleInput|)
                0
                (cons "console" ufos)
                (cons |Top| states)))
      (set tail (|Rest|))
      (set n (|incNConsoles| ufos))
      (cond
       ((< 0 n)
        (setq head
          (cons (|xlConActive| eb str lno ufos n) head))
          (set tail
            (cons (|xlConStill| eb str lno ufos n) tail)))
        (set head (cons (|xlConsole| eb str lno ufos) head))
        (cons (|xlOK| eb str lno (elt ufos 0))
              (|incAppend| head tail))))))
    ((equal (elt info 2) "fin")
     (cond
      ((|Skipping?| state)
       (cons (|xlSkippingFin| eb str lno ufos) (|Rest|)))
      ((null (|Top?| state))
       (cons (|xlPrematureFin| eb str lno ufos) |StreamNil|))
      (t
       (cons (|xlOK| eb str lno (elt ufos 0)) |StreamNil|))))
    ((equal (elt info 2) "assert")
     (cond
      ((|Skipping?| state)
       (cons (|xlSkippingFin| eb str lno ufos) (|Rest|)))
      (t
       (progn
        (|assertCond| str info)
        (cons (|xlOK| eb str lno (elt ufos 0))
              (|incAppend| includee (|Rest|))))))
      ((equal (elt info 2) "if")

```

```

(progn
  (setq s1
    (cond
      ((|Skipping?| state) |IfSkipToEnd|)
      (t
        (cond
          ((|ifCond| str info) |IfKeepPart|)
          (t |IfSkipPart|))))))
  (cons (|xlOK| eb str lno (elt ufos 0))
    (|incLude| eb (cdr ss) lno ufos (cons s1 states))))))
((equal (elt info 2) "elseif")
  (cond
    ((and (null (|If?| state)) (null (|Elseif?| state)))
      (cons (|xlIfSyntax| eb str lno ufos info states)
        |StreamNil|))
    (t
      (cond
        ((or (|SkipEnd?| state)
          (|KeepPart?| state)
          (|SkipPart?| state))
          (setq s1
            (cond
              ((|SkipPart?| state)
                (setq pred (|ifCond| str info))
                (cond
                  (pred |ElseifKeepPart|)
                  (t |ElseifSkipPart|)))
              (t |ElseifSkipToEnd|)))
            (cons (|xlOK| eb str lno (elt ufos 0))
              (|incLude| eb (cdr ss) lno ufos (cons s1 (cdr states))))))
          (t
            (cons (|xlIfBug| eb str lno ufos) |StreamNil|))))))
    ((equal (elt info 2) "else")
      (cond
        ((and (null (|If?| state)) (null (|Elseif?| state)))
          (cons (|xlIfSyntax| eb str lno ufos info states)
            |StreamNil|))
        (t
          (cond
            ((or (|SkipEnd?| state)
              (|KeepPart?| state)
              (|SkipPart?| state))
              (setq s1
                (cond ((|SkipPart?| state) |ElseKeepPart|) (t |ElseSkipToEnd|)))
              (cons (|xlOK| eb str lno (elt ufos 0))
                (|incLude| eb (cdr ss) lno ufos (cons s1 (cdr states))))))
            (t
              (cons (|xlIfBug| eb str lno ufos) |StreamNil|))))))
        ((equal (elt info 2) "endif")
          (cond

```

```

(|Top?| state)
  (cons (|xlIfSyntax| eb str lno ufos info states)
        |StreamNil|))
(t
  (cons (|xlOK| eb str lno (elt ufos 0))
        (|incLude| eb (cdr ss) lno ufos (cdr states))))))
(t (cons (|xlCmdBug| eb str lno ufos) |StreamNil|))))))

```

defun xlPrematureEOF

[xlMsg p84]

[inclmsgPrematureEOF p86]

— defun xlPrematureEOF —

```

(defun |xlPrematureEOF| (eb str lno ufos)
  (|xlMsg| eb str lno (elt ufos 0)
    (list (|inclmsgPrematureEOF| (elt ufos 0)) '|error|)))

```

defun xlMsg

[incLine p86]

— defun xlMsg —

```

(defun |xlMsg| (extrablanks string localnum fileobj mess)
  (let ((globalnum -1))
    (list (incLine extrablanks string globalnum localnum fileobj) mess)))

```

defun xlOK

[lxOK1 p??]

— defun xlOK —

```

(defun |xlOK| (extrablanks string localnum fileobj)
  (|xlOK1| extrablanks string string localnum fileobj))

```

defun xlOK1

[incLine1 p86]

— defun xlOK1 —

```
(defun |xlOK1| (extrablanks string string1 localnum fileobj)
  (let ((globalnum -1))
    (list (incLine1 extrablanks string string1 globalnum localnum fileobj)
          (list nil '|none|))))
```

defun incAppend

[Delay p102]

[incAppend1 p85]

— defun incAppend —

```
(defun |incAppend| (x y)
  (|Delay| #'|incAppend1| (list x y)))
```

defun incAppend1

[StreamNull p333]

[incAppend p85]

— defun incAppend1 —

```
(defun |incAppend1| (&rest z)
  (let (y x)
    (setq x (car z))
    (setq y (cadr z))
    (cond
     ((|StreamNull| x)
      (cond ((|StreamNull| y) |StreamNil|) (t y)))
     (t
      (cons (car x) (|incAppend| (cdr x) y))))))
```

defun incLine

[incLine1 p86]

— defun incLine —

```
(defun incLine (extrablanks string globalnum localnum fileobj)
  (incLine1 extrablanks string string globalnum localnum fileobj))
```

defun incLine1

[lnCreate p345]

— defun incLine1 —

```
(defun incLine1 (extrablanks string string1 globalnum localnum fileobj)
  (cons
    (cons (|lnCreate| extrablanks string globalnum localnum fileobj) 1) string1))
```

defun inclmsgPrematureEOF

[origin p??]

— defun inclmsgPrematureEOF 0 —

```
(defun |inclmsgPrematureEOF| (ufo)
  (list 'S2CI0002 (list (|theorigin| ufo))))
```

defun theorigin

— defun theorigin 0 —

```
(defun |theorigin| (x) (list #'|porigin| x))
```

defun porigin

```
[stringp p??]
```

— defun porigin —

```
(defun |porigin| (x)
  (if (stringp x)
      x
      (|pfname| x)))
```

defun ifCond

```
[MakeSymbol p??]
[incCommandTail p99]
[$inclAssertions p??]
```

— defun ifCond —

```
(defun |ifCond| (s info)
  (let (word)
    (declare (special |$inclAssertions|))
    (setq word
      (|MakeSymbol| (string-trim *whitespace* (|incCommandTail| s info))))
    (member word |$inclAssertions|)))
```

defun xlSkip

```
[incLine p86]
[CONCAT p??]
```

— defun xlSkip —

```
(defun |xlSkip| (extrablanks str localnum fileobj)
```



```
(let ((string (concat "-- Omitting:" str)) (globalnum -1))
(list
 (incLine extrablanks string globalnum localnum fileobj)
 (list nil '|none|))))
```

defun xISay

[xIMsg p84]

[inclmsgSay p88]

— defun xISay —

```
(defun |xISay| (eb str lno ufos x)
(|xIMsg| eb str lno (elt ufos 0) (list (|inclmsgSay| x) '|say|)))
```

defun inclmsgSay

[id p??]

— defun inclmsgSay —

```
(defun |inclmsgSay| (str)
(list 'S2CI0001 (list (|theid| str))))
```

defun theid

— defun theid 0 —

```
(defun |theid| (a) (list identity a))
```

defun xlNoSuchFile

[xlMsg p84]

[inclmsgNoSuchFile p89]

— defun xlNoSuchFile —

```
(defun |xlNoSuchFile| (eb str lno ufos fn)
  (|xlMsg| eb str lno (elt ufos 0) (list (|inclmsgNoSuchFile| fn) 'error))))
```

—————

defun inclmsgNoSuchFile

[thefname p89]

— defun inclmsgNoSuchFile —

```
(defun |inclmsgNoSuchFile| (fn)
  (list 'S2CI0010 (list (|thefname| fn))))
```

—————

defun thefname

[pfname p89]

— defun thefname 0 —

```
(defun |thefname| (x) (list #'|pfname| x))
```

—————

defun pfname

[PathnameString p??]

— defun pfname —

```
(defun |pfname| (x) (|PathnameString| x))
```

—————

defun xlCannotRead

[xlMsg p84]

[inclmsgCannotRead p90]

— defun xlCannotRead —

```
(defun |xlCannotRead| (eb str lno ufos fn)
  (|xlMsg| eb str lno (elt ufos 0) (list (|inclmsgCannotRead| fn) '|error|)))
```

—————

defun inclmsgCannotRead

[thefname p89]

— defun inclmsgCannotRead —

```
(defun |inclmsgCannotRead| (fn)
  (list 'S2CI0011 (list (|thefname| fn))))
```

—————

defun xlFileCycle

[xlMsg p84]

[inclmsgFileCycle p90]

— defun xlFileCycle —

```
(defun |xlFileCycle| (eb str lno ufos fn)
  (|xlMsg| eb str lno (elt ufos 0)
    (list (|inclmsgFileCycle| ufos fn) '|error|)))
```

—————

defun inclmsgFileCycle

```
;inclmsgFileCycle(ufos,fn) ==
;   flist := [porigin n for n in reverse ufos]
;   f1    := porigin fn
;   cycle := [[:[n,'==>"] for n in flist], f1]
;   ['S2CI0004, [%id cycle, %id f1] ]
```

[porigin p87]
[id p??]

— defun inclmsgFileCycle —

```
(defun |inclmsgFileCycle| (ufos fn)
  (let (cycle f1 flist)
    (setq flist
      ((lambda (Var8 Var7 n)
         (loop
          (cond
            ((or (atom Var7) (progn (setq n (car Var7)) nil))
             (return (nreverse Var8)))
            (t
             (setq Var8 (cons (|porigin| n) Var8))))
          (setq Var7 (cdr Var7))))
      nil (reverse ufos) nil))
    (setq f1 (|porigin| fn))
    (setq cycle
      (append
        ((lambda (Var10 Var9 n)
           (loop
            (cond
              ((or (atom Var9) (progn (setq n (car Var9)) nil))
               (return (nreverse Var10)))
              (t
               (setq Var10 (append (reverse (list n "==">)) Var10))))
            (setq Var9 (cdr Var9))))
          nil flist nil)
        (cons f1 nil)))
    (list 'S2CI0004 (list (|theid| cycle) (|theid| f1)))))
```

—————

defun xlConActive

[xlMsg p84]
[inclmsgConActive p92]

— defun xlConActive —

```
(defun |xlConActive| (eb str lno ufos n)
  (|xlMsg| eb str lno (elt ufos 0) (list (|inclmsgConActive| n) '|warning|)))
```

—————

defun inclmsgConActive

[id p??]

— defun inclmsgConActive —

```
(defun |inclmsgConActive| (n)
  (list 'S2CI0006 (list (|theid| n))))
```

—————→

defun xlConStill

[xlMsg p84]

[inclmsgConStill p92]

— defun xlConStill —

```
(defun |xlConStill| (eb str lno ufos n)
  (|xlMsg| eb str lno (elt ufos 0) (list (|inclmsgConStill| n) '|say|)))
```

—————→

defun inclmsgConStill

[id p??]

— defun inclmsgConStill —

```
(defun |inclmsgConStill| (n)
  (list 'S2CI0007 (list (|theid| n))))
```

—————→

defun xlConsole

[xlMsg p84]

[inclmsgConsole p93]

— defun xlConsole —

```
(defun |xlConsole| (eb str lno ufos)
  (|xlMsg| eb str lno (elt ufos 0) (list (|inclmsgConsole|) '|say|)))
```

defun inclmsgConsole

— defun inclmsgConsole 0 —

```
(defun |inclmsgConsole| ()
  (list 'S2CI0005 nil))
```

defun xlSkippingFin

```
[xlMsg p84]
[inclmsgFinSkipped p93]
```

— defun xlSkippingFin —

```
(defun |xlSkippingFin| (eb str lno ufos)
  (|xlMsg| eb str lno (elt ufos 0)
    (list (|inclmsgFinSkipped|) '|warning|)))
```

defun inclmsgFinSkipped

— defun inclmsgFinSkipped 0 —

```
(defun |inclmsgFinSkipped| ()
  (list 'S2CI0008 nil))
```

defun xlPrematureFin

```
[xlMsg p84]
[inclmsgPrematureFin p94]
```

— defun xlPrematureFin —

```
(defun |xlPrematureFin| (eb str lno ufos)
  (|xlMsg| eb str lno (elt ufos 0)
    (list (|inclmsgPrematureFin| (elt ufos 0)) '|error|)))
```

defun inclmsgPrematureFin

[origin p??]

— defun inclmsgPrematureFin —

```
(defun |inclmsgPrematureFin| (ufo)
  (list 'S2CI0003 (list (|theorigin| ufo))))
```

defun assertCond

[MakeSymbol p??]
 [incCommandTail p99]
 [\$inclAssertions p??]
 [*whitespace* p22]

— defun assertCond —

```
(defun |assertCond| (s info)
  (let (word)
    (declare (special |$inclAssertions| *whitespace*))
    (setq word
      (|MakeSymbol| (string-trim *whitespace* (|incCommandTail| s info))))
    (unless (member word |$inclAssertions|)
      (setq |$inclAssertions| (cons word |$inclAssertions|)))))
```

defun xIfSyntax

[Top? p77]
 [Else? p78]
 [xlMsg p84]
 [inclmsgIfSyntax p95]

— defun xIfSyntax —

```
(defun |xIfSyntax| (eb str lno ufos info sts)
  (let (context found st)
    (setq st (elt sts 0))
    (setq found (elt info 2))
    (setq context
      (cond
        ((|Top?| st) '|not in an )if...endif|)
        ((|Else?| st) '|after an )else|)
        (t '|but can't figure out where|)))
    (|xMsg| eb str lno (elt ufos 0)
      (list (|inclmsgIfSyntax| (elt ufos 0) found context) '|error|))))
```

—————

defun inclmsgIfSyntax

```
[concat p1047]
[id p??]
[origin p??]
```

— defun inclmsgIfSyntax —

```
(defun |inclmsgIfSyntax| (ufo found context)
  (setq found (concat ")" found))
  (list 'S2CI0009 (list (|theid| found)
                        (|theid| context)
                        (|theorigin| ufo))))
```

—————

defun xIfBug

```
[xMsg p84]
[inclmsgIfBug p96]
```

— defun xIfBug —

```
(defun |xIfBug| (eb str lno ufos)
  (|xMsg| eb str lno (elt ufos 0) (list (|inclmsgIfBug|) '|bug|)))
```

—————

defun inclmsgIfBug

— defun inclmsgIfBug 0 —

```
(defun |inclmsgIfBug| ()
  (list 'S2CB0002 nil))
```

—————

defun xlCmdBug

[xlMsg p84]
[inclmsgCmdBug p96]

— defun xlCmdBug —

```
(defun |xlCmdBug| (eb str lno ufos)
  (|xlMsg| eb str lno (elt ufos 0) (list (|inclmsgCmdBug|) '|bug|)))
```

—————

defun inclmsgCmdBug

— defun inclmsgCmdBug 0 —

```
(defun |inclmsgCmdBug| ()
  (list 'S2CB0003 nil))
```

—————

defvar \$incCommands

This is a list of commands that can be in an include file

— postvars —

```
(eval-when (eval load)
  (setq |incCommands|
    (list "say" "include" "console" "fin" "assert" "if" "elseif" "else" "endif")))
```

—————

defvar \$pfMacros

The \$pfMacros variable is an alist [[id, state, body-pform], ...] where state is one of: mbody, mparam, mlambda

User-defined macros are maintained in a stack of definitions. This is the stack sequence resulting from the command lines:

```
a ==> 3
a ==> 4
b ==> 7
(
  (|b| |mbody| ((|integer| (|posn| (0 "b ==> 7" 1 1 "strings") . 6)) . "7"))
  (|a| |mbody| ((|integer| (|posn| (0 "a ==> 4" 1 1 "strings") . 6)) . "4"))
  (|a| |mbody| ((|integer| (|posn| (0 "a ==> 3" 1 1 "strings") . 6)) . "3"))
)
```

— **initvars** —

```
(defvar |$pfMacros| nil)
```

defun incClassify

```
;incClassify(s) ==
;      not incCommand? s => [false,0, '"]
;      i := 1; n := #s
;      while i < n and s.i = char " " repeat i := i + 1
;      i >= n => [true,0,'other"]
;      eb := (i = 1 => 0; i)
;      bad:=true
;      for p in incCommands while bad repeat
;          incPrefix?(p, i, s) =>
;              bad:=false
;              p1 :=p
;      if bad then [true,0,'other"] else [true,eb,p1]
```

[incCommand? [p98](#)]

[incCommands [p96](#)]

— **defun incClassify** —

```
(defun |incClassify| (s)
  (let (p1 bad eb n i)
    (declare (special |incCommands|))
```

```

(if (null (|incCommand?| s))
  (list nil 0 ""))
(progn
  (setq i 1)
  (setq n (length s))
  ((lambda ()
    (loop
      (cond
        ((not (and (< i n) (char= (elt s i) #\space)))
         (return nil))
        (t (setq i (1+ i)))))))
  (cond
    ((not (< i n)) (list t 0 "other"))
    (t
     (if (= i 1)
         (setq eb 0)
         (setq eb i))
     (setq bad t)
     ((lambda (tmp1 p)
        (loop
          (cond
            ((or (atom tmp1)
                 (progn (setq p (car tmp1)) nil)
                 (not bad))
             (return nil))
            (t
             (cond
               ((|incPrefix?| p i s)
                (identity
                 (progn
                  (setq bad nil)
                  (setq p1 p))))))
            (setq tmp1 (cdr tmp1))))
        |incCommands| nil)
     (if bad
         (list t 0 "other")
         (list t eb p1))))))

```

defun incCommand?

[char p??]

— defun incCommand? 0 —

```

(defun |incCommand?| (s)
  "does this start with a close paren?"

```

```
(and (< 0 (length s)) (equal (elt s 0) #\)))))
```

defun incPrefix?

```
;incPrefix?(prefix, start, whole) ==
;      #prefix > #whole-start => false
;      good:=true
;      for i in 0..#prefix-1 for j in start.. while good repeat
;          good:= prefix.i = whole.j
;      good
```

— defun incPrefix? 0 —

```
(defun |incPrefix?| (prefix start whole)
  (let (good)
    (cond
      ((< (- (length whole) start) (length prefix)) nil)
      (t
       (setq good t)
       ((lambda (Var i j)
          (loop
            (cond
              ((or (> i Var) (not good)) (return nil))
              (t (setq good (equal (elt prefix i) (elt whole j)))))
            (setq i (+ i 1))
            (setq j (+ j 1))))
          (- (length prefix) 1) 0 start)
       good))))
```

defun incCommandTail

[incDrop p100]

— defun incCommandTail —

```
(defun |incCommandTail| (s info)
  (let ((start (elt info 1)))
    (when (= start 0) (setq start 1))
    (|incDrop| (+ start (length (elt info 2)) 1) s)))
```

defun incDrop

[substring p??]

— defun incDrop 0 —

```
(defun |incDrop| (n b)
  (if (>= n (length b))
      '||
      (substring b n nil)))
```

—————→

defun inclFname

[incFileName p622]

[incCommandTail p99]

— defun inclFname —

```
(defun |inclFname| (s info)
  (|incFileName| (|incCommandTail| s info)))
```

—————→

defun incFileInput

[incRgen p101]

[make-instream p981]

— defun incFileInput —

```
(defun |incFileInput| (fn)
  (|incRgen| (make-instream fn)))
```

—————→

defun incConsoleInput

[incRgen p101]

[make-instream p981]

— defun incConsoleInput —

```
(defun |incConsoleInput| ()
  (|incRgen| (make-instream 0)))
```

defun incNConsoles

[incNConsoles p101]

— defun incNConsoles —

```
(defun |incNConsoles| (ufos)
  (let ((a (member "console" ufos)))
    (if a
      (+ 1 (|incNConsoles| (cdr a)))
      0)))
```

defun incActive?

— defun incActive? 0 —

```
(defun |incActive?| (fn ufos)
  (member fn ufos))
```

defun incRgen

Note that incRgen1 recursively calls this function. [Delay p102]
[incRgen1 p102]

— defun incRgen —

```
(defun |incRgen| (s)
  (|Delay| #'|incRgen1| (list s)))
```

defun Delay

— defun Delay 0 —

```
(defun |Delay| (f x)
  (cons '|nonnullstream| (cons f x)))
```

—————

defvar \$StreamNil

— initvars —

```
(defvar |StreamNil| (list '|nullstream|))
```

—————

— postvars —

```
(eval-when (eval load)
  (setq |StreamNil| (list '|nullstream|)))
```

—————

defun incRgen1

This function reads a line from the stream and then conses it up with a recursive call to `incRgen`. Note that `incRgen` recursively wraps this function in a delay list. [[incRgen p101](#)] [[StreamNil p102](#)]

— defun incRgen1 —

```
(defun |incRgen1| (&rest z)
  (let (a s)
    (declare (special |StreamNil|))
    (setq s (car z))
    (setq a (read-line s nil nil))
    (if (null a)
        (progn
          (close s)
          |StreamNil|)
```

```
(cons a (|incRgen| s))))
```

Chapter 5

The Token Scanner

defvar \$SPACE

— postvars —

```
(eval-when (eval load)
  (defvar SPACE (qenum ' " " 0)))
```

—————

defvar \$ESCAPE

— postvars —

```
(eval-when (eval load)
  (defvar ESCAPE (qenum ' "_ " 0)))
```

—————

defvar \$STRINGCHAR

— postvars —

```
(eval-when (eval load)
  (defvar STRINGCHAR (qenum ' "\" " 0)))
```

defvar \$PLUSCOMMENT

— postvars —

```
(eval-when (eval load)
  (defvar PLUSCOMMENT (qenum '+' " 0)))
```

defvar \$MINUSCOMMENT

— postvars —

```
(eval-when (eval load)
  (defvar MINUSCOMMENT (qenum '-' " 0)))
```

defvar \$RADIXCHAR

— postvars —

```
(eval-when (eval load)
  (defvar RADIXCHAR (qenum 'r " 0)))
```

defvar \$DOT

— postvars —

```
(eval-when (eval load)
  (defvar DOT (qenum '.' " 0)))
```

defvar \$EXPONENT1

— postvars —

```
(eval-when (eval load)
  (defvar EXPONENT1 (qenum ' "E" 0)))
```

—————

defvar \$EXPONENT2

— postvars —

```
(eval-when (eval load)
  (defvar EXPONENT2 (qenum ' "e" 0)))
```

—————

defvar \$CLOSEPAREN

— postvars —

```
(eval-when (eval load)
  (defvar CLOSEPAREN (qenum ' " " 0)))
```

—————

defvar \$QUESTION

— postvars —

```
(eval-when (eval load)
  (defvar QUESTION (qenum ' "?" 0)))
```

—————

defvar \$scanKeyWords

— postvars —

```
(eval-when (eval load)
(defvar |scanKeyWords|
(list
(list "add" 'add)
(list "and" 'and)
(list "break" 'break)
(list "by" 'by)
(list "case" 'case)
(list "default" 'default)
(list "define" 'defn)
(list "do" 'do)
(list "else" 'else)
(list "exit" 'exit)
(list "export" 'export)
(list "for" 'for)
(list "free" 'free)
(list "from" 'from)
(list "has" 'has)
(list "if" 'if)
(list "import" 'import)
(list "in" 'in)
(list "inline" 'inline)
(list "is" 'is)
(list "isnt" 'isnt)
(list "iterate" 'iterate)
(list "local" ' |local|)
(list "macro" 'macro)
(list "mod" 'mod)
(list "or" 'or)
(list "pretend" 'pretend)
(list "quo" 'quo)
(list "rem" 'rem)
(list "repeat" 'repeat)
(list "return" 'return)
(list "rule" 'rule)
(list "then" 'then)
(list "where" 'where)
(list "while" 'while)
(list "with" 'with)
(list "|" 'bar)
(list "." 'dot)
(list "::" 'coerce)
(list ":" 'colon)
(list ":-" 'colondash)
(list "@" 'at)
```

```

(list "@@" 'atat)
(list "," 'comma)
(list ";" 'semicolon)
(list "***" 'power)
(list "*" 'times)
(list "+" 'plus)
(list "-" 'minus)
(list "<" 'lt)
(list ">" 'gt)
(list "<=" 'le)
(list ">=" 'ge)
(list "=" 'equal)
(list "~=" 'notequal)
(list "~" '~)
(list "^" 'carat)
(list ".." 'seg)
(list "#" '|#|)
(list "&" 'ampersand)
(list "$" '$)
(list "/" 'slash)
(list "\" 'backslash)
(list "//" 'slasheslash)
(list "\\\" 'backslashbackslash)
(list "/\" 'slashbackslash)
(list "\\\" 'backslashslash)
(list "=>" 'exit)
(list "!=" 'becomes)
(list "==" 'def)
(list "==" 'mdef)
(list "->" 'arrow)
(list "<-" 'larrow)
(list "+->" 'gives)
(list "(" '|(|)
(list ")" '|)|)
(list "(|" '|(\\|)
(list "|)" '|\\|)|)
(list "[" '[])
(list "]" '])
(list "[_]" '[_])
(list "{" '{)
(list "}" '}')
(list "{_}" '{_}')
(list "[|" '|[\\|)
(list "|]" '|\\|)|)
(list "[_|]" '|[\\|\\|)|)
(list "{|" '|{\\|)
(list "|}" '|\\|)|)
(list "{|_|}" '|{\\|\\|)|)
(list "<<" 'oangle)
(list ">>" 'cangle)

```

```
(list "'" '|'|)
(list "``" 'backquote))))
```

—————

defvar \$infgeneric

— postvars —

```
(eval-when (eval load)
(prog ()
  (return
    ((lambda (var value)
      (loop
        (cond
          ((or (atom var) (progn (setq value (car var)) nil))
           (return nil))
          (t
           (setf (get (car value) 'infgeneric) (cadr value))))
        (setq var (cdr var))))))
(list
  (list 'equal '=)
  (list 'times '*)
  (list 'has '|has|)
  (list 'case '|case|)
  (list 'rem '|rem|)
  (list 'mod '|mod|)
  (list 'quo '|quo|)
  (list 'slash '/')
  (list 'backslash '\\|)
  (list 'slasheslash '//)
  (list 'backslashbackslash '\\\\|)
  (list 'slashbackslash '|/\\|)
  (list 'backslasheslash '\\\\|)
  (list 'power '**)
  (list 'carat '^)
  (list 'plus '+)
  (list 'minus '-')
  (list 'lt '<)
  (list 'gt '>)
  (list 'oangle '<<)
  (list 'cangle '>>)
  (list 'le '<=)
  (list 'ge '>=)
  (list 'notequal '~=)
  (list 'by '|by|)
  (list 'arrow '->))
```

```

(list 'larrow '<-)
(list 'bar '|\\|)
(list 'seg '|..|)
nil))))

```

defun lineoftoks

lineoftoks bites off a token-dq from a line-stream returning the token-dq and the rest of the line-stream

```

;lineoftoks(s)==
;  $f: local:=nil
;  $r:local :=nil
;  $ln:local :=nil
;  $linepos:local:=nil
;  $n:local:=nil
;  $sz:local := nil
;  $floatok:local:=true
;  if not nextline s
;  then CONS(nil,nil)
;  else
;    if null scanIgnoreLine($ln,$n) -- line of spaces or starts ) or >
;    then cons(nil,$r)
;    else
;      toks:=[]
;      a:= incPrefix?('command",1,$ln)
;      a =>
;          $ln:=SUBSTRING($ln,8,nil)
;          b:= dqUnit constoken($ln,$linepos,["command",$ln],0)
;          cons([ [b,s] ],$r)
;
;      while $n<$sz repeat toks:=dqAppend(toks,scanToken())
;      if null toks
;      then cons([], $r)
;      else cons([ [toks,s] ], $r)

```

[\[nextline p112\]](#)
[\[scanIgnoreLine p113\]](#)
[\[incPrefix? p99\]](#)
[\[substring p??\]](#)
[\[dqUnit p343\]](#)
[\[constoken p113\]](#)
[\[\\$floatok p??\]](#)
[\[\\$f p??\]](#)
[\[\\$sz p??\]](#)


```
[$linepos p??]
[$r p??]
[$n p??]
[$ln p??]
```

— defun lineoftoks —

```
(defun |lineoftoks| (s)
  (let (|$floatok| |$sz| |$n| |$linepos| |$ln| |$r| |$f| |b| |a| |toks|)
    (declare (special |$floatok| |$f| |$sz| |$linepos| |$r| |$n| |$ln|))
    (setq |$f| nil)
    (setq |$r| nil)
    (setq |$ln| nil)
    (setq |$linepos| nil)
    (setq |$n| nil)
    (setq |$sz| nil)
    (setq |$floatok| t)
    (cond
      ((null (|nextline| s)) (cons nil nil))
      ((null (|scanIgnoreLine| |$ln| |$n|)) (cons nil |$r|))
      (t
       (setq |toks| nil)
       (setq |a| (|incPrefix?| "command" 1 |$ln|))
       (cond
         (|a|
          (setq |$ln| (substring |$ln| 8 nil))
          (setq |b|
            (|dqUnit| (|constoken| |$ln| |$linepos| (list '|command| |$ln|) 0)))
          (cons (list (list |b| s)) |$r|))
         (t
          ((lambda ()
              (loop
                (cond
                  ((not (< |$n| |$sz|)) (return nil))
                  (t (setq |toks| (|dqAppend| |toks| (|scanToken|))))))))
              (cond
                ((null |toks|) (cons nil |$r|))
                (t (cons (list (list |toks| s)) |$r|))))))))))
```

defun nextline

```
[npNull p333]
[strposl p1046]
[$sz p??]
[$n p??]
```

```
[$linepos p??]
[$ln p??]
[$r p??]
[$f p??]
```

— defun nextline —

```
(defun |nextline| (s)
  (declare (special |$sz| |$n| |$linepos| |$ln| |$r| |$f|))
  (cond
    ((|npNull| s) nil)
    (t
     (setq |$f| (car s))
     (setq |$r| (cdr s))
     (setq |$ln| (cdr |$f|))
     (setq |$linepos| (caar |$f|))
     (setq |$n| (strpos1 " " |$ln| 0 t)) ; spaces at beginning
     (setq |$sz| (length |$ln|))
     t))))
```

—————

defun scanIgnoreLine

```
[qenum p1046]
[incPrefix? p99]
```

— defun scanIgnoreLine —

```
(defun |scanIgnoreLine| (ln n)
  (cond
    ((null n) n)
    (t
     (cond
       ((equal (qenum ln 0) CLOSEPAREN)
        (cond
          ((|incPrefix?| "command" 1 ln) t)
          (t nil)))
       (t n))))))
```

—————

defun constoken

```
[ncPutQ p416]
```

— **defun constoken** —

```
(defun |constoken| (ln lp b n)
  (declare (ignore ln))
  (let (a)
    (setq a (cons (elt b 0) (elt b 1)))
    (incPutQ| a '|posn| (cons lp n))
    a))
```

—————

defun scanToken

```
[qenum p1046]
[startsComment? p115]
[scanComment p116]
[startsNegComment? p117]
[scanNegComment p117]
[lfid p115]
[punctuation? p118]
[scanPunct p118]
[startsId? p1044]
[scanWord p126]
[scanSpace p129]
[scanString p130]
[digit? p122]
[scanNumber p132]
[scanEscape p135]
[scanError p135]
[dqUnit p343]
[constoken p113]
[lnExtraBlanks p345]
[$linepos p??]
[$n p??]
[$ln p??]
```

— **defun scanToken** —

```
(defun |scanToken| ()
  (let (b ch n linepos c ln)
    (declare (special |$linepos| |$n| |$ln|))
    (setq ln |$ln|)
    (setq c (qenum |$ln| |$n|))
    (setq linepos |$linepos|)
    (setq n |$n|)
    (setq ch (elt |$ln| |$n|))
```

```

(setq b
  (cond
    ((|startsComment?|) (|scanComment|) nil)
    ((|startsNegComment?|) (|scanNegComment|) nil)
    ((equal c QUESTION)
      (setq |$n| (+ |$n| 1))
      (|lfid| "?"))
    ((|punctuation?| c) (|scanPunct|))
    ((|startsId?| ch) (|scanWord| nil))
    ((equal c SPACE) (|scanSpace|) nil)
    ((equal c STRINGCHAR) (|scanString|))
    ((|digit?| ch) (|scanNumber|))
    ((equal c ESCAPE) (|scanEscape|))
    (t (|scanError|))))
(cond
  ((null b) nil)
  (t
    (|dqUnit|
      (|constoken| ln linepos b (+ n (|lnExtraBlanks| linepos)))))))

```

defun lfid

To pair badge and badgee

— defun lfid 0 —

```

(defun |lfid| (x)
  (list '|id| (intern x "BOOT")))

```

defun startsComment?

[qenum p¹⁰⁴⁶]

[\$ln p??]

[\$sz p??]

[\$n p??]

— defun startsComment? —

```

(defun |startsComment?| ()
  (let (www)
    (declare (special |$ln| |$sz| |$n|))
    (cond

```

```

((< |$n| |$sz|)
 (cond
  ((equal (qenum |$ln| |$n|) PLUSCOMMENT)
   (setq www (+ |$n| 1))
   (cond
    ((not (< www |$sz|)) nil)
    (t (equal (qenum |$ln| www) PLUSCOMMENT))))
  (t nil)))
(t nil)))

```

defun scanComment

```

[lfcomment p116]
[substring p??]
[$ln p??]
[$sz p??]
[$n p??]

```

— defun scanComment —

```

(defun |scanComment| ()
  (let (n)
    (declare (special |$ln| |$sz| |$n|))
    (setq n |$n|)
    (setq |$n| |$sz|)
    (|lfcomment| (substring |$ln| n nil))))

```

defun lfcomment

— defun lfcomment 0 —

```

(defun |lfcomment| (x)
  (list '|comment| x))

```

defun startsNegComment?

[qenum p1046]
 [\$ln p??]
 [\$sz p??]
 [\$n p??]

— defun startsNegComment? —

```
(defun |startsNegComment?| ()
  (let (www)
    (declare (special |$ln| |$sz| |$n|))
    (cond
      ((< |$n| |$sz|)
        (cond
          ((equal (qenum |$ln| |$n|) MINUSCOMMENT)
            (setq www (+ |$n| 1))
            (cond
              ((not (< www |$sz|)) nil)
              (t (equal (qenum |$ln| www) MINUSCOMMENT))))
          (t nil)))
      (t nil))))
```

—————

defun scanNegComment

[lfnegcomment p118]
 [substring p??]
 [\$ln p??]
 [\$sz p??]
 [\$n p??]

— defun scanNegComment —

```
(defun |scanNegComment| ()
  (let (n)
    (declare (special |$ln| |$sz| |$n|))
    (setq n |$n|)
    (setq |$n| |$sz|)
    (|lfnegcomment| (substring |$ln| n nil))))
```

—————

defun lfnegcomment

— defun lfnegcomment 0 —

```
(defun |lfnegcomment| (x)
  (list '|negcomment| x))
```

—————

defun punctuation?

— defun punctuation? —

```
(defun |punctuation?| (c)
  (eq1 (elt |scanPun| c) 1))
```

—————

defun scanPunct

```
[subMatch p119]
[scanError p135]
[scanKeyTr p120]
[$n p??]
[$ln p??]
```

— defun scanPunct —

```
(defun |scanPunct| ()
  (let (a sss)
    (declare (special |$n| |$ln|))
    (setq sss (|subMatch| |$ln| |$n|))
    (setq a (length sss))
    (cond
      ((eq1 a 0) (|scanError|))
      (t (setq |$n| (+ |$n| a)) (|scanKeyTr| sss)))))
```

—————

defun subMatch

[substringMatch p119]

— defun subMatch —

```
(defun |subMatch| (a b)
  (|substringMatch| a |scanDict| b))
```

—————

defun substringMatch

```
;substringMatch (l,d,i)==
;      h:= QENUM(l, i)
;      u:=ELT(d,h)
;      ll:=SIZE l
;      done:=false
;      s1:=""
;      for j in 0.. SIZE u - 1 while not done repeat
;        s:=ELT(u,j)
;        ls:=SIZE s
;        done:=if ls+i > ll
;              then false
;              else
;                eql:= true
;                for k in 1..ls-1 while eql repeat
;                  eql:= EQL(QENUM(s,k),QENUM(l,k+i))
;                if eql
;                  then
;                    s1:=s
;                    true
;                else false
;      s1
```

[qenum p1046]

[size p1045]

— defun substringMatch —

```
(defun |substringMatch| (l dict i)
  (let (eql ls s s1 done ll u h)
    (setq h (qenum l i))
    (setq u (elt dict h))
    (setq ll (size l))
    (setq s1 "")
    ((lambda (Var4 j)
```



```

(loop
  (cond
    ((or (> j Var4) done) (return nil))
    (t
     (setq s (elt u j))
     (setq ls (size s))
     (setq done
      (cond
        ((< ll (+ ls i)) nil)
        (t
         (setq eql t)
         ((lambda (Var5 k)
          (loop
            (cond
              ((or (> k Var5) (not eql)) (return nil))
              (t
               (setq eql (eql (qenum s k) (qenum l (+ k i))))
               (setq k (+ k 1))))
             (- ls 1) 1)
          (cond (eql (setq s1 s) t) (t nil)))))))
      (setq j (+ j 1))))
    (- (size u) 1) 0)
  s1))

```

defun scanKeyTr

```

[keyword p121]
[scanPossFloat p121]
[lfkey p122]
[scanCloser? p125]
[$floatok p??]

```

— defun scanKeyTr —

```

(defun |scanKeyTr| (w)
  (declare (special |$floatok|))
  (cond
    ((eq (|keyword| w) 'dot)
     (cond
      (|$floatok| (|scanPossFloat| w))
      (t (|lfkey| w))))
    (t (setq |$floatok| (null (|scanCloser?| w)) (|lfkey| w))))

```

defun keyword

[hget p1044]

— defun keyword 0 —

```
(defun |keyword| (st)
  (hget |scanKeyTable| st))
```

defun keyword?

[hget p1044]

— defun keyword? 0 —

```
(defun |keyword?| (st)
  (null (null (hget |scanKeyTable| st))))
```

defun scanPossFloat

```
[digit? p122]
[lfkey p122]
[spleI p122]
[scanExponent p126]
[$ln p??]
[$sz p??]
[$n p??]
```

— defun scanPossFloat —

```
(defun |scanPossFloat| (w)
  (declare (special |$ln| |$sz| |$n|))
  (cond
    ((or (not (< |$n| |$sz|)) (null (|digit?| (elt |$ln| |$n|))))
      (|lfkey| w))
    (t
      (setq w (|spleI| #'|digit?|)) (|scanExponent| "0" w))))
```

defun digit?

[digitp p1045]

— defun digit? —

```
(defun |digit?| (x)
  (digitp x))
```

defun lfkey

[keyword p121]

— defun lfkey —

```
(defun |lfkey| (x)
  (list '|key| (|keyword| x)))
```

defun spleI

[spleI1 p122]

— defun spleI —

```
(defun |spleI| (dig)
  (|spleI1| dig nil))
```

defun spleI1

```
[qenum p1046]
[substring p??]
[scanEsc p123]
[spleI1 p122]
[concat p1047]
[$ln p??]
[$sz p??]
```

[$\$n$ p??]

— defun spleI1 —

```
(defun |spleI1| (dig zro)
  (let (bb a str l n)
    (declare (special |$ln| |$sz| |$n|))
    (setq n |$n|)
    (setq l |$sz|)
    ; while $n<l and FUNCALL(dig,($ln.$n)) repeat $n:=$n+1
    ((lambda ()
      (loop
        (cond
          ((not (and (< |$n| l) (funcall dig (elt |$ln| |$n|))))
            (return nil))
          (t
            (setq |$n| (+ |$n| 1)))))))
    (cond
      ((or (equal |$n| l) (not (equal (qenum |$ln| |$n|) ESCAPE)))
        (cond
          ((and (equal n |$n|) zro) "0")
          (t (substring |$ln| n (- |$n| n)))))
      (t
        ; escaped
        (setq str (substring |$ln| n (- |$n| n)))
        (setq |$n| (+ |$n| 1))
        (setq a (|scanEsc|))
        (setq bb (|spleI1| dig zro)) ; escape, any number of spaces are ignored
        (concat str bb)))))
```

—————

defun scanEsc

```
;scanEsc()==
;   if $n>=$sz
;   then if nextline($r)
;       then
;           while null $n repeat nextline($r)
;           scanEsc()
;       false
;   else false
;   else
;       n1:=STRPOSL(' "',$ln,$n,true)
;       if null n1
;       then if nextline($r)
;           then
;               while null $n repeat nextline($r)
;               scanEsc()
```

```

;           false
;         else false
;       else
;         if $n=n1
;         then true
;         else if QENUM($ln,n1)=ESCAPE
;           then
;             $n:=n1+1
;             scanEsc()
;             false
;         else
;           $n:=n1
;           startsNegComment?() or startsComment?() =>
;             nextline($r)
;             scanEsc()
;             false
;         false
;

```

[\[nextline p112\]](#)
[\[scanEsc p123\]](#)
[\[strposl p1046\]](#)
[\[qenum p1046\]](#)
[\[startsNegComment? p117\]](#)
[\[startsComment? p115\]](#)
[\[\\$ln p??\]](#)
[\[\\$r p??\]](#)
[\[\\$sz p??\]](#)
[\[\\$n p??\]](#)

— defun scanEsc —

```

(defun |scanEsc| ()
  (let (n1)
    (declare (special |$ln| |$r| |$sz| |$n|))
    (cond
      ((not (< |$n| |$sz|))
        (cond
          ((|nextline| |$r|)
            ((lambda ()
              (loop
                (cond
                  (|$n| (return nil))
                  (t (|nextline| |$r|))))))
            (|scanEsc|)
            nil)
          (t nil)))
      (t
        (setq n1 (strposl " " |$ln| |$n| t))
        (cond

```

```

((null n1)
 (cond
  ((|nextline| |$r|)
   ((lambda ()
    (loop
     (cond
      (|$n| (return nil))
      (t (|nextline| |$r|))))))
   (|scanEsc|)
   nil)
  (t nil)))
((equal |$n| n1) t)
((equal (qenum |$ln| n1) ESCAPE)
 (setq |$n| (+ n1 1))
 (|scanEsc|)
 nil)
(t (setq |$n| n1)
 (cond
  ((or (|startsNegComment?|) (|startsComment?|))
   (progn
    (|nextline| |$r|)
    (|scanEsc|)
    nil))
  (t nil))))))

```

defvar \$scanCloser

— postvars —

```

(eval-when (eval load)
 (defvar |scanCloser| (list '|| '}' ']' '\|'| '\|}| '\|]|)))

```

defun scanCloser?

[keyword p121]
[scanCloser p125]

— defun scanCloser? 0 —

```

(defun |scanCloser?| (w)

```

```
(declare (special |scanCloser|))
(member (|keyword| w) |scanCloser|))
```

defun scanWord

```
[scanW p128]
[lfid p115]
[keyword? p121]
[lfkey p122]
[$floatok p??]
```

— defun scanWord —

```
(defun |scanWord| (esp)
  (let (w aaa)
    (declare (special |$floatok|))
    (setq aaa (|scanW| nil))
    (setq w (elt aaa 1))
    (setq |$floatok| nil)
    (cond
      ((or esp (elt aaa 0))
       (|lfid| w))
      ((|keyword?| w)
       (setq |$floatok| t)
       (|lfkey| w))
      (t
       (|lfid| w))))))
```

defun scanExponent

```
[lffloat p127]
[qenum p1046]
[digit? p122]
[spleI p122]
[concat p1047]
[$ln p??]
[$sz p??]
[$n p??]
```

— defun scanExponent —

```

(defun |scanExponent| (a w)
  (let (c1 e c n)
    (declare (special |$ln| |$sz| |$n|))
    (cond
      ((not (< |$n| |$sz|)) (|lffloat| a w "0"))
      (t
       (setq n |$n|)
       (setq c (qenum |$ln| |$n|))
       (cond
         ((or (equal c EXPONENT1) (equal c EXPONENT2))
          (setq |$n| (+ |$n| 1))
          (cond
            ((not (< |$n| |$sz|))
             (setq |$n| n)
             (|lffloat| a w "0"))
            ((|digit?| (elt |$ln| |$n|))
             (setq e (|spleI| #'|digit?|))
             (|lffloat| a w e))
            (t
             (setq c1 (qenum |$ln| |$n|))
             (cond
               ((or (equal c1 PLUSCOMMENT) (equal c1 MINUSCOMMENT))
                (setq |$n| (+ |$n| 1))
                (cond
                  ((not (< |$n| |$sz|))
                   (setq |$n| n)
                   (|lffloat| a w "0"))
                  ((|digit?| (elt |$ln| |$n|))
                   (setq e (|spleI| #'|digit?|))
                   (|lffloat| a w
                     (cond
                       ((equal c1 MINUSCOMMENT)
                        (concat "-" e))
                       (t e))))
                  (t
                   (setq |$n| n)
                   (|lffloat| a w "0"))))))))
             (t (|lffloat| a w "0"))))))))

```

defun lffloat

[concat p1047]

— defun lffloat 0 —

```
(defun |lffloat| (a w e)
```



```
(list '|float| (concat a "." w "e" e)))
```

defmacro idChar?

— defmacro idChar? 0 —

```
(defmacro |idChar?| (x)
  '(or (alphanumericp ,x) (member ,x '(#\? #\% #\' #\!) :test #'char=)))
```

defun scanW

```
[posend p129]
[qenum p1046]
[substring p??]
[scanEsc p123]
[scanW p128]
[idChar? p128]
[concat p1047]
[$ln p??]
[$sz p??]
[$n p??]
```

— defun scanW —

```
(defun |scanW| (b)
  (let (bb a str endid l n1)
    (declare (special |$ln| |$sz| |$n|))
    (setq n1 |$n|)
    (setq |$n| (+ |$n| 1))
    (setq l |$sz|)
    (setq endid (|posend| |$ln| |$n|))
    (cond
     ((or (equal endid l) (not (equal (qenum |$ln| endid) ESCAPE)))
      (setq |$n| endid)
      (list b (substring |$ln| n1 (- endid n1))))
     (t
      (setq str (substring |$ln| n1 (- endid n1)))
      (setq |$n| (+ endid 1))
      (setq a (|scanEsc|))
```

```
(setq bb
  (cond
    (a (|scanW| t))
    ((not (< |$n| |$sz|)) (list b ""))
    ((|idChar?| (elt |$ln| |$n|)) (|scanW| b))
    (t (list b ""))))
(list (or (elt bb 0) b) (concat str (elt bb 1))))))
```

defun posend

```
;posend(line,n)==
;   while n<#line and idChar? line.n repeat n:=n+1
;   n
```

NOTE: do not replace “lyne” with “line”

— defun posend —

```
(defun |posend| (lyne n)
  ((lambda ()
    (loop
      (cond
        ((not (and (< n (length lyne)) (|idChar?| (elt lyne n))))
        (return nil))
        (t (setq n (+ n 1)))))))
  n)
```

defun scanSpace

```
[strposl p1046]
[lfspace p130]
[$floatok p??]
[$ln p??]
[$n p??]
```

— defun scanSpace —

```
(defun |scanSpace| ()
  (let (n)
    (declare (special |$floatok| |$ln| |$n|))
    (setq n |$n|)
    (setq |$n| (strposl " " |$ln| |$n| t))
```

```

(when (null |$n|) (setq |$n| (length |$ln|)))
(setq |$floatok| t)
(|lfspaces| (- |$n| n)))

```

defun lfspaces

— defun lfspaces 0 —

```

(defun |lfspaces| (x)
  (list '|spaces| x))

```

defun scanString

```

[lfstring p130]
[scanS p131]
[$floatok p??]
[$n p??]

```

— defun scanString —

```

(defun |scanString| ()
  (declare (special |$floatok| |$n|))
  (setq |$n| (+ |$n| 1))
  (setq |$floatok| nil)
  (|lfstring| (|scanS|)))

```

defun lfstring

— defun lfstring 0 —

```

(defun |lfstring| (x)
  (if (eql (length x) 1)
      (list '|char| x)
      (list '|string| x)))

```

defun scanS

[ncSoftError p351]
 [lnExtraBlanks p345]
 [strpos p1045]
 [substring p??]
 [scanEsc p123]
 [concat p1047]
 [scanTransform p132]
 [scanS p131]
 [\$ln p??]
 [\$linepos p??]
 [\$sz p??]
 [\$n p??]

— defun scanS —

```
(defun |scanS| ()
  (let (b a str mn escsym strsym n)
    (declare (special |$ln| |$linepos| |$sz| |$n|))
    (cond
      ((not (< |$n| |$sz|))
        (|ncSoftError|
          (cons |$linepos| (+ (|lnExtraBlanks| |$linepos|) |$n|)) 'S2CN0001 nil) ""))
      (t
        (setq n |$n|)
        (setq strsym (or (strpos "\" |$ln| |$n| nil) |$sz|))
        (setq escsym (or (strpos "_" |$ln| |$n| nil) |$sz|))
        (setq mn (min strsym escsym))
        (cond
          ((equal mn |$sz|)
            (setq |$n| |$sz|)
            (|ncSoftError|
              (cons |$linepos| (+ (|lnExtraBlanks| |$linepos|) |$n|)) 'S2CN0001 nil)
            (substring |$ln| n nil))
          ((equal mn strsym)
            (setq |$n| (+ mn 1))
            (substring |$ln| n (- mn n)))
          (t
            (setq str (substring |$ln| n (- mn n)))
            (setq |$n| (+ mn 1))
            (setq a (|scanEsc|))
            (setq b
              (cond
                (a
                  (setq str (concat str (|scanTransform| (elt |$ln| |$n|))))
                  (setq |$n| (+ |$n| 1)) (|scanS|))
                (t (|scanS|))))
              (concat str b)))))))
```

defun scanTransform

— defun scanTransform —

```
(defun |scanTransform| (x) x)
```

defun scanNumber

```
[spleI p122]
```

```
[lfinteger p133]
```

```
[qenum p1046]
```

```
[spleI1 p122]
```

```
[scanExponent p126]
```

```
[scanCheckRadix p134]
```

```
[lfrinteger p134]
```

```
[concat p1047]
```

```
[$floatok p??]
```

```
[$ln p??]
```

```
[$sz p??]
```

```
[$n p??]
```

— defun scanNumber —

```
(defun |scanNumber| ()
```

```
  (let (v w n a)
```

```
    (declare (special [$floatok] [$ln] [$sz] [$n]))
```

```
    (setq a (|spleI| #'|digit?|))
```

```
    (cond
```

```
      ((not (< |$n| |$sz|))
```

```
        (|lfinteger| a))
```

```
      ((not (equal (qenum |$ln| |$n|) RADIXCHAR))
```

```
        (cond
```

```
          ((and |$floatok| (equal (qenum |$ln| |$n|) DOT))
```

```
            (setq n |$n|)
```

```
            (setq |$n| (+ |$n| 1))
```

```
          (cond
```

```
            ((and (< |$n| |$sz|) (equal (qenum |$ln| |$n|) DOT))
```

```
              (setq |$n| n)
```

```

(|lfinteger| a))
(t
  (setq w (|spleI1| #'|digit?| t))
  (|scanExponent| a w)))
(t (|lfinteger| a)))
(t
  (setq |$n| (+ |$n| 1))
  (setq w (|spleI1| #'|rdigit?| t))
  (|scanCheckRadix| (parse-integer a) w)
  (cond
    ((not (< |$n| |$sz|))
     (|lfrinteger| a w))
    ((equal (qenum |$ln| |$n|) DOT)
     (setq n |$n|)
     (setq |$n| (+ |$n| 1))
     (cond
       ((and (< |$n| |$sz|) (equal (qenum |$ln| |$n|) DOT))
        (setq |$n| n)
        (|lfrinteger| a w))
       (t
        (setq v (|spleI1| #'|rdigit?| t))
        (|scanCheckRadix| (parse-integer a) v)
        (|scanExponent| (concat a "r" w) v))))
    (t (|lfrinteger| a w))))))

```

defun rdigit?

[strpos p1045]

— defun rdigit? 0 —

```

(defun |rdigit?| (x)
  (strpos x "0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ" 0 nil))

```

defun lfinteger

— defun lfinteger 0 —

```

(defun |lfinteger| (x)
  (list '|integer| x))

```

defun lfrinteger

[concat p1047]

— defun lfrinteger 0 —

```
(defun |lfrinteger| (r x)
  (list '|integer| (concat r (concat "r" x))))
```

defun scanCheckRadix

```
;scanCheckRadix(r,w)==
;      ns:=#w
;      done:=false
;      for i in 0..ns-1 repeat
;        a:=rdigit? w.i
;        if null a or a>=r
;          then ncSoftError(cons($linepos,lnExtraBlanks $linepos+$n-ns+i),
;                                "S2CN0002", [w.i])
;
```

[\$n p??]

[\$linepos p??]

— defun scanCheckRadix —

```
(defun |scanCheckRadix| (r w)
  (let (a ns)
    (declare (special |$n| |$linepos|))
    (setq ns (length w))
    ((lambda (Var1 i)
      (loop
        (cond
          ((> i Var1) (return nil))
          (t
           (setq a (|rdigit?| (elt w i)))
           (cond
             ((or (null a) (not (< a r)))
              (|ncSoftError|
               (cons |$linepos| (+ (- (+ (|lnExtraBlanks| |$linepos|) |$n|) ns) i))
               'S2CN0002 (list (elt w i)))))))
        (setq i (+ i 1))))
    (- ns 1) 0)))
```

defun scanEscape

[scanEsc p[123](#)]
 [scanWord p[126](#)]
 [\$n p??]

— defun scanEscape —

```
(defun |scanEscape| ()
  (declare (special |$n|))
  (setq |$n| (+ |$n| 1))
  (when (|scanEsc|) (|scanWord| t)))
```

defun scanError

[ncSoftError p[351](#)]
 [lnExtraBlanks p[345](#)]
 [lerror p[135](#)]
 [\$ln p??]
 [\$linepos p??]
 [\$n p??]

— defun scanError —

```
(defun |scanError| ()
  (let (n)
    (declare (special |$ln| |$linepos| |$n|))
    (setq n |$n|)
    (setq |$n| (+ |$n| 1))
    (|ncSoftError|
     (cons |$linepos| (+ (|lnExtraBlanks| |$linepos|) |$n|))
     'S2CN0003 (list (elt |$ln| n)))
    (|lerror| (elt |$ln| n))))
```

defun lferror

— defun lferror 0 —


```
(defun |lerror| (x)
  (list '|error| x))
```

defvar \$scanKeyTable

— postvars —

```
(eval-when (eval load)
  (defvar |scanKeyTable| (|scanKeyTableCons|)))
```

defun scanKeyTableCons

This function is used to build the scanKeyTable

```
;scanKeyTableCons()==
;   KeyTable:=MAKE_-HASHTABLE("CVEC",true)
;   for st in scanKeyWords repeat
;       HPUT(KeyTable,CAR st,CADR st)
;   KeyTable
```

— defun scanKeyTableCons —

```
(defun |scanKeyTableCons| ()
  (let (KeyTable)
    (setq KeyTable (make-hash-table :test #'equal))
    ((lambda (Var6 st)
      (loop
        (cond
          ((or (atom Var6) (progn (setq st (car Var6)) nil))
           (return nil))
          (t
           (hput KeyTable (car st) (cadr st))))
        (setq Var6 (cdr Var6))))
      |scanKeyWords| nil)
    KeyTable))
```

defvar \$scanDict

— postvars —

```
(eval-when (eval load)
  (defvar |scanDict| (|scanDictCons|)))
```

—————

defun scanDictCons

```
;scanDictCons()==
;      l:= HKEYS scanKeyTable
;      d :=
;          a:=MAKE_-VEC(256)
;          b:=MAKE_-VEC(1)
;          VEC_-SETELT(b,0,MAKE_-CVEC 0)
;          for i in 0..255 repeat VEC_-SETELT(a,i,b)
;          a
;      for s in l repeat scanInsert(s,d)
;      d
```

[hkeys p1044]

— defun scanDictCons —

```
(defun |scanDictCons| ()
  (let (d b a l)
    (setq l (hkeys |scanKeyTable|))
    (setq d
      (progn
        (setq a (make-array 256))
        (setq b (make-array 1))
        (setf (svref b 0)
          (make-array 0 :fill-pointer 0 :element-type 'string-char))
        ((lambda (i)
          (loop
            (cond
              ((> i 255) (return nil))
              (t (setf (svref a i) b)))
            (setq i (+ i 1))))
          0)
        a))
    ((lambda (Var7 s)
      (loop
        (cond
```

```

      ((or (atom Var7) (progn (setq s (car Var7)) nil))
       (return nil))
      (t (|scanInsert| s d)))
      (setq Var7 (cdr Var7))))
  1 nil)
d))

```

defun scanInsert

```

;scanInsert(s,d) ==
;   l := #s
;   h := QENUM(s,0)
;   u := ELT(d,h)
;   n := #u
;   k:=0
;   while l <= #(ELT(u,k)) repeat
;     k:=k+1
;   v := MAKE_-VEC(n+1)
;   for i in 0..k-1 repeat VEC_-SETELT(v,i,ELT(u,i))
;   VEC_-SETELT(v,k,s)
;   for i in k..n-1 repeat VEC_-SETELT(v,i+1,ELT(u,i))
;   VEC_-SETELT(d,h,v)
;   s

```

[qenum p1046]

— defun scanInsert —

```

(defun |scanInsert| (s d)
  (let (v k n u h l)
    (setq l (length s))
    (setq h (qenum s 0))
    (setq u (elt d h))
    (setq n (length u))
    (setq k 0)
    ((lambda ()
      (loop
        (cond
          ((< (length (elt u k)) l) (return nil))
          (t (setq k (+ k 1))))))
      (setq v (make-array (+ n 1)))
      ((lambda (Var2 i)
        (loop
          (cond
            ((> i Var2) (return nil))

```

```

      (t (setf (svref v i) (elt u i))))
    (setq i (+ i 1))))
  (- k 1) 0)
(setf (svref v k) s)
((lambda (Var3 i)
  (loop
    (cond
      ((> i Var3) (return nil))
      (t (setf (svref v (+ i 1)) (elt u i))))
    (setq i (+ i 1))))
  (- n 1) k)
(setf (svref d h) v)
s))

```

defvar \$scanPun

— postvars —

```

(eval-when (eval load)
  (defvar |scanPun| (|scanPunCons|)))

```

defun scanPunCons

```

;scanPunCons()==
;   listing := HKEYS scanKeyTable
;   a:=MAKE_-BVEC 256
;   for i in 0..255 repeat BVEC_-SETELT(a,i,0)
;   for k in listing repeat
;     if not startsId? k.0
;     then BVEC_-SETELT(a,QENUM(k,0),1)
;   a

```

[hkeys p1044]

— defun scanPunCons —

```

(defun |scanPunCons| ()
  (let (a listing)
    (setq listing (hkeys |scanKeyTable|))
    (setq a (make-array (list 256) :element-type 'bit :initial-element 0))

```

```
((lambda (i)
  (loop
    (cond
      ((> i 255) (return nil))
      (t (setf (sbit a i) 0)))
    (setq i (+ i 1))))
  0)
(lambda (Var8 k)
  (loop
    (cond
      ((or (atom Var8) (progn (setq k (car Var8)) nil))
        (return nil))
      (t
        (cond
          ((null (|startsId?| (elt k 0)))
            (setf (sbit a (qenum k 0)) 1))))
        (setq Var8 (cdr Var8))))
    listing nil)
  a))
```

Chapter 6

Input Stream Parser

defun Input Stream Parser

```
[trappoint p??]  
[npFirstTok p143]  
[npItem p142]  
[ncSoftError p351]  
[tokPosn p413]  
[pfWrong p296]  
[pfDocument p246]  
[pfListOf p245]  
[$ttok p??]  
[$stok p??]  
[$stack p??]  
[$inputStream p??]
```

— **defun** npParse —

```
(defun |npParse| (stream)  
  (let (|$ttok| |$stok| |$stack| |$inputStream| found)  
    (declare (special |$ttok| |$stack| |$inputStream| |$stok|))  
    (setq |$inputStream| stream)  
    (setq |$stack| nil)  
    (setq |$stok| nil)  
    (setq |$ttok| nil)  
    (|npFirstTok|)  
    (setq found (catch 'trappoint (|npItem|)))  
    (cond  
      ((eq found 'trapped)  
       (|ncSoftError| (|tokPosn| |$stok|) 's2cy0006 nil)  
       (|pfWrong| (|pfDocument| "top level syntax error") (|pfListOf| nil)))  
      ((null (null |$inputStream|))
```

```

(|ncSoftError| (|tokPosn| |$stok|) 's2cy0002 nil)
(|pfWrong|
  (|pfDocument| (list "input stream not exhausted"))
  (|pfListOf| nil)))
((null |$stack|)
  (|ncSoftError| (|tokPosn| |$stok|) 's2cy0009 nil)
  (|pfWrong| (|pfDocument| (list "stack empty")) (|pfListOf| nil)))
(t (car |$stack|))))

```

defun npItem

```

[npQualDef p145]
[npEqKey p145]
[npItem1 p142]
[npPop1 p144]
[pfEnSequence p263]
[npPush p143]
[pfNovalue p279]

```

— defun npItem —

```

(defun |npItem| ()
  (let (c b a tmp1)
    (when (|npQualDef|)
      (if (|npEqKey| 'semicolon)
        (progn
          (setq tmp1 (|npItem1| (|npPop1|)))
          (setq a (car tmp1))
          (setq b (cadr tmp1))
          (setq c (|pfEnSequence| b))
          (if a
            (|npPush| c)
            (|npPush| (|pfNovalue| c))))
        (|npPush| (|pfEnSequence| (|npPop1|)))))))

```

defun npItem1

```

[npQualDef p145]
[npEqKey p145]
[npItem1 p142]
[npPop1 p144]

```

— defun npItem1 —

```
(defun |npItem1| (c)
  (let (b a tmp1)
    (if (|npQualDef|)
      (if (|npEqKey| 'semicolon)
        (progn
          (setq tmp1 (|npItem1| (|npPop1|)))
          (setq a (car tmp1))
          (setq b (cadr tmp1))
          (list a (append c b)))
        (list t (append c (|npPop1|))))
      (list nil c))))
```

—————

defun npFirstTok

Sets the current leaf (\$tok) to the next leaf in the input stream. Sets the current token (\$ttok) cdr of the leaf. A leaf token looks like [head, token, position] where head is either an id or (id . alist) [tokConstruct p411]

```
[tokPosn p413]
[tokPart p413]
[$ttok p??]
[$tok p??]
[$inputStream p??]
```

— defun npFirstTok —

```
(defun |npFirstTok| ()
  (declare (special |$ttok| |$tok| |$inputStream|))
  (if (null |$inputStream|)
    (setq |$tok| (|tokConstruct| 'error 'nomore (|tokPosn| |$tok|)))
    (setq |$tok| (car |$inputStream|)))
  (setq |$ttok| (|tokPart| |$tok|)))
```

—————

defun Push one item onto \$stack

```
[$stack p??]
```

— defun npPush 0 —


```
(defun |npPush| (x)
  (declare (special |$stack|))
  (push x |$stack|))
```

defun Pop one item off \$stack

[*\$stack* *p??*]

— defun npPop1 0 —

```
(defun |npPop1| ()
  (declare (special |$stack|))
  (pop |$stack|))
```

defun Pop the second item off \$stack

[*\$stack* *p??*]

— defun npPop2 0 —

```
(defun |npPop2| ()
  (let (a)
    (declare (special |$stack|))
    (setq a (cadr |$stack|))
    (rplacd |$stack| (cddr |$stack|))
    a))
```

defun Pop the third item off \$stack

[*\$stack* *p??*]

— defun npPop3 0 —

```
(defun |npPop3| ()
  (let (a)
    (declare (special |$stack|))
    (setq a (caddr |$stack|))
```

```
(rplacd (cdr |$stack|) (cdddr |$stack|)) a))
```

defun npQualDef

```
[npComma p146]
[npPush p143]
[npPop1 p144]
```

— defun npQualDef —

```
(defun |npQualDef| ()
  (and (|npComma|) (|npPush| (list (|npPop1|)))))
```

defun Advance over a keyword

Test for the keyword, if found advance the token stream [npNext p145]

```
[$ttok p??]
[$stok p??]
```

— defun npEqKey —

```
(defun |npEqKey| (keyword)
  (declare (special |$ttok| |$stok|))
  (and
    (eq (caar |$stok|) '|key|)
    (eq keyword |$ttok|)
    (|npNext|)))
```

defun Advance the input stream

This advances the input stream. The call to npFirstTok picks off the next token in the input stream and updates the current leaf (\$stok) and the current token (\$ttok) [npFirstTok p143]

```
[$inputStream p??]
```

— defun npNext —

```
(defun |npNext| ()
  (declare (special |$inputStream|))
  (setq |$inputStream| (cdr |$inputStream|))
  (|npFirstTok|))
```

defun npComma

[npTuple p146]
[npQualifiedDefinition p147]

— defun npComma —

```
(defun |npComma| ()
  (|npTuple| #'|npQualifiedDefinition|))
```

defun npTuple

[npListofFun p221]
[npCommaBackSet p146]
[pfTupleListOf p292]

— defun npTuple —

```
(defun |npTuple| (|p|)
  (|npListofFun| |p| #'|npCommaBackSet| #'|pfTupleListOf|))
```

defun npCommaBackSet

[npEqKey p145]

— defun npCommaBackSet —

```
(defun |npCommaBackSet| ()
  (and
    (|npEqKey| 'comma)
    (or (|npEqKey| 'backset) t)))
```

defun npQualifiedDefinition

[npQualified p147]
[npDefinitionOrStatement p147]

— defun npQualifiedDefinition —

```
(defun |npQualifiedDefinition| ()
  (|npQualified| #'|npDefinitionOrStatement|))
```

defun npQualified

[npEqKey p145]
[npDefinition p167]
[npTrap p212]
[npPush p143]
[pfWhere p294]
[npPop1 p144]
[npLetQualified p166]

— defun npQualified —

```
(defun |npQualified| (f)
  (if (funcall f)
      (progn
        (do () ; while ... do
          ((not (and (|npEqKey| 'where) (or (|npDefinition|) (|npTrap|)))))
          (|npPush| (|pfWhere| (|npPop1|) (|npPop1|))))
        t)
      (|npLetQualified| f)))
```

defun npDefinitionOrStatement

[npBackTrack p148]
[npGives p148]
[npDef p187]

— defun npDefinitionOrStatement —

```
(defun |npDefinitionOrStatement| ()
  (|npBackTrack| #'|npGives| 'def #'|npDef|))
```

defun npBackTrack

```
[npState p212]
[npEqPeek p152]
[npRestore p152]
[npTrap p212]
```

— defun npBackTrack —

```
(defun |npBackTrack| (p1 p2 p3)
  (let (a)
    (setq a (|npState|))
    (when (apply p1 nil)
      (cond
        ((|npEqPeek| p2)
         (|npRestore| a)
         (or (apply p3 nil) (|npTrap|)))
        (t t)))))
```

defun npGives

```
[npBackTrack p148]
[npExit p215]
[npLambda p148]
```

— defun npGives —

```
(defun |npGives| ()
  (|npBackTrack| #'|npExit| 'gives #'|npLambda|))
```

defun npLambda

```
[npVariable p213]
[npLambda p148]
```

[\[npTrap p212\]](#)
[\[npPush p143\]](#)
[\[pfLam p272\]](#)
[\[npPop2 p144\]](#)
[\[npPop1 p144\]](#)
[\[npEqKey p145\]](#)
[\[npDefinitionOrStatement p147\]](#)
[\[npType p149\]](#)
[\[pfReturnTyped p285\]](#)

— **defun npLambda** —

```

(defun |npLambda| ()
  (or
    (and
      (|npVariable|)
      (or (|npLambda|) (|npTrap|))
      (|npPush| (|pfLam| (|npPop2|) (|npPop1|))))
    (and
      (|npEqKey| 'gives)
      (or (|npDefinitionOrStatement|) (|npTrap|)))
    (and
      (|npEqKey| 'colon)
      (or (|npType|) (|npTrap|))
      (|npEqKey| 'gives)
      (or (|npDefinitionOrStatement|) (|npTrap|))
      (|npPush| (|pfReturnTyped| (|npPop2|) (|npPop1|))))))

```

—————

defun npType

[\[npMatch p150\]](#)
[\[npPop1 p144\]](#)
[\[npWith p150\]](#)
[\[npPush p143\]](#)

— **defun npType** —

```

(defun |npType| ()
  (and
    (|npMatch|)
    (let ((a (|npPop1|)))
      (or
        (|npWith| a)
        (|npPush| a))))

```

defun npMatch

[npLeftAssoc p206]
[npSuch p150]

— defun npMatch —

```
(defun |npMatch| ()
  (|npLeftAssoc| '(is isnt) #'|npSuch|))
```

defun npSuch

[npLeftAssoc p206]
[npLogical p197]

— defun npSuch —

```
(defun |npSuch| ()
  (|npLeftAssoc| '(bar) #'|npLogical|))
```

defun npWith

[npEqKey p145]
[npState p212]
[npCategoryL p152]
[npTrap p212]
[npEqPeek p152]
[npRestore p152]
[npVariable p213]
[npCompMissing p151]
[npPush p143]
[pfWith p296]
[npPop2 p144]
[npPop1 p144]
[pfNothing p245]

— defun npWith —

```
(defun |npWith| (extra)
  (let (a)
    (and
      (|npEqKey| 'with)
      (progn
        (setq a (|npState|))
        (or (|npCategoryL|) (|npTrap|))
        (if (|npEqPeek| 'in)
            (progn
              (|npRestore| a)
              (and
                (or (|npVariable|) (|npTrap|))
                (|npCompMissing| 'in)
                (or (|npCategoryL|) (|npTrap|))
                (|npPush| (|pfWith| (|npPop2|) (|npPop1|) extra))))
              (|npPush| (|pfWith| (|pfNothing|) (|npPop1|) extra)))))))
```

defun npCompMissing

[npEqKey p145]
[npMissing p151]

— defun npCompMissing —

```
(defun |npCompMissing| (s)
  (or (|npEqKey| s) (|npMissing| s)))
```

defun npMissing

[trappoint p??]
[ncSoftError p351]
[tokPosn p413]
[pname p1045]
[\$stok p??]

— defun npMissing —

```
(defun |npMissing| (s)
  (declare (special |$stok|))
  (|ncSoftError| (|tokPosn| |$stok|) 'S2CY0007 (list (pname s)))
  (throw 'trappoint 'trapped))
```

defun npRestore

```
[npFirstTok p143]
[$stack p??]
[$inputStream p??]
```

— defun npRestore —

```
(defun |npRestore| (x)
  (declare (special |$stack| |$inputStream|))
  (setq |$inputStream| (car x))
  (|npFirstTok|)
  (setq |$stack| (cdr x))
  t)
```

defun Peek for keyword s, no advance of token stream

```
[$ttok p??]
[$stok p??]
```

— defun npEqPeek 0 —

```
(defun |npEqPeek| (s)
  (declare (special |$ttok| |$stok|))
  (and (eq (caar |$stok|) '|key|) (eq s |$ttok|)))
```

defun npCategoryL

```
[npCategory p153]
[npPush p143]
[pfUnSequence p293]
[npPop1 p144]
```

— defun npCategoryL —

```
(defun |npCategoryL| ()
  (and
    (|npCategory|)
    (|npPush| (|pfUnSequence| (|npPop1|)))))
```

defun npCategory

[npPP p209]
[npSCategory p153]

— defun npCategory —

```
(defun |npCategory| ()
  (|npPP| #'|npSCategory|))
```

defun npSCategory

[npWConditional p195]
[npCategoryL p152]
[npPush p143]
[npPop1 p144]
[npDefaultValue p194]
[npState p212]
[npPrimary p157]
[npEqPeek p152]
[npRestore p152]
[npSignature p154]
[npApplication p162]
[pfAttribute p253]
[npTrap p212]

— defun npSCategory —

```
(defun |npSCategory| ()
  (let (a)
    (cond
      ((|npWConditional| #'|npCategoryL|) (|npPush| (list (|npPop1|)))))
      ((|npDefaultValue|) t)
      (t
       (setq a (|npState|))
```

```

(cond
  ((|npPrimary|)
   (cond
    ((|npEqPeek| 'colon) (|npRestore| a) (|npSignature|))
    (t
     (|npRestore| a)
     (or
      (and (|npApplication|) (|npPush| (list (|pfAttribute| (|npPop1|)))))
      (|npTrap|))))))
  (t nil))))))

```

defun npSignature

[npSigItemList p154]
 [npPush p143]
 [pfWDec p293]
 [pfNothing p245]
 [npPop1 p144]

— defun npSignature —

```

(defun |npSignature| ()
  (and (|npSigItemList|) (|npPush| (|pfWDec| (|pfNothing|) (|npPop1|)))))

```

defun npSigItemList

[npListing p155]
 [npSigItem p156]
 [npPush p143]
 [pfListOf p245]
 [pfAppend p255]
 [pfParts p249]
 [npPop1 p144]

— defun npSigItemList —

```

(defun |npSigItemList| ()
  (and
   (|npListing| #'|npSigItem|)
   (|npPush| (|pfListOf| (|pfAppend| (|pfParts| (|npPop1|)))))
  )

```

defun npListing

[npList p155]
[pfListOf p245]

— defun npListing —

```
(defun |npListing| (p)
  (|npList| p 'comma #'|pfListOf|))
```

defun Always produces a list, fn is applied to it

[npEqKey p145]
[npTrap p212]
[npPush p143]
[npPop3 p144]
[npPop2 p144]
[npPop1 p144]
[\$stack p??]

— defun npList —

```
(defun |npList| (f str1 fn)
  (let (a)
    (declare (special |$stack|))
    (cond
      ((apply f nil)
       (cond
         ((and (|npEqKey| str1)
              (or (|npEqKey| 'backset) t)
              (or (apply f nil) (|npTrap|))))
          (setq a |$stack|)
          (setq |$stack| nil)
          (do () ; while .. do nothing
              ((not
                (and (|npEqKey| str1)
                     (or (|npEqKey| 'backset) t)
                     (or (apply f nil) (|npTrap|))))
               nil))
          (setq |$stack| (cons (nreverse |$stack|) a))
          (|npPush| (funcall fn (cons (|npPop3|) (cons (|npPop2|) (|npPop1|))))))
      (t (|npPush| (funcall fn (list (|npPop1|))))))
```

```
(t (|npPush| (funcall fn nil))))))
```

defun npSigItem

```
[npTypeVariable p156]
[npSigDecl p157]
[npTrap p212]
```

— defun npSigItem —

```
(defun |npSigItem| ()
  (and (|npTypeVariable|) (or (|npSigDecl|) (|npTrap|))))
```

defun npTypeVariable

```
[npParenthesized p214]
[npTypeVariablelist p157]
[npSignatureDefinee p156]
[npPush p143]
[pfListOf p245]
[npPop1 p144]
```

— defun npTypeVariable —

```
(defun |npTypeVariable| ()
  (or
    (|npParenthesized| #'|npTypeVariablelist|)
    (and (|npSignatureDefinee|) (|npPush| (|pfListOf| (list (|npPop1|)))))))
```

defun npSignatureDefinee

```
[npName p204]
[npInfixOperator p160]
[npPrefixColon p161]
```

— defun npSignatureDefinee —

```
(defun |npSignatureDefinee| ()
  (or (|npName|) (|npInfixOperator|) (|npPrefixColon|)))
```

defun npTypeVariablelist

```
[npListing p155]
[npSignatureDefinee p156]
```

— defun npTypeVariablelist —

```
(defun |npTypeVariablelist| ()
  (|npListing| #'|npSignatureDefinee|))
```

defun npSigDecl

```
[npEqKey p145]
[npType p149]
[npTrap p212]
[npPush p143]
[pfSpread p239]
[pfParts p249]
[npPop2 p144]
[npPop1 p144]
```

— defun npSigDecl —

```
(defun |npSigDecl| ()
  (and
    (|npEqKey| 'colon)
    (or (|npType|) (|npTrap|))
    (|npPush| (|pfSpread| (|pfParts| (|npPop2|)) (|npPop1|)))))
```

defun npPrimary

```
[npPrimary1 p164]
[npPrimary2 p158]
```

— defun npPrimary —

```
(defun |npPrimary| ()
  (or (|npPrimary1|) (|npPrimary2|)))
```

—————

defun npPrimary2

```
[npEncAp p182]
[npAtom2 p159]
[npAdd p159]
[pfNothing p245]
[npWith p150]
```

— defun npPrimary2 —

```
(defun |npPrimary2| ()
  (or
    (|npEncAp| #'|npAtom2|)
    (|npAdd| (|pfNothing|))
    (|npWith| (|pfNothing|))))
```

—————

defun npADD

TPDHERE: Note that there is also an npAdd function [npType p149]

```
[npPop1 p144]
[npAdd p159]
[npPush p143]
```

— defun npADD —

```
(defun |npADD| ()
  (let (a)
    (and
      (|npType|)
      (progn
        (setq a (|npPop1|))
        (or
          (|npAdd| a)
          (|npPush| a))))))
```

defun npAdd

TPDHERE: Note that there is also an npADD function [npEqKey p145]

[npState p212]
 [npDefinitionOrStatement p147]
 [npTrap p212]
 [npEqPeek p152]
 [npRestore p152]
 [npVariable p213]
 [npCompMissing p151]
 [npDefinitionOrStatement p147]
 [npPush p143]
 [pfAdd p252]
 [npPop2 p144]
 [npPop1 p144]
 [pfNothing p245]

— defun npAdd —

```
(defun |npAdd| (extra)
  (let (a)
    (and
      (|npEqKey| 'add)
      (progn
        (setq a (|npState|))
        (or (|npDefinitionOrStatement|) (|npTrap|))
        (cond
          ((|npEqPeek| 'in)
            (progn
              (|npRestore| a)
              (and
                (or (|npVariable|) (|npTrap|))
                (|npCompMissing| 'in)
                (or (|npDefinitionOrStatement|) (|npTrap|))
                (|npPush| (|pfAdd| (|npPop2|) (|npPop1|) extra))))))
          (t
            (|npPush| (|pfAdd| (|pfNothing|) (|npPop1|) extra))))))))
```

defun npAtom2

[npInfixOperator p160]
 [npAmpersand p204]


```
[npPrefixColon p161]
[npFromdom p202]
```

— defun npAtom2 —

```
(defun |npAtom2| ()
  (and
    (or (|npInfixOperator|) (|npAmpersand|) (|npPrefixColon|))
    (|npFromdom|)))
```

—————

defun npInfixOperator

```
[npInfixOp p161]
[npState p212]
[npEqKey p145]
[npInfixOp p161]
[npPush p143]
[pfSymb p251]
[npPop1 p144]
[tokPosn p413]
[npRestore p152]
[tokConstruct p411]
[tokPart p413]
[$stok p??]
```

— defun npInfixOperator —

```
(defun |npInfixOperator| ()
  (let (b a)
    (declare (special |$stok|))
    (or (|npInfixOp|)
      (progn
        (setq a (|npState|))
        (setq b |$stok|)
        (cond
          ((and (|npEqKey| ' '|) (|npInfixOp|))
            (|npPush| (|pfSymb| (|npPop1|) (|tokPosn| b))))
          (t
            (|npRestore| a)
            (cond
              ((and (|npEqKey| 'backquote) (|npInfixOp|))
                (setq a (|npPop1|))
                (|npPush| (|tokConstruct| '|idsy| (|tokPart| a) (|tokPosn| a))))
              (t
```

```
(|npRestore| a)
nil))))))
```

defun npInfixOp

```
[npPushId p209]
[|$tok p??|]
[|$stok p??|]
```

— defun npInfixOp —

```
(defun |npInfixOp| ()
  (declare (special |$tok| |$stok|))
  (and
    (eq (caar |$stok|) '|key|)
    (get |$tok| 'infgeneric)
    (|npPushId|)))
```

defun npPrefixColon

```
[npEqPeek p152]
[|npPush p143|]
[|tokConstruct p411|]
[|tokPosn p413|]
[|npNext p145|]
[|$stok p??|]
```

— defun npPrefixColon —

```
(defun |npPrefixColon| ()
  (declare (special |$stok|))
  (and
    (|npEqPeek| 'colon)
    (progn
      (|npPush| (|tokConstruct| '|id| '|:| (|tokPosn| |$stok|)))
      (|npNext|))))
```

defun npApplication

```
[npDotted p162]
[ npPrimary p157]
[ npApplication2 p163]
[ npPush p143]
[ pfApplication p253]
[ npPop2 p144]
[ npPop1 p144]
```

— defun npApplication —

```
(defun |npApplication| ()
  (and
    (|npDotted| #'|npPrimary|)
    (or
      (and
        (|npApplication2|)
        (|npPush| (|pfApplication| (|npPop2|) (|npPop1|))))
      t)))
```

—————

defun npDotted

```
[ p??]
```

— defun npDotted —

```
(defun |npDotted| (f)
  (and (apply f nil) (|npAnyNo| #'|npSelector|)))
```

—————

defun npAnyNo

fn must transform the head of the stack

— defun npAnyNo 0 —

```
(defun |npAnyNo| (fn)
  (do () ((not (apply fn nil)))) ; while apply do...
  t)
```

—————

defun npSelector

```
[npEqKey p145]
[npPrimary p157]
[npTrap p212]
[npPush p143]
[pfApplication p253]
[npPop2 p144]
[npPop1 p144]
```

— defun npSelector —

```
(defun |npSelector| ()
  (and
    (|npEqKey| 'dot)
    (or (|npPrimary|) (|npTrap|))
    (|npPush| (|pfApplication| (|npPop2|) (|npPop1|))))))
```

defun npApplication2

```
[npDotted p162]
[npPrimary1 p164]
[npApplication2 p163]
[npPush p143]
[pfApplication p253]
[npPop2 p144]
[npPop1 p144]
```

— defun npApplication2 —

```
(defun |npApplication2| ()
  (and
    (|npDotted| #'|npPrimary1|)
    (or
      (and
        (|npApplication2|)
        (|npPush| (|pfApplication| (|npPop2|) (|npPop1|))))
      t)))
```

defun npPrimary1

[npEncAp p182]
 [npAtom1 p183]
 [npLet p166]
 [npFix p166]
 [npMacro p164]
 [npBFileDefinition p188]
 [npDefn p187]
 [npRule p193]

— defun npPrimary1 —

```
(defun |npPrimary1| ()
  (or
    (|npEncAp| #'|npAtom1|)
    (|npLet|)
    (|npFix|)
    (|npMacro|)
    (|npBFileDefinition|)
    (|npDefn|)
    (|npRule|)))
```

defun npMacro

[npPP p209]
 [npMdef p164]

— defun npMacro —

```
(defun |npMacro| ()
  (and
    (|npEqKey| 'macro)
    (|npPP| #'|npMdef|)))
```

defun npMdef

TPDHERE: Beware that this function occurs with uppercase also [npQuiver p198]
 [pfCheckMacroOut p240]
 [npPop1 p144]

[npDefTail p194]
 [npTrap p212]
 [npPop1 p144]
 [npPush p143]
 [pfMacro p277]
 [pfPushMacroBody p243]

— defun npMdef —

```
(defun |npMdef| ()
  (let (body arg op tmp)
    (when (|npQuiver|) ;[op,arg] := pfCheckMacroOut(npPop1())
      (setq tmp (|pfCheckMacroOut| (|npPop1|)))
      (setq op (car tmp))
      (setq arg (cadr tmp))
      (or (|npDefTail|) (|npTrap|))
      (setq body (|npPop1|))
      (if (null arg)
          (|npPush| (|pfMacro| op body))
          (|npPush| (|pfMacro| op (|pfPushMacroBody| arg body)))))))
```

—————

defun npMDEF

TPDHERE: Beware that this function occurs with lowercase also [npBackTrack p148]

[npStatement p170]
 [npMDEFinition p165]

— defun npMDEF —

```
(defun |npMDEF| ()
  (|npBackTrack| #'|npStatement| 'mdef #'|npMDEFinition|))
```

—————

defun npMDEFinition

[npPP p209]
 [npMdef p164]

— defun npMDEFinition —

```
(defun |npMDEFinition| ()
  (|npPP| #'|npMDef|))
```

defun npFix

```
[npEqKey p145]
[npDef p187]
[npPush p143]
[pfFix p265]
[npPop1 p144]
```

— **defun npFix** —

```
(defun |npFix| ()
  (and
    (|npEqKey| 'fix)
    (|npPP| #'|npDef|)
    (|npPush| (|pfFix| (|npPop1|)))))
```

defun npLet

```
[npLetQualified p166]
[npDefinitionOrStatement p147]
```

— **defun npLet** —

```
(defun |npLet| ()
  (|npLetQualified| #'|npDefinitionOrStatement|))
```

defun npLetQualified

```
[npEqKey p145]
[npDefinition p167]
[npTrap p212]
[npCompMissing p151]
[npPush p143]
```

[pfWhere p294]
 [npPop2 p144]
 [npPop1 p144]

— **defun npLetQualified** —

```
(defun |npLetQualified| (f)
  (and
    (|npEqKey| 'let)
    (or (|npDefinition|) (|npTrap|))
    (|npCompMissing| 'in)
    (or (funcall f) (|npTrap|))
    (|npPush| (|pfWhere| (|npPop2|) (|npPop1|)))))
```

—————

defun npDefinition

[npPP p209]
 [npDefinitionItem p167]
 [npPush p143]
 [pfSequenceToList p238]
 [npPop1 p144]

— **defun npDefinition** —

```
(defun |npDefinition| ()
  (and
    (|npPP| #'|npDefinitionItem|)
    (|npPush| (|pfSequenceToList| (|npPop1|)))))
```

—————

defun npDefinitionItem

[npTyping p168]
 [npImport p180]
 [npState p212]
 [npStatement p170]
 [npEqPeek p152]
 [npRestore p152]
 [npDef p187]
 [npMacro p164]
 [npDefn p187]

[npTrap p212]

— defun npDefinitionItem —

```
(defun |npDefinitionItem| ()
  (let (a)
    (or (|npTyping|)
        (|npImport|)
        (progn
          (setq a (|npState|))
          (cond
            ((|npStatement|)
             (cond
              ((|npEqPeek| 'def)
               (|npRestore| a)
               (|npDef|))
              (t
               (|npRestore| a)
               (or (|npMacro|) (|npDefn|))))))
          (t (|npTrap|))))))
```

—————

defun npTyping

[npEqKey p145]
 [npDefaultItemList p168]
 [npTrap p212]
 [npPush p143]
 [pfTyping p291]
 [npPop1 p144]

— defun npTyping —

```
(defun |npTyping| ()
  (and
    (|npEqKey| 'default)
    (or (|npDefaultItemList|) (|npTrap|))
    (|npPush| (|pfTyping| (|npPop1|)))))
```

—————

defun npDefaultItemList

[npPC p??]
 [npSDefaultItem p169]

[npPush p143]
 [pfUnSequence p293]
 [npPop1 p144]

— defun npDefaultItemList —

```
(defun |npDefaultItemList| ()
  (and
    (|npPC| #'|npSDefaultItem|)
    (|npPush| (|pfUnSequence| (|npPop1|)))))
```

—————

defun npSDefaultItem

[npListing p155]
 [npDefaultItem p169]
 [npPush p143]
 [pfAppend p255]
 [pfParts p249]
 [npPop1 p144]

— defun npSDefaultItem —

```
(defun |npSDefaultItem| ()
  (and
    (|npListing| #'|npDefaultItem|)
    (|npPush| (|pfAppend| (|pfParts| (|npPop1|)))))
```

—————

defun npDefaultItem

[npTypeVariable p156]
 [npDefaultDecl p170]
 [npTrap p212]

— defun npDefaultItem —

```
(defun |npDefaultItem| ()
  (and
    (|npTypeVariable|)
    (or (|npDefaultDecl|) (|npTrap|))))
```

—————

defun npDefaultDecl

[npEqKey p145]
 [npType p149]
 [npTrap p212]
 [npPush p143]
 [pfSpread p239]
 [pfParts p249]
 [npPop2 p144]
 [npPop1 p144]

— defun npDefaultDecl —

```
(defun |npDefaultDecl| ()
  (and
    (|npEqKey| 'colon)
    (or (|npType|) (|npTrap|))
    (|npPush| (|pfSpread| (|pfParts| (|npPop2|) (|npPop1|))))))
```

—————

defun npStatement

[npExpress p179]
 [npLoop p175]
 [npIterate p174]
 [npReturn p178]
 [npBreak p174]
 [npFree p173]
 [npImport p180]
 [npInline p174]
 [npLocal p173]
 [npExport p171]
 [npTyping p168]
 [npVoid p179]

— defun npStatement —

```
(defun |npStatement| ()
  (or
    (|npExpress|)
    (|npLoop|)
    (|npIterate|)
    (|npReturn|)
    (|npBreak|)
    (|npFree|)
```

```
(|npImport|)
(|npInline|)
(|npLocal|)
(|npExport|)
(|npTyping|)
(|npVoid|)))
```

defun npExport

```
[npEqKey p145]
[npLocalItemlist p171]
[npTrap p212]
[npPush p143]
[pfExport p264]
[npPop1 p144]
```

— defun npExport —

```
(defun |npExport| ()
  (and
    (|npEqKey| 'export)
    (or (|npLocalItemlist|) (|npTrap|))
    (|npPush| (|pfExport| (|npPop1|)))))
```

defun npLocalItemlist

```
[npPC p??]
[npSLocalItem p172]
[npPush p143]
[pfUnSequence p293]
[npPop1 p144]
```

— defun npLocalItemlist —

```
(defun |npLocalItemlist| ()
  (and
    (|npPC| #'|npSLocalItem|)
    (|npPush| (|pfUnSequence| (|npPop1|)))))
```

defun npSLocalItem

[npListing p155]

[npLocalItem p172]

[npPush p143]

[pfAppend p255]

[pfParts p249]

[npPop1 p144]

— defun npSLocalItem —

(defun |npSLocalItem| ()

(and

(|npListing| #'|npLocalItem|)

(|npPush| (|pfAppend| (|pfParts| (|npPop1|))))))

—————

defun npLocalItem

[npTypeVariable p156]

[npLocalDecl p172]

— defun npLocalItem —

(defun |npLocalItem| ()

(and

(|npTypeVariable|)

(|npLocalDecl|)))

—————

defun npLocalDecl

[npEqKey p145]

[npType p149]

[npTrap p212]

[npPush p143]

[pfSpread p239]

[pfParts p249]

[npPop2 p144]

[npPop1 p144]

[pfNothing p245]

— defun npLocalDecl —

```
(defun |npLocalDecl| ()
  (or
    (and
      (|npEqKey| 'colon)
      (or (|npType|) (|npTrap|))
      (|npPush| (|pfSpread| (|pfParts| (|npPop2|)) (|npPop1|))))
      (|npPush| (|pfSpread| (|pfParts| (|npPop1|)) (|pfNothing|)))))
```

—————

defun npLocal

```
[npEqKey p145]
[npLocalItemlist p171]
[npTrap p212]
[npPush p143]
[pfLocal p274]
[npPop1 p144]
```

— defun npLocal —

```
(defun |npLocal| ()
  (and
    (|npEqKey| '|local|)
    (or (|npLocalItemlist|) (|npTrap|))
    (|npPush| (|pfLocal| (|npPop1|)))))
```

—————

defun npFree

```
[npEqKey p145]
[npLocalItemlist p171]
[npTrap p212]
[npPush p143]
[pfFree p265]
[npPop1 p144]
```

— defun npFree —

```
(defun |npFree| ()
```

```
(and
  (|npEqKey| 'free)
  (or (|npLocalItemList|) (|npTrap|))
  (|npPush| (|pfFree| (|npPop1|))))))
```

defun npInline

```
[npAndOr p181]
[npQualTypelist p180]
[pfInline p272]
```

— defun npInline —

```
(defun |npInline| ()
  (|npAndOr| 'inline #'|npQualTypelist| #'|pfInline|))
```

defun npIterate

```
[npEqKey p145]
[npPush p143]
[pfIterate p271]
[pfNothing p245]
```

— defun npIterate —

```
(defun |npIterate| ()
  (and (|npEqKey| 'iterate) (|npPush| (|pfIterate| (|pfNothing|)))))
```

defun npBreak

```
[npEqKey p145]
[npPush p143]
[pfBreak p258]
[pfNothing p245]
```

— defun npBreak —

```
(defun |npBreak| ()
  (and (|npEqKey| 'break) (|npPush| (|pfBreak| (|pfNothing|))))))
```

defun npLoop

```
[npIterators p175]
[npCompMissing p151]
[npAssign p216]
[npTrap p212]
[npPush p143]
[pfLp p276]
[npPop2 p144]
[npPop1 p144]
[npEqKey p145]
[pfLoop1 p275]
```

— defun npLoop —

```
(defun |npLoop| ()
  (or
    (and
      (|npIterators|)
      (|npCompMissing| 'repeat)
      (or (|npAssign|) (|npTrap|))
      (|npPush| (|pfLp| (|npPop2|) (|npPop1|))))))
    (and
      (|npEqKey| 'repeat)
      (or (|npAssign|) (|npTrap|))
      (|npPush| (|pfLoop1| (|npPop1|))))))
```

defun npIterators

```
[npForIn p177]
[npZeroOrMore p177]
[npIterator p176]
[npPush p143]
[npPop2 p144]
[npPop1 p144]
[npWhile p177]
[npIterators p175]
```


— defun npIterators —

```
(defun |npIterators| ()
  (or
    (and
      (|npForIn|)
      (|npZeroOrMore| #'|npIterator|)
      (|npPush| (cons (|npPop2|) (|npPop1|))))
    (and
      (|npWhile|)
      (or
        (and (|npIterators|) (|npPush| (cons (|npPop2|) (|npPop1|))))
        (|npPush| (list (|npPop1|)))))))
```

—————

defun npIterator

```
[npForIn p177]
[npSuchThat p176]
[npWhile p177]
```

— defun npIterator —

```
(defun |npIterator| ()
  (or
    (|npForIn|)
    (|npSuchThat|)
    (|npWhile|)))
```

—————

defun npSuchThat

```
[npAndOr p181]
[npLogical p197]
[pfSuchthat p288]
```

— defun npSuchThat —

```
(defun |npSuchThat| ()
  (|npAndOr| 'bar #'|npLogical| #'|pfSuchthat|))
```

—————

defun Apply argument 0 or more times

[npPush p143]
 [npPop2 p144]
 [npPop1 p144]
 [\$stack p??]

— defun npZeroOrMore —

```
(defun |npZeroOrMore| (f)
  (let (a)
    (declare (special |$stack|))
    (cond
      ((apply f nil)
       (setq a |$stack|)
       (setq |$stack| nil)
       (do () ((not (apply f nil)))) ; while .. do
       (setq |$stack| (cons (nreverse |$stack|) a))
       (|npPush| (cons (|npPop2|) (|npPop1|))))
      (t (progn (|npPush| nil) t)))))
```

—————

defun npWhile

[npAndOr p181]
 [npLogical p197]
 [pfWhile p295]

— defun npWhile —

```
(defun |npWhile| ()
  (|npAndOr| 'while #'|npLogical| #'|pfWhile|))
```

—————

defun npForIn

[npEqKey p145]
 [npVariable p213]
 [npTrap p212]
 [npCompMissing p151]
 [npBy p199]
 [npPush p143]

[pfForin p266]
 [npPop2 p144]
 [npPop1 p144]

— defun npForIn —

```
(defun |npForIn| ()
  (and
    (|npEqKey| 'for)
    (or (|npVariable|) (|npTrap|))
    (|npCompMissing| 'in)
    (or (|npBy|) (|npTrap|))
    (|npPush| (|pfForin| (|npPop2|) (|npPop1|))))))
```

defun npReturn

[npEqKey p145]
 [npExpress p179]
 [npPush p143]
 [pfNothing p245]
 [npEqKey p145]
 [npName p204]
 [npTrap p212]
 [pfReturn p284]
 [npPop2 p144]
 [npPop1 p144]
 [pfReturnNoName p285]

— defun npReturn —

```
(defun |npReturn| ()
  (and
    (|npEqKey| 'return)
    (or
      (|npExpress|)
      (|npPush| (|pfNothing|)))
    (or
      (and
        (|npEqKey| 'from)
        (or (|npName|) (|npTrap|))
        (|npPush| (|pfReturn| (|npPop2|) (|npPop1|))))
      (|npPush| (|pfReturnNoName| (|npPop1|))))))
```

defun npVoid

[npAndOr p181]
 [npStatement p170]
 [pfNovalue p279]

— defun npVoid —

```
(defun |npVoid| ()
  (|npAndOr| 'do #'|npStatement| #'|pfNovalue|))
```

—————

defun npExpress

[npExpress1 p179]
 [npIterators p175]
 [npPush p143]
 [pfCollect p260]
 [npPop2 p144]
 [pfListOf p245]
 [npPop1 p144]

— defun npExpress —

```
(defun |npExpress| ()
  (and
    (|npExpress1|)
    (or
      (and
        (|npIterators|)
        (|npPush| (|pfCollect| (|npPop2|) (|pfListOf| (|npPop1|))))))
      t)))
```

—————

defun npExpress1

[npConditionalStatement p180]
 [npADD p158]

— defun npExpress1 —

```
(defun |npExpress1| ()
```

```
(or (|npConditionalStatement|) (|npADD|)))
```

defun npConditionalStatement

```
[npConditional p195]
[npQualifiedDefinition p147]
```

— defun npConditionalStatement —

```
(defun |npConditionalStatement| ()
  (|npConditional| #'|npQualifiedDefinition|))
```

defun npImport

```
[npAndOr p181]
[npQualTypelist p180]
[pfImport p271]
```

— defun npImport —

```
(defun |npImport| ()
  (|npAndOr| 'import #'|npQualTypelist| #'|pfImport|))
```

defun npQualTypelist

```
[npPC p??]
[npSQualTypelist p181]
[npPush p143]
[pfUnSequence p293]
[npPop1 p144]
```

— defun npQualTypelist —

```
(defun |npQualTypelist| ()
  (and
    (|npPC| #'|npSQualTypelist|)
```

```
(|npPush| (|pfUnSequence| (|npPop1|))))))
```

defun npSQualTypelist

```
[npListing p155]
[npQualType p181]
[npPush p143]
[pfParts p249]
[npPop1 p144]
```

— defun npSQualTypelist —

```
(defun |npSQualTypelist| ()
  (and
    (|npListing| #'|npQualType|)
    (|npPush| (|pfParts| (|npPop1|))))))
```

defun npQualType

```
[npType p149]
[npPush p143]
[pfQualType p282]
[npPop1 p144]
[pfNothing p245]
```

— defun npQualType —

```
(defun |npQualType| ()
  (and
    (|npType|)
    (|npPush| (|pfQualType| (|npPop1|) (|pfNothing|))))))
```

defun npAndOr

```
[npEqKey p145]
[npTrap p212]
```

[npPush p143]
[npPop1 p144]

— defun npAndOr —

```
(defun |npAndOr| (keyword p f)
  (and
    (|npEqKey| keyword)
    (or (apply p nil) (|npTrap|))
    (|npPush| (funcall f (|npPop1|)))))
```

—————

defun npEncAp

[npAnyNo p162]
[npEncl p182]
[npFromdom p202]

— defun npEncAp —

```
(defun |npEncAp| (f)
  (and (apply f nil) (|npAnyNo| #'|npEncl|) (|npFromdom|)))
```

—————

defun npEncl

[npBDefinition p185]
[npPush p143]
[pfApplication p253]
[npPop2 p144]
[npPop1 p144]

— defun npEncl —

```
(defun |npEncl| ()
  (and
    (|npBDefinition|)
    (|npPush| (|pfApplication| (|npPop2|) (|npPop1|)))))
```

—————

defun npAtom1

[npPDefinition p183]
 [npName p204]
 [npConstTok p184]
 [npDollar p183]
 [npBDefinition p185]
 [npFromdom p202]

— defun npAtom1 —

```
(defun |npAtom1| ()
  (or
    (|npPDefinition|)
    (and
      (or (|npName|) (|npConstTok|) (|npDollar|) (|npBDefinition|))
      (|npFromdom|))))
```

—————

defun npPDefinition

[npParenthesized p214]
 [npDefinitionlist p193]
 [npPush p143]
 [pfEnSequence p263]
 [npPop1 p144]

— defun npPDefinition —

```
(defun |npPDefinition| ()
  (and
    (|npParenthesized| #'|npDefinitionlist|)
    (|npPush| (|pfEnSequence| (|npPop1|)))))
```

—————

defun npDollar

[npEqPeek p152]
 [npPush p143]
 [tokConstruct p411]
 [tokPosn p413]
 [npNext p145]

[\$tok p??]

— defun npDollar —

```
(defun |npDollar| ()
  (declare (special |$tok|))
  (and (|npEqPeek| '$)
    (progn
      (|npPush| (|tokConstruct| '|id| '$ (|tokPosn| |$tok|)))
      (|npNext|))))
```

—————

defun npConstTok

```
[tokType p413]
[npPush p143]
[npNext p145]
[npEqPeek p152]
[npState p212]
[npPrimary1 p164]
[pfSymb p251]
[npPop1 p144]
[tokPosn p413]
[npRestore p152]
[$tok p??]
```

— defun npConstTok —

```
(defun |npConstTok| ()
  (let (b a)
    (declare (special |$tok|))
    (cond
      ((member (|tokType| |$tok|) '(|integer| |string| |char| |float| |command|))
        (|npPush| |$tok|)
        (|npNext|))
      ((|npEqPeek| '|'|)
        (setq a |$tok|)
        (setq b (|npState|))
        (|npNext|)
        (cond
          ((and (|npPrimary1|)
            (|npPush| (|pfSymb| (|npPop1|) (|tokPosn| a))))
            t)
          (t (|npRestore| b) nil)))
      (t nil))))
```

defun npBDefinition

[npPDefinition p183]
 [npBracketed p185]
 [npDefinitionlist p193]

— defun npBDefinition —

```
(defun |npBDefinition| ()
  (or
   (|npPDefinition|)
   (|npBracketed| #'|npDefinitionlist|)))
```

defun npBracketed

[npParened p185]
 [npBracked p186]
 [npBraced p186]
 [npAngleBared p186]

— defun npBracketed —

```
(defun |npBracketed| (f)
  (or
   (|npParened| f)
   (|npBracked| f)
   (|npBraced| f)
   (|npAngleBared| f)))
```

defun npParened

[npEnclosed p211]
 [pfParen p281]

— defun npParened —

```
(defun |npParened| (f)
```

```
(or (|npEnclosed| '(| ')| #'|pfParen| f)
    (|npEnclosed| '(\| | '|\|)| #'|pfParen| f)))
```

defun npBracked

```
[npEnclosed p211]
[pfBracket p257]
[pfBracketBar p257]
```

— defun npBracked —

```
(defun |npBracked| (f)
  (or (|npEnclosed| '[' '] #'|pfBracket| f)
      (|npEnclosed| '[\| | '|\|]| #'|pfBracketBar| f)))
```

defun npBraced

```
[npEnclosed p211]
[pfBrace p257]
[pfBraceBar p257]
```

— defun npBraced —

```
(defun |npBraced| (f)
  (or (|npEnclosed| '{ '}' #'|pfBrace| f)
      (|npEnclosed| '{\| | '|\|}| #'|pfBraceBar| f)))
```

defun npAngleBared

```
[npEnclosed p211]
[pfHide p269]
```

— defun npAngleBared —

```
(defun |npAngleBared| (f)
  (|npEnclosed| '<| | '>| | #'|pfHide| f))
```

defun npDefn

[npEqKey p145]
 [npPP p209]
 [npDef p187]

— defun npDefn —

```
(defun |npDefn| ()
  (and
    (|npEqKey| 'defn)
    (|npPP| #'|npDef|)))
```

defun npDef

[npMatch p150]
 [pfCheckItOut p239]
 [npPop1 p144]
 [npDefTail p194]
 [npTrap p212]
 [npPop1 p144]
 [npPush p143]
 [pfDefinition p261]
 [pfPushBody p249]

— defun npDef —

```
(defun |npDef| ()
  (let (body rt arg op tmp1)
    (when (|npMatch|)
      ; [op,arg,rt]:= pfCheckItOut(npPop1())
      (setq tmp1 (|pfCheckItOut| (|npPop1|)))
      (setq op (car tmp1))
      (setq arg (cadr tmp1))
      (setq rt (caddr tmp1))
      (or (|npDefTail|) (|npTrap|))
      (setq body (|npPop1|))
      (if (null arg)
        (|npPush| (|pfDefinition| op body))
        (|npPush| (|pfDefinition| op (|pfPushBody| rt arg body)))))))
```

defun npBPileDefinition

```
[npPileBracketed p188]
[npPileDefinitionlist p189]
[npPush p143]
[pfSequence p287]
[pfListOf p245]
[npPop1 p144]
```

— defun npBPileDefinition —

```
(defun |npBPileDefinition| ()
  (and
    (|npPileBracketed| #'|npPileDefinitionlist|)
    (|npPush| (|pfSequence| (|pfListOf| (|npPop1|))))))
```

defun npPileBracketed

```
[npEqKey p145]
[npPush p143]
[pfNothing p245]
[npMissing p151]
[pfPile p249]
[npPop1 p144]
```

— defun npPileBracketed —

```
(defun |npPileBracketed| (f)
  (cond
    ((|npEqKey| 'settab)
     (cond
       ((|npEqKey| 'backtab) (|npPush| (|pfNothing|))) ; never happens
       ((and (apply f nil)
              (or (|npEqKey| 'backtab) (|npMissing| 'backtab))))
       (|npPush| (|pfPile| (|npPop1|))))
      (t nil)))
    (t nil)))
```

defun npPileDefinitionlist

```
[npListAndRecover p189]
[npDefinitionlist p193]
[npPush p143]
[pfAppend p255]
[npPop1 p144]
```

— defun npPileDefinitionlist —

```
(defun |npPileDefinitionlist| ()
  (and
    (|npListAndRecover| #'|npDefinitionlist|)
    (|npPush| (|pfAppend| (|npPop1|)))))
```

—————

defun npListAndRecover

```
[trappoint p??]
[npRecoverTrap p190]
[syGeneralErrorHere p192]
[npEqKey p145]
[npEqPeek p152]
[npNext p145]
[npPop1 p144]
[npPush p143]
[$inputStream p??]
[$stack p??]
```

— defun npListAndRecover —

```
(defun |npListAndRecover| (f)
  (let (found c done b savestack)
    (declare (special |$inputStream| |$stack|))
    (setq savestack |$stack|)
    (setq |$stack| nil)
    (setq c |$inputStream|)
    (do ()
      (done)
      (setq found (catch 'trappoint (apply f nil)))
      (cond
        ((eq found 'trapped)
         (setq |$inputStream| c)
         (|npRecoverTrap|))
        ((null found)
```

```

      (setq |$inputStream| c)
      (|syGeneralErrorHere|) (|npRecoverTrap|)))
(cond
  ((|npEqKey| 'backset) (setq c |$inputStream|))
  ((|npEqPeek| 'backtab) (setq done t))
  (t
    (setq |$inputStream| c)
    (|syGeneralErrorHere|)
    (|npRecoverTrap|)
    (cond
      ((|npEqPeek| 'backtab) (setq done t))
      (t
        (|npNext|)
        (setq c |$inputStream|))))))
(setq b (cons (|npPop1|) b)))
(setq |$stack| savestack)
(|npPush| (nreverse b)))

```

defun npRecoverTrap

```

[npFirstTok p143]
[tokPosn p413]
[npMoveTo p191]
[syIgnoredFromTo p191]
[npPush p143]
[pfWrong p296]
[pfDocument p246]
[pfListOf p245]
[$tok p??]

```

— defun npRecoverTrap —

```

(defun |npRecoverTrap| ()
  (let (pos2 pos1)
    (declare (special |$tok|))
    (|npFirstTok|)
    (setq pos1 (|tokPosn| |$tok|))
    (|npMoveTo| 0)
    (setq pos2 (|tokPosn| |$tok|))
    (|syIgnoredFromTo| pos1 pos2)
    (|npPush|
      (list (|pfWrong| (|pfDocument| (list "pile syntax error")))
            (|pfListOf| nil))))))

```

defun npMoveTo

[npEqPeek p152]
 [npNext p145]
 [npMoveTo p191]
 [npEqKey p145]
 [\$inputStream p??]

— defun npMoveTo —

```
(defun |npMoveTo| (|n|)
  (declare (special |$inputStream|))
  (cond
    ((null |$inputStream|) t)
    ((|npEqPeek| 'backtab)
      (cond
        ((eq1 |n| 0) t)
        (t (|npNext|) (|npMoveTo| (1- |n|)))))
    ((|npEqPeek| 'backset)
      (cond
        ((eq1 |n| 0) t)
        (t (|npNext|) (|npMoveTo| |n|)))
    ((|npEqKey| 'settab) (|npMoveTo| (+ |n| 1)))
    (t (|npNext|) (|npMoveTo| |n|))))
```

defun syIgnoredFromTo

[pfGlobalLinePosn p235]
 [ncSoftError p351]
 [FromTo p380]
 [From p380]
 [To p380]

— defun syIgnoredFromTo —

```
(defun |syIgnoredFromTo| (pos1 pos2)
  (cond
    ((equal (|pfGlobalLinePosn| pos1) (|pfGlobalLinePosn| pos2))
      (|ncSoftError| (|FromTo| pos1 pos2) 'S2CY0005 nil))
    (t
      (|ncSoftError| (|From| pos1) 'S2CY0003 nil)
      (|ncSoftError| (|To| pos2) 'S2CY0004 nil))))
```

defun syGeneralErrorHere

[sySpecificErrorHere p192]

— **defun syGeneralErrorHere** —

```
(defun |syGeneralErrorHere| ()
  (|sySpecificErrorHere| 'S2CY0002 nil))
```

defun sySpecificErrorHere

[sySpecificErrorAtToken p192]
[\$tok p??]

— **defun sySpecificErrorHere** —

```
(defun |sySpecificErrorHere| (key args)
  (declare (special |$tok|))
  (|sySpecificErrorAtToken| |$tok| key args))
```

defun sySpecificErrorAtToken

[ncSoftError p351]
[tokPosn p413]

— **defun sySpecificErrorAtToken** —

```
(defun |sySpecificErrorAtToken| (tok key args)
  (|ncSoftError| (|tokPosn| tok) key args))
```

defun npDefinitionlist

[npSemiListing p193]
 [npQualDef p145]

— defun npDefinitionlist —

```
(defun |npDefinitionlist| ()
  (|npSemiListing| #'|npQualDef|))
```

—————

defun npSemiListing

[npListofFun p221]
 [npSemiBackSet p193]
 [pfAppend p255]

— defun npSemiListing —

```
(defun |npSemiListing| (p)
  (|npListofFun| p #'|npSemiBackSet| #'|pfAppend|))
```

—————

defun npSemiBackSet

[npEqKey p145]

— defun npSemiBackSet —

```
(defun |npSemiBackSet| ()
  (and (|npEqKey| 'semicolon) (or (|npEqKey| 'backset) t)))
```

—————

defun npRule

[npEqKey p145]
 [npPP p209]
 [npSingleRule p194]

— defun npRule —

```
(defun |npRule| ()
  (and
    (|npEqKey| 'rule)
    (|npPP| #'|npSingleRule|)))
```

defun npSingleRule

```
[npQuiver p198]
[npDefTail p194]
[npTrap p212]
[npPush p143]
[pfRule p285]
[npPop2 p144]
[npPop1 p144]
```

— defun npSingleRule —

```
(defun |npSingleRule| ()
  (when (|npQuiver|)
    (or (|npDefTail|) (|npTrap|)
      (|npPush| (|pfRule| (|npPop2|) (|npPop1|))))))
```

defun npDefTail

```
[npEqKey p145]
[npDefinitionOrStatement p147]
```

— defun npDefTail —

```
(defun |npDefTail| ()
  (and
    (or (|npEqKey| 'def) (|npEqKey| 'mdef))
    (|npDefinitionOrStatement|)))
```

defun npDefaultValue

```
[npEqKey p145]
[npDefinitionOrStatement p147]
```

[npTrap p212]
 [npPush p143]
 [pfAdd p252]
 [pfNothing p245]
 [npPop1 p144]

— defun npDefaultValue —

```
(defun |npDefaultValue| ()
  (and
    (|npEqKey| 'default)
    (or (|npDefinitionOrStatement|) (|npTrap|))
    (|npPush| (list (|pfAdd| (|pfNothing|) (|npPop1|) (|pfNothing|))))))
```

—————

defun npWConditional

[npConditional p195]
 [npPush p143]
 [pfTweakIf p290]
 [npPop1 p144]

— defun npWConditional —

```
(defun |npWConditional| (f)
  (when (|npConditional| f) (|npPush| (|pfTweakIf| (|npPop1|)))))
```

—————

defun npConditional

[npEqKey p145]
 [npLogical p197]
 [npTrap p212]
 [npMissing p151]
 [npElse p196]

— defun npConditional —

```
(defun |npConditional| (f)
  (cond
    ((and (|npEqKey| 'IF)
      (or (|npLogical|) (|npTrap|))
```

```

      (or (|npEqKey| 'backset) t))
    (cond
      ((|npEqKey| 'settab)
        (cond
          ((|npEqKey| 'then)
            (and (or (apply f nil) (|npTrap|))
              (|npElse| f)
              (|npEqKey| 'backtab)))
          (t (|npMissing| 'then))))
      ((|npEqKey| 'then)
        (and (or (apply f nil) (|npTrap|)) (|npElse| f)))
      (t (|npMissing| 'then))))
    (t nil)))

```

defun npElse

[\[npState p212\]](#)
[\[npBacksetElse p197\]](#)
[\[npTrap p212\]](#)
[\[npPush p143\]](#)
[\[pfIf p269\]](#)
[\[npPop3 p144\]](#)
[\[npPop2 p144\]](#)
[\[npPop1 p144\]](#)
[\[npRestore p152\]](#)
[\[pfIfThenOnly p270\]](#)

— defun npElse —

```

(defun |npElse| (f)
  (let (a)
    (setq a (|npState|))
    (cond
      ((|npBacksetElse|)
        (and
          (or (apply f nil) (|npTrap|))
          (|npPush| (|pfIf| (|npPop3|) (|npPop2|) (|npPop1|)))))
      (t
        (|npRestore| a)
        (|npPush| (|pfIfThenOnly| (|npPop2|) (|npPop1|)))))

```

defun npBacksetElse

TPDHERE: Well this makes no sense. [npEqKey p145]

— defun npBacksetElse —

```
(defun |npBacksetElse| ()
  (if (|npEqKey| 'backset)
      (|npEqKey| 'else)
      (|npEqKey| 'else)))
```

—————

defun npLogical

[npLeftAssoc p206]
[npDisjand p197]

— defun npLogical —

```
(defun |npLogical| ()
  (|npLeftAssoc| '(or) #'|npDisjand|))
```

—————

defun npDisjand

[npLeftAssoc p206]
[npDiscrim p197]

— defun npDisjand —

```
(defun |npDisjand| ()
  (|npLeftAssoc| '(and) #'|npDiscrim|))
```

—————

defun npDiscrim

[npLeftAssoc p206]
[npQuiver p198]

— defun npDiscrim —

```
(defun |npDiscrim| ()
  (|npLeftAssoc| '(case has) #'|npQuiver|))
```

defun npQuiver

```
[npRightAssoc p206]
[npRelation p198]
```

— defun npQuiver —

```
(defun |npQuiver| ()
  (|npRightAssoc| '(arrow larrow) #'|npRelation|))
```

defun npRelation

```
[npLeftAssoc p206]
[npSynthetic p198]
```

— defun npRelation —

```
(defun |npRelation| ()
  (|npLeftAssoc| '(equal notequal lt le gt ge oangle cangle) #'|npSynthetic|))
```

defun npSynthetic

```
[npBy p199]
[npAmpersandFrom p202]
[npPush p143]
[pfApplication p253]
[npPop2 p144]
[npPop1 p144]
[pfInfApplication p271]
```

— defun npSynthetic —

```
(defun |npSynthetic| ()
```

```

(cond
  ((|npBy|)
   (lambda ()
    (loop
     (cond
      ((not (and (|npAmpersandFrom|)
                  (or (|npBy|)
                      (progn
                       (|npPush| (|pfApplication| (|npPop2|) (|npPop1|))))
                       nil))))
      (return nil))
     (t
      (|npPush| (|pfInfApplication| (|npPop2|) (|npPop2|) (|npPop1|)))))))
    (t nil)))

```

defun npBy

[npLeftAssoc p206]
 [npInterval p199]

— defun npBy —

```

(defun |npBy| ()
  (|npLeftAssoc| '(by) #'|npInterval|))

```

defun

[npArith p200]
 [npSegment p200]
 [npEqPeek p152]
 [npPush p143]
 [pfApplication p253]
 [npPop1 p144]
 [pfInfApplication p271]
 [npPop2 p144]

— defun npInterval —

```

(defun |npInterval| ()

```



```

(and
  (|npArith|)
  (or
    (and
      (|npSegment|)
      (or
        (and
          (|npEqPeek| 'bar)
          (|npPush| (|pfApplication| (|npPop1|) (|npPop1|))))
        (and
          (|npArith|)
          (|npPush| (|pfInfApplication| (|npPop2|) (|npPop2|) (|npPop1|))))
          (|npPush| (|pfApplication| (|npPop1|) (|npPop1|))))
      t)))

```

defun npSegment

```

[|npEqPeek| p152]
[|npPushId| p209]
[|npFromdom| p202]

```

— defun npSegment —

```

(defun |npSegment| ()
  (and (|npEqPeek| 'seg) (|npPushId|) (|npFromdom|)))

```

defun npArith

```

[|npLeftAssoc| p206]
[|npSum| p201]

```

— defun npArith —

```

(defun |npArith| ()
  (|npLeftAssoc| '(mod) #'|npSum|))

```

defun npSum

[npLeftAssoc p206]
[npTerm p201]

— defun npSum —

```
(defun |npSum| ()
  (|npLeftAssoc| '(plus minus) #'|npTerm|))
```

—————

defun npTerm

[npInfGeneric p207]
[npRemainder p201]
[npPush p143]
[pfApplication p253]
[npPop2 p144]
[npPop1 p144]

— defun npTerm —

```
(defun |npTerm| ()
  (or
    (and
      (|npInfGeneric| '(minus plus))
      (or
        (and (|npRemainder|) (|npPush| (|pfApplication| (|npPop2|) (|npPop1|))))
        t))
      (|npRemainder|)))
```

—————

defun npRemainder

[npLeftAssoc p206]
[npProduct p202]

— defun npRemainder —

```
(defun |npRemainder| ()
  (|npLeftAssoc| '(rem quo) #'|npProduct|))
```

—————

defun npProduct

[npLeftAssoc p206]
 [npPower p202]

— defun npProduct —

```
(defun |npProduct| ()
  (|npLeftAssoc|
   '(times slash backslash slashslash backslashbackslash
        slashbackslash backslashslash)
   #'|npPower|))
```

—————

defun npPower

[npRightAssoc p206]
 [npColon p217]

— defun npPower —

```
(defun |npPower| ()
  (|npRightAssoc| '(power carat) #'|npColon|))
```

—————

defun npAmpersandFrom

[npAmpersand p204]
 [npFromdom p202]

— defun npAmpersandFrom —

```
(defun |npAmpersandFrom| ()
  (and (|npAmpersand|) (|npFromdom|)))
```

—————

defun npFromdom

[npEqKey p145]
 [npApplication p162]

[npTrap p212]
 [npFromdom1 p203]
 [npPop1 p144]
 [npPush p143]
 [pfFromDom p267]

— defun npFromdom —

```
(defun |npFromdom| ()
  (or
    (and
      (|npEqKey| '$)
      (or (|npApplication|) (|npTrap|))
      (|npFromdom1| (|npPop1|))
      (|npPush| (|pfFromDom| (|npPop1|) (|npPop1|))))
    t))
```

—————

defun npFromdom1

[npEqKey p145]
 [npApplication p162]
 [npTrap p212]
 [npFromdom1 p203]
 [npPop1 p144]
 [npPush p143]
 [pfFromDom p267]

— defun npFromdom1 —

```
(defun |npFromdom1| (c)
  (or
    (and
      (|npEqKey| '$)
      (or (|npApplication|) (|npTrap|))
      (|npFromdom1| (|npPop1|))
      (|npPush| (|pfFromDom| (|npPop1|) c)))
    (|npPush| c)))
```

—————

defun npAmpersand

[npEqKey p145]
 [npName p204]
 [npTrap p212]

— defun npAmpersand —

```
(defun |npAmpersand| ()
  (and
    (|npEqKey| 'ampersand)
    (or (|npName|) (|npTrap|))))
```

—————

defun npName

[npId p204]
 [npSymbolVariable p205]

— defun npName —

```
(defun |npName| ()
  (or (|npId|) (|npSymbolVariable|)))
```

—————

defvar \$npTokToNames

— initvars —

```
(defvar |$npTokToNames| (list '~ '|#| '[] '{| '|\|}| '|\|}|))
```

—————

defun npId

[npPush p143]
 [npNext p145]
 [tokConstruct p411]
 [tokPosn p413]

[[\\$npTokToNames p204](#)]

[[\\$ttok p??](#)]

[[\\$stok p??](#)]

— **defun npId** —

```
(defun |npId| ()
  (declare (special |$npTokToNames| |$ttok| |$stok|))
  (cond
    ((eq (caar |$stok|) '|id|)
      (|npPush| |$stok|)
      (|npNext|))
    ((and (eq (caar |$stok|) '|key|) (member |$ttok| |$npTokToNames|))
      (|npPush| (|tokConstruct| '|id| |$ttok| (|tokPosn| |$stok|)))
      (|npNext|))
    (t nil)))
```

defun npSymbolVariable

[[npState p212](#)]

[[npEqKey p145](#)]

[[npId p204](#)]

[[npPop1 p144](#)]

[[npPush p143](#)]

[[tokConstruct p411](#)]

[[tokPart p413](#)]

[[tokPosn p413](#)]

[[npRestore p152](#)]

— **defun npSymbolVariable** —

```
(defun |npSymbolVariable| ()
  (let (a)
    (setq a (|npState|))
    (cond
      ((and (|npEqKey| 'backquote) (|npId|))
        (setq a (|npPop1|))
        (|npPush| (|tokConstruct| '|idsy| (|tokPart| a) (|tokPosn| a))))
      (t (|npRestore| a) nil))))
```

defun npRightAssoc

```

[npState p212]
[npInfGeneric p207]
[npRightAssoc p206]
[npPush p143]
[pfApplication p253]
[npPop2 p144]
[npPop1 p144]
[pfInfApplication p271]
[npRestore p152]

```

— **defun npRightAssoc** —

```

(defun |npRightAssoc| (o p)
  (let (a)
    (setq a (|npState|))
    (cond
      ((apply p nil)
        ((lambda ()
          (loop
            (cond
              ((not
                (and
                  (|npInfGeneric| o)
                  (or
                    (|npRightAssoc| o p)
                    (progn (|npPush| (|pfApplication| (|npPop2|) (|npPop1|))) nil))))
              (return nil))
            (t
              (|npPush| (|pfInfApplication| (|npPop2|) (|npPop2|) (|npPop1|))))))))
        t)
      (t
        (|npRestore| a)
        nil))))

```

defun p o p o p o p = (((p o p) o p) o p)

```

p o p o p o p = (((p o p) o p) o p)
p o p o = (p o p) o
;npLeftAssoc(operations,parser)==
;  if APPLY(parser,nil)
;  then
;    while npInfGeneric(operations)
;    and (APPLY(parser,nil) or

```

```

;      (npPush pfApplication(npPop2(),npPop1());false))
;      repeat
;      npPush pfInfApplication(npPop2(),npPop2(),npPop1())
;      true
;      else false

```

[npInfGeneric p207]
 [npPush p143]
 [pfApplication p253]
 [npPop2 p144]
 [npPop1 p144]
 [pfInfApplication p271]

— defun npLeftAssoc —

```

(defun |npLeftAssoc| (operations parser)
  (when (apply parser nil)
    ((lambda nil
      (loop
        (cond
          ((not
            (and
              (|npInfGeneric| operations)
              (or
                (apply parser nil)
                (progn (|npPush| (|pfApplication| (|npPop2|) (|npPop1|))) nil))))
            (return nil))
          (t
            (|npPush| (|pfInfApplication| (|npPop2|) (|npPop2|) (|npPop1|)))))))
      t))

```

—

defun npInfGeneric

[npDDInfKey p208]
 [npEqKey p145]

— defun npInfGeneric —

```

(defun |npInfGeneric| (s)
  (and
    (|npDDInfKey| s)
    (or (|npEqKey| 'backset) t)))

```

—

defun npDDInfKey

```

[npInfKey p208]
[npState p212]
[npEqKey p145]
[npPush p143]
[pfSymb p251]
[npPop1 p144]
[tokPosn p413]
[npRestore p152]
[tokConstruct p411]
[tokPart p413]
[$stok p??]

```

— defun npDDInfKey —

```

(defun |npDDInfKey| (s)
  (let (b a)
    (declare (special |$stok|))
    (or
      (|npInfKey| s)
      (progn
        (setq a (|npState|))
        (setq b |$stok|)
        (cond
          ((and (|npEqKey| '|'|) (|npInfKey| s))
            (|npPush| (|pfSymb| (|npPop1|) (|tokPosn| b))))
          (t
            (|npRestore| a)
            (cond
              ((and (|npEqKey| 'backquote) (|npInfKey| s))
                (setq a (|npPop1|))
                (|npPush| (|tokConstruct| '|idsy| (|tokPart| a) (|tokPosn| a))))
              (t
                (|npRestore| a)
                nil))))))))))

```

—————

defun npInfKey

```

[npPushId p209]
[$stok p??]
[$ttok p??]

```

— defun npInfKey —

```
(defun |npInfKey| (s)
  (declare (special |$ttok| |$stok|))
  (and (eq (caar |$stok|) '|key|) (member |$ttok| s) (|npPushId|)))
```

defun npPushId

```
[tokConstruct p411]
[tokPosn p413]
[npNext p145]
[$stack p??]
[$stok p??]
[$ttok p??]
```

— defun npPushId —

```
(defun |npPushId| ()
  (let (a)
    (declare (special |$stack| |$stok| |$ttok|))
    (setq a (get |$ttok| 'infgeneric))
    (when a (setq |$ttok| a))
    (setq |$stack|
      (cons (|tokConstruct| '|id| |$ttok| (|tokPosn| |$stok|)) |$stack|))
    (|npNext|)))
```

defvar \$npPParg

— initvars —

```
(defvar *npPParg* nil "rewrite npPP without flets, using global scoping")
```

defun npPP

This was rewritten by NAG to remove flet. [npParened p185]
 [npPPf p211]
 [npPileBracketed p188]

[npPPg p210]
 [npPush p143]
 [pfEnSequence p263]
 [npPop1 p144]
 [npPParg p209]

— defun npPP —

```
(defun |npPP| (f)
  (declare (special *npPParg*))
  (setq *npPParg* f)
  (or
    (|npPared| #'npPPf)
    (and (|npPileBracketed| #'npPPg) (|npPush| (|pfEnSequence| (|npPop1|))))
    (funcall f)))
```

—————

defun npPPf

[npPop1 p144]
 [npPush p143]
 [\$npPParg p209]

— defun npPPf —

```
(defun npPPf ()
  (and (funcall *npPParg*) (|npPush| (list (|npPop1|)))))
```

—————

defun npPPg

[npListAndRecover p189]
 [npPPf p211]
 [npPush p143]
 [pfAppend p255]
 [npPop1 p144]

— defun npPPg —

```
(defun npPPg ()
  (and (|npListAndRecover| #'npPPf)
    (|npPush| (|pfAppend| (|npPop1|)))))
```

defun npPPf

[npSemiListing p193]
 [npPPff p210]

— defun npPPf —

```
(defun npPPf ()
  (|npSemiListing| #'npPPff))
```

defun npEnclosed

[npEqKey p145]
 [npPush p143]
 [pfTuple p292]
 [pfListOf p245]
 [npMissingMate p215]
 [pfEnSequence p263]
 [npPop1 p144]
 [\$stok p??]

— defun npEnclosed —

```
(defun |npEnclosed| (open close fn f)
  (let (a)
    (declare (special |$stok|))
    (setq a |$stok|)
    (when (|npEqKey| open)
      (cond
        ((|npEqKey| close)
         (|npPush| (funcall fn a (|pfTuple| (|pfListOf| NIL))))))
        ((and (apply f nil)
              (or (|npEqKey| close)
                  (|npMissingMate| close a)))
         (|npPush| (funcall fn a (|pfEnSequence| (|npPop1|))))))
        ('t nil))))
```

defun npState

```
[$stack p??]
[$inputStream p??]
```

— defun npState —

```
(defun |npState| ()
  (declare (special |$stack| |$inputStream|))
  (cons |$inputStream| |$stack|))
```

defun npTrap

```
[trappoint p??]
[tokPosn p413]
[ncSoftError p351]
[$stok p??]
```

— defun npTrap —

```
(defun |npTrap| ()
  (declare (special |$stok|))
  (|ncSoftError| (|tokPosn| |$stok|) 'S2CY0002 nil)
  (throw 'trappoint 'trapped))
```

defun npTrapForm

```
[trappoint p??]
[pfSourceStok p243]
[syGeneralErrorHere p192]
[ncSoftError p351]
[tokPosn p413]
```

— defun npTrapForm —

```
(defun |npTrapForm| (x)
  (let (a)
    (setq a (|pfSourceStok| x))
    (cond
      ((eq a ' |NoToken|)
```

```

(|syGeneralErrorHere|)
(throw 'trappoint 'trapped))
(t
(|ncSoftError| (|tokPosn| a) 'S2CY0002 nil)
(throw 'trappoint 'trapped))))))

```

defun npVariable

```

[npParenthesized p214]
[npVariablelist p213]
[npVariableName p213]
[npPush p143]
[pfListOf p245]
[npPop1 p144]

```

— defun npVariable —

```

(defun |npVariable| ()
  (or
    (|npParenthesized| #'|npVariablelist|)
    (and (|npVariableName|) (|npPush| (|pfListOf| (list (|npPop1|)))))))

```

defun npVariablelist

```

[npListing p155]
[npVariableName p213]

```

— defun npVariablelist —

```

(defun |npVariablelist| ()
  (|npListing| #'|npVariableName|))

```

defun npVariableName

```

[npName p204]
[npDecl p214]

```

```
[npPush p143]
[pfTyped p290]
[npPop1 p144]
[pfNothing p245]
```

— defun npVariableName —

```
(defun |npVariableName| ()
  (and
    (|npName|)
    (or (|npDecl|) (|npPush| (|pfTyped| (|npPop1|) (|pfNothing|))))))
```

—————

defun npDecl

```
[npEqKey p145]
[npType p149]
[npTrap p212]
[npPush p143]
[pfTyped p290]
[npPop2 p144]
[npPop1 p144]
```

— defun npDecl —

```
(defun |npDecl| ()
  (and
    (|npEqKey| 'colon)
    (or (|npType|) (|npTrap|))
    (|npPush| (|pfTyped| (|npPop2|) (|npPop1|)))))
```

—————

defun npParenthesized

```
[npParenthesize p215]
```

— defun npParenthesized —

```
(defun |npParenthesized| (f)
  (or (|npParenthesize| '(| ')| f) (|npParenthesize| '(\(| '|\)| f)))
```

—————

defun npParenthesize

[npEqKey p145]
 [npMissingMate p215]
 [npPush p143]
 [\$stok p??]

— defun npParenthesize —

```
(defun |npParenthesize| (open close f)
  (let (a)
    (declare (special |$stok|))
    (setq a |$stok|)
    (cond
      ((|npEqKey| open)
       (cond
         ((and (apply f nil)
              (or (|npEqKey| close)
                  (|npMissingMate| close a)))
          t)
        ((|npEqKey| close) (|npPush| nil))
        (t (|npMissingMate| close a))))
      (t nil))))
```

—————

defun npMissingMate

[ncSoftError p351]
 [tokPosn p413]
 [npMissing p151]

— defun npMissingMate —

```
(defun |npMissingMate| (close open)
  (|ncSoftError| (|tokPosn| open) 'S2CY0008 nil)
  (|npMissing| close))
```

—————

defun npExit

[npBackTrack p148]
 [npAssign p216]

[npPileExit p216]

— defun npExit —

```
(defun |npExit| ()
  (|npBackTrack| #'|npAssign| 'exit #'|npPileExit|))
```

—————

defun npPileExit

```
[npAssign p216]
[npEqKey p145]
[npStatement p170]
[npPush p143]
[pfExit p263]
[npPop2 p144]
[npPop1 p144]
```

— defun npPileExit —

```
(defun |npPileExit| ()
  (and
    (|npAssign|)
    (or (|npEqKey| 'exit) (|npTrap|))
    (or (|npStatement|) (|npTrap|))
    (|npPush| (|pfExit| (|npPop2|) (|npPop1|)))))
```

—————

defun npAssign

```
[npBackTrack p148]
[npMDEF p165]
[npAssignment p217]
```

— defun npAssign —

```
(defun |npAssign| ()
  (|npBackTrack| #'|npMDEF| 'becomes #'|npAssignment|))
```

—————

defun npAssignment

[npAssignVariable p217]
 [npEqKey p145]
 [npTrap p212]
 [npGives p148]
 [npPush p143]
 [pfAssign p255]
 [npPop2 p144]
 [npPop1 p144]

— defun npAssignment —

```
(defun |npAssignment| ()
  (and
    (|npAssignVariable|)
    (or (|npEqKey| 'becomes) (|npTrap|))
    (or (|npGives|) (|npTrap|))
    (|npPush| (|pfAssign| (|npPop2|) (|npPop1|)))))
```

—————

defun npAssignVariable

[npColon p217]
 [npPush p143]
 [pfListOf p245]
 [npPop1 p144]

— defun npAssignVariable —

```
(defun |npAssignVariable| ()
  (and (|npColon|) (|npPush| (|pfListOf| (list (|npPop1|))))))
```

—————

defun npColon

[npTypified p218]
 [npAnyNo p162]
 [npTagged p218]

— defun npColon —

```
(defun |npColon| ()
  (and (|npTypified|) (|npAnyNo| #'|npTagged|)))
```

defun npTagged

```
[npTypedForm1 p218]
[pfTagged p288]
```

— defun npTagged —

```
(defun |npTagged| ()
  (|npTypedForm1| 'colon #'|pfTagged|))
```

defun npTypedForm1

```
[npEqKey p145]
[npType p149]
[npTrap p212]
[npPush p143]
[npPop2 p144]
[npPop1 p144]
```

— defun npTypedForm1 —

```
(defun |npTypedForm1| (sy fn)
  (and
    (|npEqKey| sy)
    (or (|npType|) (|npTrap|))
    (|npPush| (funcall fn (|npPop2|) (|npPop1|)))))
```

defun npTypified

```
[npApplication p162]
[npAnyNo p162]
[npTypeStyle p219]
```

— defun npTypified —

```
(defun |npTypified| ()
  (and (|npApplication|) (|npAnyNo| #'|npTypeStyle|)))
```

defun npTypeStyle

```
[npCoerceTo p220]
[npRestrict p220]
[npPretend p219]
[npColonQuery p219]
```

— defun npTypeStyle —

```
(defun |npTypeStyle| ()
  (or (|npCoerceTo|) (|npRestrict|) (|npPretend|) (|npColonQuery|)))
```

defun npPretend

```
[npTypedForm p220]
[pfPretend p281]
```

— defun npPretend —

```
(defun |npPretend| ()
  (|npTypedForm| 'pretend #'|pfPretend|))
```

defun npColonQuery

```
[npTypedForm p220]
[pfRetractTo p284]
```

— defun npColonQuery —

```
(defun |npColonQuery| ()
  (|npTypedForm| 'atat #'|pfRetractTo|))
```

defun npCoerceTo

[npTypedForm p220]
 [pfCoerceto p259]

— defun npCoerceTo —

```
(defun |npCoerceTo| ()
  (|npTypedForm| 'coerce #'|pfCoerceto|))
```

—————

defun npTypedForm

[npEqKey p145]
 [npApplication p162]
 [npTrap p212]
 [npPush p143]
 [npPop2 p144]
 [npPop1 p144]

— defun npTypedForm —

```
(defun |npTypedForm| (sy fn)
  (and
    (|npEqKey| sy)
    (or (|npApplication|) (|npTrap|))
    (|npPush| (funcall fn (|npPop2|) (|npPop1|))))))
```

—————

defun npRestrict

[npTypedForm p220]
 [pfRestrict p283]

— defun npRestrict —

```
(defun |npRestrict| ()
  (|npTypedForm| 'at #'|pfRestrict|))
```

—————

defun npListofFun

```
[npTrap p212]
[npPush p143]
[npPop3 p144]
[npPop2 p144]
[npPop1 p144]
[$stack p??]
```

— **defun npListofFun** —

```
(defun |npListofFun| (f h g)
  (let (a)
    (declare (special |$stack|))
    (cond
      ((apply f nil)
       (cond
         ((and (apply h nil) (or (apply f nil) (|npTrap|)))
          (setq a |$stack|)
          (setq |$stack| nil)
          (do ()
              ((not (and (apply h nil)
                        (or (apply f nil) (|npTrap|)))))
              (setq |$stack| (cons (nreverse |$stack|) a))
              (|npPush| (funcall g (cons (|npPop3|) (cons (|npPop2|) (|npPop1|))))))
            (t t)))
          (t nil))))
```

6.1 Macro handling

defun phMacro

TPDHERE: The pform function has a leading percent sign

```
carrier[ptree,...] -> carrier[ptree, ptreePremacro,...]
```

```
[ncEltQ p416]
[ncPutQ p416]
[macroExpanded p222]
[pform p??]
```

— **defun phMacro** —

```
(defun |phMacro| (carrier)
```

```
(let (ptree)
  (setq ptree (|ncEltQ| carrier '|ptree|))
  (|ncPutQ| carrier '|ptreePremacro| ptree)
  (setq ptree (|macroExpanded| ptree))
  (|ncPutQ| carrier '|ptree| ptree)
  'ok))
```

defun macroExpanded

\$macActive is a list of the bodies being expanded. \$posActive is a list of the parse forms where the bodies came from. [macExpand p222]

[\$posActive p??]

[\$macActive p??]

— defun macroExpanded —

```
(defun |macroExpanded| (pf)
  (let (|$posActive| |$macActive|)
    (declare (special |$posActive| |$macActive|))
    (setq |$macActive| nil)
    (setq |$posActive| nil)
    (|macExpand| pf)))
```

defun macExpand

[pfWhere? p294]
 [macWhere p228]
 [pfLambda? p273]
 [macLambda p228]
 [pfMacro? p277]
 [macMacro p229]
 [pfId? p246]
 [macId p227]
 [pfApplication? p255]
 [macApplication p223]
 [pfMapParts p236]
 [macExpand p222]

— defun macExpand —

```
(defun |macExpand| (pf)
  (cond
    ((|pfWhere?| pf)      (|macWhere| pf))
    ((|pfLambda?| pf)     (|macLambda| pf))
    ((|pfMacro?| pf)      (|macMacro| pf))
    ((|pfId?| pf)         (|macId| pf))
    ((|pfApplication?| pf) (|macApplication| pf))
    (t                    (|pfMapParts| #'|macExpand| pf))))
```

defun macApplication

```
[pfMapParts p236]
[macExpand p222]
[pfApplicationOp p254]
[pfMLambda? p278]
[pf0ApplicationArgs p237]
[mac0MLambdaApply p223]
[$pfMacros p97]
```

— defun macApplication —

```
(defun |macApplication| (pf)
  (let (args op)
    (declare (special |$pfMacros|))
    (setq pf (|pfMapParts| #'|macExpand| pf))
    (setq op (|pfApplicationOp| pf))
    (cond
      ((null (|pfMLambda?| op)) pf)
      (t
       (setq args (|pf0ApplicationArgs| pf))
       (|mac0MLambdaApply| op args pf |$pfMacros|))))
```

defun mac0MLambdaApply

TPDHERE: The pform function has a leading percent sign. fix this [pf0MLambdaArgs p278]

```
[pfMLambdaBody p279]
[pfSourcePosition p238]
[ncHardError p352]
[pfId? p246]
```



```
[pform p??]
[mac0Define p230]
[mac0ExpandBody p224]
[$pfMacros p97]
[$posActive p??]
[$macActive p??]
```

— **defun mac0MLambdaApply** —

```
(defun |mac0MLambdaApply| (mlambda args opf |$pfMacros|)
  (declare (special |$pfMacros|))
  (let (pos body params)
    (declare (special |$posActive| |$macActive|))
    (setq params (|pf0MLambdaArgs| mlambda))
    (setq body (|pfMLambdaBody| mlambda))
    (cond
      ((not (eql (length args) (length params)))
        (setq pos (|pfSourcePosition| opf))
        (|incHardError| pos 'S2CM0003 (list (length params) (length args))))
      (t
        (lambda (parms p arrgs a) ; for p in params for a in args repeat
          (loop
            (cond
              ((or (atom parms)
                (progn (setq p (car parms)) nil)
                (atom arrgs)
                (progn (setq a (CAR arrgs)) nil))
                (return nil))
              (t
                (cond
                  ((null (|pfId?| p))
                    (setq pos (|pfSourcePosition| opf))
                    (|incHardError| pos 'S2CM0004 (list (|%pform| p))))
                  (t
                    (|mac0Define| (|pfIdSymbol| p) '|mparam| a))))
                (setq parms (cdr parms))
                (setq arrgs (cdr arrgs))))
          params nil args nil)
        (|mac0ExpandBody| body opf |$macActive| |$posActive|))))))
```

—————

defun mac0ExpandBody

```
[pfSourcePosition p238]
[mac0InfiniteExpansion p225]
[macExpand p222]
```

```
[$posActive p??]
[$macActive p??]
```

— defun `mac0ExpandBody` —

```
(defun |mac0ExpandBody| (body opf |$macActive| |$posActive|)
  (declare (special |$macActive| |$posActive|))
  (let (posn pf)
    (cond
      ((member body |$macActive|)
       (setq pf (cadr |$posActive|))
       (setq posn (|pfSourcePosition| pf))
       (|mac0InfiniteExpansion| posn body |$macActive|))
      (t
       (setq |$macActive| (cons body |$macActive|))
       (setq |$posActive| (cons opf |$posActive|))
       (|macExpand| body))))))
```

defun `mac0InfiniteExpansion`

TPDHERE: The `pform` function has a leading percent sign. fix this `[mac0InfiniteExpansion,name`
[p226\]](#)

```
[ncSoftError p351]
[pform p??]
```

— defun `mac0InfiniteExpansion` —

```
(defun |mac0InfiniteExpansion| (posn body active)
  (let (rnames fname tmp1 blist result)
    (setq blist (cons body active))
    (setq tmp1 (mapcar #'|mac0InfiniteExpansion,name| blist))
    (setq fname (car tmp1)) ;[fname, :rnames] := [name b for b in blist]
    (setq rnames (cdr tmp1))
    (|ncSoftError| posn 'S2CM0005
      (list
        (dolist (n (reverse rnames) (nreverse result))
          (setq result (append (reverse (list n "==">)) result)))
        fname (|pform| body)))
    body))
```

defun mac0InfiniteExpansion,name

[mac0GetName p226]
 [pname p1045]

— **defun mac0InfiniteExpansion,name 0** —

```
(defun |mac0InfiniteExpansion,name| (b)
  (let (st sy got)
    (setq got (|mac0GetName| b))
    (cond
      ((null got) "??")
      (t
       (setq sy (car got))
       (setq st (cadr got))
       (if (eq st '|mlambda|)
           (concat (pname sy) "...")
           (pname sy))))))
```

—

defun mac0GetName

Returns [state, body] or NIL. Returns [sy, state] or NIL. [pfMLambdaBody p279]
 [\$pfMacros p97]

— **defun mac0GetName** —

```
(defun |mac0GetName| (body)
  (let (bd tmp1 st tmp2 sy name)
    (declare (special |$pfMacros|))
    ; for [sy,st,bd] in $pfMacros while not name repeat
    ((lambda (macros tmplist)
      (loop
        (cond
          ((or (atom macros)
               (progn (setq tmplist (car macros)) nil)
               name)
           (return nil))
          (t
           (and (consp tmplist)
                (progn
                  (setq sy (car tmplist))
                  (setq tmp2 (cdr tmplist))
                  (and (consp tmp2)
                       (progn
                        (setq st (car tmp2))
```

```

      (setq tmp1 (cdr tmp2))
      (and (consp tmp1)
            (eq (cdr tmp1) nil)
            (progn
              (setq bd (car tmp1))
              t))))
    (progn
      (when (eq st 'mlambda) (setq bd (|pfMLambdaBody| bd)))
      (when (eq bd body) (setq name (list sy st))))))
    (setq macros (cdr macros)))
  |$pfMacros| nil)
  name))

```

defun macId

```

[pfIdSymbol p247]
[mac0Get p228]
[pfCopyWithPos p236]
[pfSourcePosition p238]
[mac0ExpandBody p224]
[$posActive p??]
[$macActive p??]

```

— defun macId —

```

(defun |macId| (pf)
  (let (body state got sy)
    (declare (special |$posActive| |$macActive|))
    (setq sy (|pfIdSymbol| pf))
    (cond
      ((null (setq got (|mac0Get| sy))) pf)
      (t
       (setq state (car got))
       (setq body (cadr got))
       (cond
         ((eq state 'mparam) body)
         ((eq state 'mlambda) (|pfCopyWithPos| body (|pfSourcePosition| pf)))
         (t
          (|pfCopyWithPos|
           (|mac0ExpandBody| body pf |$macActive| |$posActive|)
           (|pfSourcePosition| pf)))))))

```

defun mac0Get

[ifcdr p??]
 [\$pfMacros p97]

— defun mac0Get —

```
(defun |mac0Get| (sy)
  (declare (special |$pfMacros|))
  (ifcdr (assoc sy |$pfMacros|)))
```

—————

defun macWhere

[macWhere,mac p228]
 [\$pfMacros p97]

— defun macWhere —

```
(defun |macWhere| (pf)
  (declare (special |$pfMacros|))
  (|macWhere,mac| pf |$pfMacros|))
```

—————

defun macWhere,mac

[pfMapParts p236]
 [macExpand p222]
 [\$pfMacros p97]

— defun macWhere,mac —

```
(defun |macWhere,mac| (pf |$pfMacros|)
  (declare (special |$pfMacros|))
  (|pfMapParts| #'|macExpand| pf))
```

—————

defun macLambda

[macLambda,mac p229]
 [\$pfMacros p97]

— defun macLambda —

```
(defun |macLambda| (pf)
  (declare (special |$pfMacros|))
  (|macLambda,mac| pf |$pfMacros|))
```

—————

defun macLambda,mac

[pfMapParts p236]
 [macExpand p222]
 [\$pfMacros p97]

— defun macLambda,mac —

```
(defun |macLambda,mac| (pf |$pfMacros|)
  (declare (special |$pfMacros|))
  (|pfMapParts| #'|macExpand| pf))
```

—————

defun Add appropriate definition the a Macro pform

This function adds the definition and returns the original Macro pform. **TPDHERE: The pform function has a leading percent sign. fix this** [pfMacroLhs p277]

[pfMacroRhs p277]
 [pfId? p246]
 [ncSoftError p351]
 [pfSourcePosition p238]
 [pfIdSymbol p247]
 [mac0Define p230]
 [pform p??]
 [pfMLambda? p278]
 [macSubstituteOuter p230]
 [pfNothing? p245]
 [pfMacro p277]
 [pfNothing p245]

— defun macMacro —

```
(defun |macMacro| (pf)
  (let (sy rhs lhs)
```

```

(setq lhs (|pfMacroLhs| pf))
(setq rhs (|pfMacroRhs| pf))
(cond
  ((null (|pfId?| lhs))
   (|ncSoftError| (|pfSourcePosition| lhs) 'S2CM0001 (list (|%pform| lhs)))
   pf)
  (t
   (setq sy (|pfIdSymbol| lhs))
   (|mac0Define| sy
    (cond
      ((|pfMLambda?| rhs) '|mlambda|)
      (t '|mbody|))
    (|macSubstituteOuter| rhs))
   (cond
     ((|pfNothing?| rhs) pf)
     (t (|pfMacro| lhs (|pfNothing|)))))))

```

defun Add a macro to the global pfMacros list

[[\\$pfMacros](#) p97]

— defun mac0Define 0 —

```

(defun |mac0Define| (sy state body)
  (declare (special |$pfMacros|))
  (setq |$pfMacros| (cons (list sy state body) |$pfMacros|)))

```

defun macSubstituteOuter

[[mac0SubstituteOuter](#) p231]

[[macLambdaParameterHandling](#) p231]

— defun macSubstituteOuter —

```

(defun |macSubstituteOuter| (pform)
  (|mac0SubstituteOuter| (|macLambdaParameterHandling| nil pform) pform))

```

defun mac0SubstituteOuter

[pfId? p246]
 [macSubstituteId p232]
 [pfLeaf? p247]
 [pfLambda? p273]
 [macLambdaParameterHandling p231]
 [mac0SubstituteOuter p231]
 [pfParts p249]

— defun mac0SubstituteOuter —

```
(defun |mac0SubstituteOuter| (repllist pform)
  (let (tmplist)
    (cond
      ((|pfId?| pform) (|macSubstituteId| replist pform))
      ((|pfLeaf?| pform) pform)
      ((|pfLambda?| pform)
       (setq tmplist (|macLambdaParameterHandling| replist pform))
       (dolist (p (|pfParts| pform)) (|mac0SubstituteOuter| tmplist p))
       pform)
      (t
       (dolist (p (|pfParts| pform)) (|mac0SubstituteOuter| replist p))
       pform))))
```

—————

defun macLambdaParameterHandling

[pfLeaf? p247]
 [pfLambda? p273]
 [pfTypeId p291]
 [pf0LambdaArgs p274]
 [pfIdSymbol p247]
 [pfMLambda? p278]
 [pf0MLambdaArgs p278]
 [pfLeaf p247]
 [pfAbSynOp p412]
 [pfLeafPosition p248]
 [pfParts p249]
 [macLambdaParameterHandling p231]

— defun macLambdaParameterHandling —

```
(defun |macLambdaParameterHandling| (repllist pform)
  (let (parlist symlist result)
```



```

(cond
  ((|pfLeaf?| pform) nil)
  ((|pfLambda?| pform) ; remove ( identifier . replacement ) from assoclist
   (setq parlist (mapcar #'|pfTypedId| (|pf0LambdaArgs| pform)))
   (setq symlist (mapcar #'|pfIdSymbol| parlist))
   (dolist (par symlist)
     (setq replist
       (let ((pr (assoc par replist :test #'equal)))
         (when pr (remove par replist :test #'equal))))))
   replist)
  ((|pfMLambda?| pform) ;construct assoclist ( identifier . replacement )
   (setq parlist (|pf0MLambdaArgs| pform)) ; extract parameter list
   (dolist (par parlist (nreverse result))
     (push
      (cons (|pfIdSymbol| par)
            (|pfLeaf| (|pfAbSynOp| par) (gensym) (|pfLeafPosition| par)))
      result)))
  (t
   (dolist (p (|pfParts| pform))
     (|macLambdaParameterHandling| replist p))))))

```

defun macSubstituteId

[pfIdSymbol p247]

— defun macSubstituteId —

```

(defun |macSubstituteId| (repllist pform)
  (let (ex)
    (setq ex (assoc (|pfIdSymbol| pform) replist :test #'eq))
    (cond
      (ex
       (rplaca pform (cadr ex))
       (rplacd pform (caddr ex))
       pform)
      (t pform))))

```

Chapter 7

Pftrees

7.1 Abstract Syntax Trees Overview

Th functions create and examine abstract syntax trees. These are called pforms, for short.

The pform data structure

- Leaves: [hd, tok, pos] where pos is optional
- Trees: [hd, tree, tree, ...]
- hd is either an id or (id . alist)

The leaves are:

char	:=	('char expr position)
Document	:=	('Document expr position)
error	:=	('error expr position)
expression	:=	('expression expr position)
float	:=	('float expr position)
id	:=	('id expr position)
idsy	:=	('idsy expr position)
integer	:=	('integer expr position)
string	:=	('string expr position)
symbol	:=	('symbol expr position)

The special nodes:

ListOf	:=	('listOf items)
Nothing	:=	('nothing)
SemiColon	:=	('SemiColon (Body: Expr))

The expression nodes:

Add	:= ('Add (Base: [Typed], Addin: Expr))
And	:= ('And left right)
Application	:= ('Application (Op: Expr, Arg: Expr))
Assign	:= ('Assign (LhsItems: [AssLhs], Rhs: Expr))
Attribute	:= ('Attribute (Expr: Primary))
Break	:= ('Break (From: ? Id))
Coerceto	:= ('Coerceto (Expr: Expr, Type: Type))
Collect	:= ('Collect (Body: Expr, Iterators: [Iterator]))
ComDefinition	:= ('ComDefinition (Doc: Document, Def: Definition))
DeclPart	
Definition	:= ('Definition (LhsItems: [Typed], Rhs: Expr))
DefinitionSequence	:= (Args: [DeclPart])
Do	:= ('Do (Body: Expr))
Document	:= ('Document strings)
DWhere	:= ('DWhere (Context: [DeclPart], Expr: [DeclPart]))
EnSequence	:=
Exit	:= ('Exit (Cond: ? Expr, Expr: ? Expr))
Export	:= ('Export (Items: [Typed]))
Forin	:= ('Forin (Lhs: [AssLhs], Whole: Expr))
Free	:= ('Free (Items: [Typed]))
Fromdom	:= ('Fromdom (What: Id, Domain: Type))
Hide	:= ('hide, arg)
If	:= ('If (Cond: Expr, Then: Expr, Else: ? Expr))
Import	:= ('Import (Items: [QualType]))
Inline	:= ('Inline (Items: [QualType]))
Iterate	:= ('Iterate (From: ? Id))
Lambda	:= ('Lambda (Args: [Typed], Rets: ReturnedTyped, Body: Expr))
Literal	
Local	:= ('Local (Items: [Typed]))
Loop	:= ('Loop (Iterators: [Iterator]))
Macro	:= ('Macro (Lhs: Id, Rhs: ExprorNot))
MLambda	:= ('MLambda (Args: [Id], Body: Expr))
Not	:= ('Not arg)
Novalue	:= ('Novalue (Expr: Expr))
Or	:= ('Or left right)
Pretend	:= ('Pretend (Expr: Expr, Type: Type))
QualType	:= ('QualType (Type: Type, Qual: ? Type))
Restrict	:= ('Restrict (Expr: Expr, Type: Type))
Retract	:= ('RetractTo (Expr: Expr, Type: Type))
Return	:= ('Return (Expr: ? Expr, From: ? Id))
ReturnTyped	:= ('returntyuped (type body))
Rule	:= ('Rule (lhsitems, rhsitems))
Sequence	:= ('Sequence (Args: [Expr]))
Suchthat	:= ('Suchthat (Cond: Expr))
Symb	:= if leaf then symbol else expression
Tagged	:= ('Tagged (Tag: Expr, Expr: Expr))
TLambda	:= ('TLambda (Args: [Typed], Rets: ReturnedTyped Type, Body: Expr))
Tuple	:= ('Tuple (Parts: [Expr]))
Typed	:= ('Typed (Id: Id, Type: ? Type))
Typing	:= ('Typing (Items: [Typed]))
Until	:= ('Until (Cond: Expr)) NOT USED
WDeclare	:= ('WDeclare (Signature: Typed, Doc: ? Document))
Where	:= ('Where (Context: [DeclPart], Expr: Expr))
While	:= ('While (Cond: Expr))
With	:= ('With (Base: [Typed], Within: [WithPart]))

Special cases of expression nodes are:

- Application. The Op parameter is one of `and`, `or`, `Y`, `|`, `{}`, `[]`, `{|}|`, `[|]|`
- DeclPart. The comment is attached to all signatutres in Typing, Import, Definition, Sequence, DWhere, Macro nodes
- EnSequence. This is either a Tuple or Sequence depending on the argument
- Literal. One of integer symbol expression one zero char string float of the form ('expression expr position)

7.2 Structure handlers

defun pfGlobalLinePosn

[poGlobalLinePosn p70]

— defun pfGlobalLinePosn —

```
(defun |pfGlobalLinePosn| (posn)
  (|poGlobalLinePosn| posn))
```

—————

defun pfCharPosn

[poCharPosn p377]

— defun pfCharPosn —

```
(defun |pfCharPosn| (posn)
  (|poCharPosn| posn))
```

—————

defun pfLinePosn

[poLinePosn p361]

— defun pfLinePosn —

```
(defun |pfLinePosn| (posn)
  (|poLinePosn| posn))
```

defun pfFileName

[poFileName p360]

— defun pfFileName —

```
(defun |pfFileName| (posn)
  (|poFileName| posn))
```

defun pfCopyWithPos

[pfLeaf? p247]
 [pfLeaf p247]
 [pfAbSynOp p412]
 [tokPart p413]
 [pfTree p252]
 [pfParts p249]
 [pfCopyWithPos p236]

— defun pfCopyWithPos —

```
(defun |pfCopyWithPos| (pform pos)
  (if (|pfLeaf?| pform)
      (|pfLeaf| (|pfAbSynOp| pform) (|tokPart| pform) pos)
      (|pfTree| (|pfAbSynOp| pform)
                (loop for p in (|pfParts| pform)
                      collect (|pfCopyWithPos| p pos))))))
```

defun pfMapParts

[pfLeaf? p247]
 [pfParts p249]
 [pfTree p252]

[pfAbSynOp p412]

— defun pfMapParts —

```
(defun |pfMapParts| (f pform)
  (let (parts1 parts0)
    (if (|pfLeaf?| pform)
        pform
        (progn
         (setq parts0 (|pfParts| pform))
         (setq parts1 (loop for p in parts0 collect (funcall f p)))
         (if (reduce #'(lambda (u v) (and u v)) (mapcar #'eq parts0 parts1))
             pform
             (|pfTree| (|pfAbSynOp| pform) parts1))))))
```

—————

defun pf0ApplicationArgs

[pf0FlattenSyntacticTuple p237]

[pfApplicationArg p254]

— defun pf0ApplicationArgs —

```
(defun |pf0ApplicationArgs| (pform)
  (|pf0FlattenSyntacticTuple| (|pfApplicationArg| pform)))
```

—————

defun pf0FlattenSyntacticTuple

[pfTuple? p292]

[pf0FlattenSyntacticTuple p237]

[pf0TupleParts p293]

— defun pf0FlattenSyntacticTuple —

```
(defun |pf0FlattenSyntacticTuple| (pform)
  (if (null (|pfTuple?| pform))
      (list pform)
      ; [:pf0FlattenSyntacticTuple p for p in pf0TupleParts pform]
      ((lambda (arg0 arg1 p)
        (loop
         (cond
          ((or (atom arg1) (progn (setq p (car arg1)) nil))
```

```

      (return (nreverse arg0)))
    (t
      (setq arg0 (append (reverse (|pf0FlattenSyntacticTuple| p)) arg0)))
      (setq arg1 (cdr arg1))))
    nil (|pf0TupleParts| pform) nil)))

```

defun pfSourcePosition

[\[pfLeaf? p247\]](#)
[\[pfLeafPosition p248\]](#)
[\[poNoPosition? p413\]](#)
[\[pfSourcePosition p238\]](#)
[\[pfParts p249\]](#)
[\[\\$nopos p26\]](#)

— defun pfSourcePosition —

```

(defun |pfSourcePosition| (form)
  (let (pos)
    (declare (special |$nopos|))
    (cond
      ((|pfLeaf?| form) (|pfLeafPosition| form))
      (t
        (setq pos |$nopos|)
        ((lambda (theparts p) ; for p in parts while poNoPosition? pos repeat
          (loop
            (cond
              ((or (atom theparts)
                (progn (setq p (car theparts)) nil)
                (not (|poNoPosition?| pos))))
              (return nil))
            (t (setq pos (|pfSourcePosition| p))))
          (setq theparts (cdr theparts))))
        (|pfParts| form) nil)
        pos))))

```

defun Convert a Sequence node to a list

[\[pfSequence? p287\]](#)
[\[pfSequenceArgs p287\]](#)
[\[pfListOf p245\]](#)

— defun pfSequenceToList —

```
(defun |pfSequenceToList| (x)
  (if (|pfSequence?| x)
      (|pfSequenceArgs| x)
      (|pfListOf| (list x))))
```

—————

defun pfSpread

[pfTyped p290]

— defun pfSpread —

```
(defun |pfSpread| (arg1 arg2)
  (mapcar #'(lambda (i) (|pfTyped| i arg2)) arg1))
```

—————

defun Deconstruct nodes to lists

```
[pfTagged? p289]
[pfTaggedExpr p289]
[pfNothing p245]
[pfTaggedTag p289]
[pfId? p246]
[pfListOf p245]
[pfTyped p290]
[pfCollect1? p242]
[pfCollectVariable1 p242]
[pfTuple? p292]
[pf0TupleParts p293]
[pfTaggedToTyped p289]
[pfDefinition? p261]
[pfApplication? p255]
[pfFlattenApp p241]
[pfTaggedToTyped1 p244]
[pfTransformArg p244]
[npTrapForm p212]
```

— defun pfCheckItOut —


```

(defun |pfCheckItOut| (x)
  (let (args op ls form rt result)
    (if (|pfTagged?| x)
      (setq rt (|pfTaggedExpr| x))
      (setq rt (|pfNothing|)))
    (if (|pfTagged?| x)
      (setq form (|pfTaggedTag| x))
      (setq form x))
    (cond
      ((|pfId?| form)
       (list (|pfListOf| (list (|pfTyped| form rt))) nil rt))
      ((|pfCollect1?| form)
       (list (|pfListOf| (list (|pfCollectVariable1| form))) nil rt))
      ((|pfTuple?| form)
       (list (|pfListOf|
              (dolist (part (|pf0TupleParts| form) (nreverse result))
                (push (|pfTaggedToTyped| part) result)))
              nil rt))
      ((|pfDefinition?| form)
       (list (|pfListOf| (list (|pfTyped| form (|pfNothing|)))) nil rt))
      ((|pfApplication?| form)
       (setq ls (|pfFlattenApp| form))
       (setq op (|pfTaggedToTyped1| (car ls)))
       (setq args
        (dolist (part (cdr ls) (nreverse result))
          (push (|pfTransformArg| part) result)))
       (list (|pfListOf| (list op)) args rt))
      (t (|npTrapForm| form)))))

```

defun pfCheckMacroOut

[\[pfId? p246\]](#)
[\[pfApplication? p255\]](#)
[\[pfFlattenApp p241\]](#)
[\[pfCheckId p241\]](#)
[\[pfCheckArg p241\]](#)
[\[npTrapForm p212\]](#)

— defun pfCheckMacroOut —

```

(defun |pfCheckMacroOut| (form)
  (let (args op ls)
    (cond
      ((|pfId?| form) (list form nil))
      ((|pfApplication?| form)

```

```

(setq ls (|pfFlattenApp| form))
(setq op (|pfCheckId| (car ls)))
(setq args (mapcar #'|pfCheckArg| (cdr ls)))
(list op args))
(t (|npTrapForm| form))))

```

defun pfCheckArg

[pfTuple? p292]
 [pf0TupleParts p293]
 [pfListOf p245]
 [pfCheckId p241]

— defun pfCheckArg —

```

(defun |pfCheckArg| (args)
  (let (arg1)
    (if (|pfTuple?| args)
        (setq arg1 (|pf0TupleParts| args))
        (setq arg1 (list args)))
    (|pfListOf| (mapcar #'|pfCheckId| arg1))))

```

defun pfCheckId

[pfId? p246]
 [npTrapForm p212]

— defun pfCheckId —

```

(defun |pfCheckId| (form)
  (if (null (|pfId?| form))
      (|npTrapForm| form)
      form))

```

defun pfFlattenApp

[pfApplication? p255]
 [pfCollect1? p242]

[pfFlattenApp p241]
 [pfApplicationOp p254]
 [pfApplicationArg p254]

— defun pfFlattenApp —

```
(defun |pfFlattenApp| (x)
  (cond
    ((|pfApplication?| x)
     (cond
       ((|pfCollect1?| x) (LIST x))
       (t
        (append (|pfFlattenApp| (|pfApplicationOp| x))
                  (|pfFlattenApp| (|pfApplicationArg| x))))))
    (t (list x))))
```

—————

defun pfCollect1?

[pfApplication? p255]
 [pfApplicationOp p254]
 [pfId? p246]
 [pfIdSymbol p247]

— defun pfCollect1? —

```
(defun |pfCollect1?| (x)
  (let (a)
    (when (|pfApplication?| x)
      (setq a (|pfApplicationOp| x))
      (when (|pfId?| a) (eq (|pfIdSymbol| a) '|\\|))))))
```

—————

defun pfCollectVariable1

[pfApplicationArg p254]
 [pf0TupleParts p293]
 [pfTaggedToTyped p289]
 [pfTyped p290]
 [pfSuch p244]
 [pfTypedId p291]
 [pfTypedType p291]

— defun pfCollectVariable1 —

```
(defun |pfCollectVariable1| (x)
  (let (id var a)
    (setq a (|pfApplicationArg| x))
    (setq var (car (|pf0TupleParts| a)))
    (setq id (|pfTaggedToTyped| var))
    (|pfTyped|
     (|pfSuch| (|pfTypedId| id) (cadr (|pf0TupleParts| a)))
     (|pfTypedType| id))))
```

defun pfPushMacroBody

[pfMLambda p278]
[pfPushMacroBody p243]

— defun pfPushMacroBody —

```
(defun |pfPushMacroBody| (args body)
  (if (null args)
      body
      (|pfMLambda| (car args) (|pfPushMacroBody| (cdr args) body))))
```

defun pfSourceStok

[pfLeaf? p247]
[pfParts p249]
[pfSourceStok p243]
[pfFirst p264]

— defun pfSourceStok —

```
(defun |pfSourceStok| (x)
  (cond
   ((|pfLeaf?| x) x)
   ((null (|pfParts| x)) '|NoToken|)
   (t (|pfSourceStok| (|pfFirst| x)))))
```

defun pfTransformArg

[pfTuple? p292]
 [pf0TupleParts p293]
 [pfListOf p245]
 [pfTaggedToTyped1 p244]

— **defun pfTransformArg** —

```
(defun |pfTransformArg| (args)
  (let (arglist result)
    (if (|pfTuple?| args)
        (setq arglist (|pf0TupleParts| args))
        (setq arglist (list args)))
    (|pfListOf|
     (dolist (|i| arglist (nreverse result))
       (push (|pfTaggedToTyped1| |i|) result))))))
```

—————→

defun pfTaggedToTyped1

[pfCollect1? p242]
 [pfCollectVariable1 p242]
 [pfDefinition? p261]
 [pfTyped p290]
 [pfNothing p245]
 [pfTaggedToTyped p289]

— **defun pfTaggedToTyped1** —

```
(defun |pfTaggedToTyped1| (arg)
  (cond
    ((|pfCollect1?| arg) (|pfCollectVariable1| arg))
    ((|pfDefinition?| arg) (|pfTyped| arg (|pfNothing|)))
    (t (|pfTaggedToTyped| arg))))
```

—————→

defun pfSuch

[pfInfApplication p271]
 [pfId p246]

— **defun pfSuch** —

```
(defun |pfSuch| (x y)
  (|pfInfApplication| (|pfId| '|\|) x y))
```

7.3 Special Nodes

defun Create a Listof node

[pfTree p252]

— defun pfListOf —

```
(defun |pfListOf| (x)
  (|pfTree| 'listOf x))
```

defun pfNothing

[pfTree p252]

— defun pfNothing —

```
(defun |pfNothing| ()
  (|pfTree| 'nothing nil))
```

defun Is this a Nothing node?

[pfAbSynOp? p412]

— defun pfNothing? —

```
(defun |pfNothing?| (form)
  (|pfAbSynOp?| form 'nothing))
```

7.4 Leaves

defun Create a Document node

[pfLeaf p247]

— defun pfDocument —

```
(defun |pfDocument| (strings)
  (|pfLeaf| '|Document| strings))
```

—————

defun Construct an Id node

[pfLeaf p247]

— defun pfId —

```
(defun |pfId| (expr)
  (|pfLeaf| '|Id| expr))
```

—————

defun Is this an Id node?

[pfAbSynOp? p412]

— defun pfId? —

```
(defun |pfId?| (form)
  (or (|pfAbSynOp?| form '|Id|) (|pfAbSynOp?| form '|idsy|)))
```

—————

defun Construct an Id leaf node

[pfLeaf p247]

— defun pfIdPos —

```
(defun |pfIdPos| (expr pos)
  (|pfLeaf| ' |id| expr pos))
```

defun Return the Id part

[tokPart p413]

— defun pfIdSymbol —

```
(defun |pfIdSymbol| (form)
  (|tokPart| form))
```

defun Construct a Leaf node

[tokConstruct p411]

[ifcar p??]

[pfNoPosition p414]

— defun pfLeaf —

```
(defun |pfLeaf| (x y &rest z)
  (|tokConstruct| x y (or (ifcar z) (|pfNoPosition|))))
```

defun Is this a leaf node?

[pfAbSynOp p412]

— defun pfLeaf? —

```
(defun |pfLeaf?| (form)
  (member (|pfAbSynOp| form)
    '(|id| |idsy| |symbol| |string| |char| |float| |expression|
      |integer| |Document| |error|)))
```

defun Return the token position of a leaf node

[tokPosn p413]

— defun pfLeafPosition —

```
(defun |pfLeafPosition| (form)
  (|tokPosn| form))
```

—————

defun Return the Leaf Token

[tokPart p413]

— defun pfLeafToken —

```
(defun |pfLeafToken| (form)
  (|tokPart| form))
```

—————

defun Is this a Literal node?

[pfAbSynOp p412]

— defun pfLiteral? 0 —

```
(defun |pfLiteral?| (form)
  (member (|pfAbSynOp| form)
    '(|integer| |symbol| |expression| |one| |zero| |char| |string| |float|)))
```

—————

defun Create a LiteralClass node

[pfAbSynOp p412]

— defun pfLiteralClass —

```
(defun |pfLiteralClass| (form)
  (|pfAbSynOp| form))
```

—————

defun Return the LiteralString

[tokPart p413]

— defun pfLiteralString —

```
(defun |pfLiteralString| (form)
  (|tokPart| form))
```

—————

defun Return the parts of a tree node

— defun pfParts 0 —

```
(defun |pfParts| (form)
  (cdr form))
```

—————

defun Return the argument unchanged

— defun pfPile 0 —

```
(defun |pfPile| (part)
  part)
```

—————

defun pfPushBody

[pfLambda p273]

[pfNothing p245]

[pfPushBody p249]

— defun pfPushBody —

```
(defun |pfPushBody| (rt args body)
  (cond
    ((null args) body)
```

```

((null (cdr args)) (|pfLambda| (car args) rt body))
(t
  (|pfLambda| (car args) (|pfNothing|)
    (|pfPushBody| rt (cdr args) body))))

```

defun An S-expression which people can read.

[pfSexpr,strip p250]

— defun pfSexpr —

```

(defun |pfSexpr| (pform)
  (|pfSexpr,strip| pform))

```

defun Create a human readable S-expression

```

[pfId? p246]
[pfIdSymbol p247]
[pfLiteral? p248]
[pfLiteralString p249]
[pfLeaf? p247]
[tokPart p413]
[pfApplication? p255]
[pfApplicationArg p254]
[pfTuple? p292]
[pf0TupleParts p293]
[pfApplicationOp p254]
[pfSexpr,strip p250]
[pfAbSynOp p412]
[pfParts p249]

```

— defun pfSexpr,strip —

```

(defun |pfSexpr,strip| (pform)
  (let (args a result)
    (cond
      ((|pfId?| pform)      (|pfIdSymbol| pform))
      ((|pfLiteral?| pform) (|pfLiteralString| pform))
      ((|pfLeaf?| pform)    (|tokPart| pform))
      ((|pfApplication?| pform)

```

```

(setq a (|pfApplicationArg| pform))
(if (|pfTuple?| a)
    (setq args (|pf0TupleParts| a))
    (setq args (list a)))
(dolist (p (cons (|pfApplicationOp| pform) args) (nreverse result))
  (push (|pfSexpr,strip| p) result)))
(t
  (cons (|pfAbSynOp| pform)
    (dolist (p (|pfParts| pform) (nreverse result))
      (push (|pfSexpr,strip| p) result))))))

```

defun Construct a Symbol or Expression node

```

[|pfLeaf?| p247]
[|pfSymbol| p251]
[|tokPart| p413]
[|ifcar| p??]
[|pfExpression| p264]
[|pfSexpr| p250]

— defun pfSymb —

(defun |pfSymb| (expr &REST optpos)
  (if (|pfLeaf?| expr)
      (|pfSymbol| (|tokPart| expr) (ifcar optpos))
      (|pfExpression| (|pfSexpr| expr) (ifcar optpos))))

```

defun Construct a Symbol leaf node

```

[|pfLeaf| p247]
[|ifcar| p??]

— defun pfSymbol —

(defun |pfSymbol| (expr &rest optpos)
  (|pfLeaf| '|symbol| expr (ifcar optpos)))

```

defun Is this a Symbol node?

[pfAbSynOp? p412]

— defun pfSymbol? —

```
(defun |pfSymbol?| (form)
  (|pfAbSynOp?| form '|symbol|))
```

—————

defun Return the Symbol part

[tokPart p413]

— defun pfSymbolSymbol —

```
(defun |pfSymbolSymbol| (form)
  (|tokPart| form))
```

—————

7.5 Trees**defun Construct a tree node**

— defun pfTree 0 —

```
(defun |pfTree| (x y)
  (cons x y))
```

—————

defun Construct an Add node

[pfNothing p245]

[pfTree p252]

— defun pfAdd —

```
(defun |pfAdd| (pfbase pfaddin &rest addon)
  (let (lhs)
    (if addon
      (setq lhs addon)
      (setq lhs (|pfNothing|)))
    (|pfTree| '|Add| (list pfbase pfaddin lhs))))
```

defun Construct an And node

[pfTree p252]

— defun pfAnd —

```
(defun |pfAnd| (pflleft pfright)
  (|pfTree| '|And| (list pflleft pfright)))
```

defun pfAttribute

[pfTree p252]

— defun pfAttribute —

```
(defun |pfAttribute| (pfexpr)
  (|pfTree| '|Attribute| (list pfexpr)))
```

defun Return an Application node

[pfTree p252]

— defun pfApplication —

```
(defun |pfApplication| (pfop pfarg)
  (|pfTree| '|Application| (list pfop pfarg)))
```

defun Return the Arg part of an Application node

— defun pfApplicationArg 0 —

```
(defun |pfApplicationArg| (pf)
  (caddr pf))
```

—————

defun Return the Op part of an Application node

— defun pfApplicationOp 0 —

```
(defun |pfApplicationOp| (pf)
  (cadr pf))
```

—————

defun Is this an And node?

[pfAbSynOp? p⁴¹²]

— defun pfAnd? —

```
(defun |pfAnd?| (pf)
  (|pfAbSynOp?| pf '|And|))
```

—————

defun Return the Left part of an And node

— defun pfAndLeft 0 —

```
(defun |pfAndLeft| (pf)
  (cadr pf))
```

—————

defun Return the Right part of an And node

— defun pfAndRight 0 —

```
(defun |pfAndRight| (pf)
  (caddr pf))
```

—————

defun Flatten a list of lists

— defun pfAppend 0 —

```
(defun |pfAppend| (list)
  (apply #'append list))
```

—————

defun Is this an Application node?

[pfAbSynOp? p412]

— defun pfApplication? —

```
(defun |pfApplication?| (pf)
  (|pfAbSynOp?| pf '|Application|))
```

—————

defun Create an Assign node

[pfTree p252]

— defun pfAssign —

```
(defun |pfAssign| (pflhsitems pfrhs)
  (|pfTree| '|Assign| (list pflhsitems pfrhs)))
```

—————

defun Is this an Assign node?

[pfAbSynOp? p412]

— defun pfAssign? —

```
(defun |pfAssign?| (pf)
  (|pfAbSynOp?| pf '|Assign|))
```

—————

defun Return the parts of an LhsItem of an Assign node

[pfParts p249]

[pfAssignLhsItems p256]

— defun pf0AssignLhsItems 0 —

```
(defun |pf0AssignLhsItems| (pf)
  (|pfParts| (|pfAssignLhsItems| pf)))
```

—————

defun Return the LhsItem of an Assign node

— defun pfAssignLhsItems 0 —

```
(defun |pfAssignLhsItems| (pf)
  (cadr pf))
```

—————

defun Return the RHS of an Assign node

— defun pfAssignRhs 0 —

```
(defun |pfAssignRhs| (pf)
  (caddr pf))
```

—————

defun Construct an application node for a brace

```
[pfApplication p253]
[pfIdPos p246]
[tokPosn p413]
```

— defun pfBrace —

```
(defun |pfBrace| (a part)
  (|pfApplication| (|pfIdPos| '{' (|tokPosn| a)) part))
```

—————

defun Construct an Application node for brace-bars

```
[pfApplication p253]
[pfIdPos p246]
[tokPosn p413]
```

— defun pfBraceBar —

```
(defun |pfBraceBar| (a part)
  (|pfApplication| (|pfIdPos| '{\| \|}' (|tokPosn| a)) part))
```

—————

defun Construct an Application node for a bracket

```
[pfApplication p253]
[pfIdPos p246]
[tokPosn p413]
```

— defun pfBracket —

```
(defun |pfBracket| (a part)
  (|pfApplication| (|pfIdPos| '[' (|tokPosn| a)) part))
```

—————

defun Construct an Application node for bracket-bars

```
[pfApplication p253]
[pfIdPos p246]
```

[tokPosn p[413](#)]

— defun pfBracketBar —

```
(defun |pfBracketBar| (a part)
  (|pfApplication| (|pfIdPos| '|\|\\|]| (|tokPosn| a)) part))
```

—————

defun Create a Break node

[pfTree p[252](#)]

— defun pfBreak —

```
(defun |pfBreak| (pffrom)
  (|pfTree| '|Break| (list pffrom)))
```

—————

defun Is this a Break node?

[pfAbSynOp? p[412](#)]

— defun pfBreak? —

```
(defun |pfBreak?| (pf)
  (|pfAbSynOp?| pf '|Break|))
```

—————

defun Return the From part of a Break node

— defun pfBreakFrom 0 —

```
(defun |pfBreakFrom| (pf)
  (cadr pf))
```

—————

defun Construct a Coerceto node[pfTree p[252](#)]

— defun pfCoerceto —

```
(defun |pfCoerceto| (pfexpr pftype)
  (|pfTree| '|Coerceto| (list pfexpr pftype)))
```

defun Is this a CoerceTo node?[pfAbSynOp? p[412](#)]

— defun pfCoerceto? —

```
(defun |pfCoerceto?| (pf)
  (|pfAbSynOp?| pf '|Coerceto|))
```

defun Return the Expression part of a CoerceTo node

— defun pfCoercetoExpr 0 —

```
(defun |pfCoercetoExpr| (pf)
  (cadr pf))
```

defun Return the Type part of a CoerceTo node

— defun pfCoercetoType 0 —

```
(defun |pfCoercetoType| (pf)
  (caddr pf))
```

defun Return the Body of a Collect node

— defun pfCollectBody 0 —

```
(defun |pfCollectBody| (pf)
  (cadr pf))
```

—————

defun Return the Iterators of a Collect node

— defun pfCollectIterators 0 —

```
(defun |pfCollectIterators| (pf)
  (caddr pf))
```

—————

defun Create a Collect node

[pfTree p252]

— defun pfCollect —

```
(defun |pfCollect| (pfbody pfiterators)
  (|pfTree| '|Collect| (list pfbody pfiterators)))
```

—————

defun Is this a Collect node?

[pfAbSynOp? p412]

— defun pfCollect? —

```
(defun |pfCollect?| (pf)
  (|pfAbSynOp?| pf '|Collect|))
```

—————

defun pfDefinition[pfTree p[252](#)]

— defun pfDefinition —

```
(defun |pfDefinition| (pflhsitems pfrhs)
  (|pfTree| '|Definition| (list pflhsitems pfrhs)))
```

—————

defun Return the Lhs of a Definition node

— defun pfDefinitionLhsItems 0 —

```
(defun |pfDefinitionLhsItems| (pf)
  (cadr pf))
```

—————

defun Return the Rhs of a Definition node

— defun pfDefinitionRhs 0 —

```
(defun |pfDefinitionRhs| (pf)
  (caddr pf))
```

—————

defun Is this a Definition node?[pfAbSynOp? p[412](#)]

— defun pfDefinition? —

```
(defun |pfDefinition?| (pf)
  (|pfAbSynOp?| pf '|Definition|))
```

—————

defun Return the parts of a Definition node

```
[pfParts p249]
[pfDefinitionLhsItems p261]

— defun pf0DefinitionLhsItems —

(defun |pf0DefinitionLhsItems| (pf)
  (|pfParts| (|pfDefinitionLhsItems| pf)))
```

defun Create a Do node

```
[pfTree p252]

— defun pfDo —

(defun |pfDo| (pfbody)
  (|pfTree| '|Do| (list pfbody)))
```

defun Is this a Do node?

```
[pfAbSynOp? p412]

— defun pfDo? —

(defun |pfDo?| (pf)
  (|pfAbSynOp?| pf '|Do|))
```

defun Return the Body of a Do node

```
— defun pfDoBody 0 —

(defun |pfDoBody| (pf)
  (cadr pf))
```

defun Construct a Sequence node

[pfTuple p292]
 [pfListOf p245]
 [pfSequence p287]

— defun pfEnSequence —

```
(defun |pfEnSequence| (a)
  (cond
    ((null a) (|pfTuple| (|pfListOf| a)))
    ((null (cdr a)) (car a))
    (t (|pfSequence| (|pfListOf| a)))))
```

—————

defun Construct an Exit node

[pfTree p252]

— defun pfExit —

```
(defun |pfExit| (pfcond pfexpr)
  (|pfTree| '|Exit| (list pfcond pfexpr)))
```

—————

defun Is this an Exit node?

[pfAbSynOp? p412]

— defun pfExit? —

```
(defun |pfExit?| (pf)
  (|pfAbSynOp?| pf '|Exit|))
```

—————

defun Return the Cond part of an Exit

— defun pfExitCond 0 —


```
(defun |pfExitCond| (pf)
  (cadr pf))
```

—————

defun Return the Expression part of an Exit

— defun pfExitExpr 0 —

```
(defun |pfExitExpr| (pf)
  (caddr pf))
```

—————

defun Create an Export node

[pfTree p252]

— defun pfExport —

```
(defun |pfExport| (pfitems)
  (|pfTree| '|Export| (list pfitems)))
```

—————

defun Construct an Expression leaf node

[pfLeaf p247]

[ifcar p??]

— defun pfExpression —

```
(defun |pfExpression| (expr &rest optpos)
  (|pfLeaf| '|expression| expr (ifcar optpos)))
```

—————

defun pfFirst

— defun pfFirst 0 —

```
(defun |pfFirst| (form)
  (cadr form))
```

defun Create an Application Fix node

[pfApplication p253]
[pfId p246]

— defun pfFix —

```
(defun |pfFix| (pf)
  (|pfApplication| (|pfId| 'Y) pf))
```

defun Create a Free node

[pfTree p252]

— defun pfFree —

```
(defun |pfFree| (pfitems)
  (|pfTree| '|Free| (list pfitems)))
```

defun Is this a Free node?

[pfAbSynOp? p412]

— defun pfFree? —

```
(defun |pfFree?| (pf)
  (|pfAbSynOp?| pf '|Free|))
```

defun Return the parts of the Items of a Free node

```
[pfParts p249]
[pfFreeItems p266]

— defun pf0FreeItems —

(defun |pf0FreeItems| (pf)
  (|pfParts| (|pfFreeItems| pf)))
```

defun Return the Items of a Free node

```
— defun pfFreeItems 0 —

(defun |pfFreeItems| (pf)
  (cadr pf))
```

defun Construct a Forin node

```
[pfTree p252]

— defun pfForin —

(defun |pfForin| (pflhs pfwhole)
  (|pfTree| '|Forin| (list pflhs pfwhole)))
```

defun Is this a ForIn node?

```
[pfAbSynOp? p412]

— defun pfForin? —

(defun |pfForin?| (pf)
  (|pfAbSynOp?| pf '|Forin|))
```

defun Return all the parts of the LHS of a ForIn node

```
[pfParts p249]
[pfForinLhs p267]

— defun pf0ForinLhs —

(defun |pf0ForinLhs| (pf)
  (|pfParts| (|pfForinLhs| pf)))
```

defun Return the LHS part of a ForIn node

```
— defun pfForinLhs 0 —

(defun |pfForinLhs| (pf)
  (cadr pf))
```

defun Return the Whole part of a ForIn node

```
— defun pfForinWhole 0 —

(defun |pfForinWhole| (pf)
  (caddr pf))
```

defun pfFromDom

```
[pfApplication? p255]
[pfApplication p253]
[pfApplicationOp p254]
[pfApplicationArg p254]
[pfFromdom p268]

— defun pfFromDom —
```

```
(defun |pfFromDom| (dom expr)
  (cond
    ((|pfApplication?| expr)
     (|pfApplication|
      (|pfFromDom| (|pfApplicationOp| expr) dom)
      (|pfApplicationArg| expr)))
    (t (|pfFromDom| expr dom))))
```

defun Construct a Fromdom node

[pfTree p252]

— defun pfFromdom —

```
(defun |pfFromdom| (pfwhat pfdomain)
  (|pfTree| '|Fromdom| (list pfwhat pfdomain)))
```

defun Is this a Fromdom mode?

[pfAbSynOp? p412]

— defun pfFromdom? —

```
(defun |pfFromdom?| (pf)
  (|pfAbSynOp?| pf '|Fromdom|))
```

defun Return the What part of a Fromdom node

— defun pfFromdomWhat 0 —

```
(defun |pfFromdomWhat| (pf)
  (cadr pf))
```

defun Return the Domain part of a Fromdom node

```

— defun pfFromdomDomain 0 —

(defun |pfFromdomDomain| (pf)
  (caddr pf))

```

defun Construct a Hide node

```

[|pfTree| p252]

— defun pfHide —

(defun |pfHide| (a part)
  (declare (ignore a))
  (|pfTree| '|Hide| (list part)))

```

defun pfIf

```

[|pfTree| p252]

— defun pfIf —

(defun |pfIf| (pfcond pfthen pfelse)
  (|pfTree| '|If| (list pfcond pfthen pfelse)))

```

defun Is this an If node?

```

[|pfAbSynOp?| p412]

— defun pfIf? —

(defun |pfIf?| (pf)
  (|pfAbSynOp?| pf '|If|))

```

defun Return the Cond part of an If

— defun pfIfCond 0 —

```
(defun |pfIfCond| (pf)
  (cadr pf))
```

—————

defun Return the Then part of an If

— defun pfIfThen 0 —

```
(defun |pfIfThen| (pf)
  (caddr pf))
```

—————

defun pfIfThenOnly

```
[pfIf p269]
[pfNothing p245]
```

— defun pfIfThenOnly —

```
(defun |pfIfThenOnly| (pred cararg)
  (|pfIf| pred cararg (|pfNothing|)))
```

—————

defun Return the Else part of an If

— defun pfIfElse 0 —

```
(defun |pfIfElse| (pf)
  (caddr pf))
```

—————

defun Construct an Import node

[pfTree p252]

— defun pfImport —

```
(defun |pfImport| (pfitems)
  (|pfTree| '|Import| (list pfitems)))
```

—————

defun Construct an Iterate node

[pfTree p252]

— defun pfIterate —

```
(defun |pfIterate| (pffrom)
  (|pfTree| '|Iterate| (list pffrom)))
```

—————

defun Is this an Iterate node?

[pfAbSynOp? p412]

— defun pfIterate? —

```
(defun |pfIterate?| (pf)
  (|pfAbSynOp?| pf '|Iterate|))
```

—————

defun Handle an infix application

[pfListOf p245]

[pfIdSymbol p247]

[pfAnd p253]

[pfOr p280]

[pfApplication p253]

[pfTuple p292]

— defun pfInfApplication —


```
(defun |pfInfApplication| (op left right)
  (cond
    ((eq (|pfIdSymbol| op) '|and|) (|pfAnd| left right))
    ((eq (|pfIdSymbol| op) '|or|) (|pfOr| left right))
    (t (|pfApplication| op (|pfTuple| (|pfListOf| (list left right)))))))
```

defun Create an Inline node

[pfTree p252]

— defun pfInline —

```
(defun |pfInline| (pfitems)
  (|pfTree| '|Inline| (list pfitems)))
```

defun pfLam

[pfAbSynOp? p412]
 [pfFirst p264]
 [pfNothing p245]
 [pfSecond p286]
 [pfLambda p273]

— defun pfLam —

```
(defun |pfLam| (variable body)
  (let (bdy rets)
    (if (|pfAbSynOp?| body '|returntyped|)
        (setq rets (|pfFirst| body))
        (setq rets (|pfNothing|)))
    (if (|pfAbSynOp?| body '|returntyped|)
        (setq bdy (|pfSecond| body))
        (setq bdy body))
    (|pfLambda| variable rets bdy)))
```

defun pfLambda

[pfTree p252]

— defun pfLambda —

```
(defun |pfLambda| (pfargs pfrets pfbody)
  (|pfTree| '|Lambda| (list pfargs pfrets pfbody)))
```

—————

defun Return the Body part of a Lambda node

— defun pfLambdaBody 0 —

```
(defun |pfLambdaBody| (pf)
  (caddr pf))
```

—————

defun Return the Rets part of a Lambda node

— defun pfLambdaRets 0 —

```
(defun |pfLambdaRets| (pf)
  (caddr pf))
```

—————

defun Is this a Lambda node?

[pfAbSynOp? p412]

— defun pfLambda? —

```
(defun |pfLambda?| (pf)
  (|pfAbSynOp?| pf '|Lambda|))
```

—————

defun Return the Args part of a Lambda node

```

— defun pfLambdaArgs 0 —

(defun |pfLambdaArgs| (pf)
  (cadr pf))

```

defun Return the Args of a Lambda Node

```

[|pfParts| p249]
[|pfLambdaArgs| p274]

— defun pf0LambdaArgs —

(defun |pf0LambdaArgs| (pf)
  (|pfParts| (|pfLambdaArgs| pf)))

```

defun Construct a Local node

```

[|pfTree| p252]

— defun pfLocal —

(defun |pfLocal| (pfitems)
  (|pfTree| '|Local| (list pfitems)))

```

defun Is this a Local node?

```

[|pfAbSynOp?| p412]

— defun pfLocal? —

(defun |pfLocal?| (pf)
  (|pfAbSynOp?| pf '|Local|))

```

defun Return the parts of Items of a Local node

```
[pfParts p249]
[pfLocalItems p275]

— defun pf0LocalItems —

(defun |pf0LocalItems| (pf)
  (|pfParts| (|pfLocalItems| pf)))
```

defun Return the Items of a Local node

```
— defun pfLocalItems 0 —

(defun |pfLocalItems| (pf)
  (cadr pf))
```

defun Construct a Loop node

```
[pfTree p252]

— defun pfLoop —

(defun |pfLoop| (pfiterators)
  (|pfTree| '|Loop| (list pfiterators)))
```

defun pfLoop1

```
[pfLoop p275]
[pfListOf p245]
[pfDo p262]

— defun pfLoop1 —

(defun |pfLoop1| (body)
  (|pfLoop| (|pfListOf| (list (|pfDo| body))))))
```

defun Is this a Loop node?

[pfAbSynOp? p[412](#)]

— defun pfLoop? —

```
(defun |pfLoop?| (pf)
  (|pfAbSynOp?| pf ' |Loop|))
```

defun Return the Iterators of a Loop node

— defun pfLoopIterators 0 —

```
(defun |pfLoopIterators| (pf)
  (cadr pf))
```

defun pf0LoopIterators

[pfParts p[249](#)]

[pf0LoopIterators p[276](#)]

— defun pf0LoopIterators —

```
(defun |pf0LoopIterators| (pf)
  (|pfParts| (|pfLoopIterators| pf)))
```

defun pfLp

[pfLoop p[275](#)]

[pfListOf p[245](#)]

[pfDo p[262](#)]

— defun pfLp —

```
(defun |pfLp| (iterators body)
  (|pfLoop| (|pfListOf| (append iterators (list (|pfDo| body))))))
```

defun Create a Macro node

[pfTree p252]

```
— defun pfMacro —

(defun |pfMacro| (pflhs pfrhs)
  (|pfTree| '|Macro| (list pflhs pfrhs)))
```

defun Is this a Macro node?

[pfAbSynOp? p412]

```
— defun pfMacro? —

(defun |pfMacro?| (pf)
  (|pfAbSynOp?| pf '|Macro|))
```

defun Return the Lhs of a Macro node

```
— defun pfMacroLhs 0 —

(defun |pfMacroLhs| (pf)
  (cadr pf))
```

defun Return the Rhs of a Macro node

```
— defun pfMacroRhs 0 —
```

```
(defun |pfMacroRhs| (pf)
  (caddr pf))
```

—————

defun Construct an MLambda node

[pfTree p252]

— defun pfMLambda —

```
(defun |pfMLambda| (pfargs pbody)
  (|pfTree| 'MLambda (list pfargs pbody)))
```

—————

defun Is this an MLambda node?

[pfAbSynOp? p412]

— defun pfMLambda? —

```
(defun |pfMLambda?| (pf)
  (|pfAbSynOp?| pf 'MLambda))
```

—————

defun Return the Args of an MLambda

— defun pfMLambdaArgs 0 —

```
(defun |pfMLambdaArgs| (pf)
  (cadr pf))
```

—————

defun Return the parts of an MLambda argument

[pfParts p249]

— defun pf0MLambdaArgs —

```
(defun |pf0MLambdaArgs| (pf)
  (|pfParts| (|pfMLambdaArgs| pf)))
```

defun pfMLambdaBody

— defun pfMLambdaBody 0 —

```
(defun |pfMLambdaBody| (pf)
  (caddr pf))
```

defun Is this a Not node?

[pfAbSynOp? p412]

— defun pfNot? —

```
(defun |pfNot?| (pf)
  (|pfAbSynOp?| pf ' |Not|))
```

defun Return the Arg part of a Not node

— defun pfNotArg 0 —

```
(defun |pfNotArg| (pf)
  (cadr pf))
```

defun Construct a NoValue node

[pfTree p252]

— defun pfNovalue —


```
(defun |pfNovalue| (pfexpr)
  (|pfTree| '|Novalue| (list pfexpr)))
```

—————→

defun Is this a Novalue node?

[pfAbSynOp? p412]

— defun pfNovalue? —

```
(defun |pfNovalue?| (pf)
  (|pfAbSynOp?| pf '|Novalue|))
```

—————→

defun Return the Expr part of a Novalue node

— defun pfNovalueExpr 0 —

```
(defun |pfNovalueExpr| (pf)
  (cadr pf))
```

—————→

defun Construct an Or node

[pfTree p252]

— defun pfOr —

```
(defun |pfOr| (pfleft pfright)
  (|pfTree| '|Or| (list pfleft pfright)))
```

—————→

defun Is this an Or node?

[pfAbSynOp? p412]

— defun pfOr? —

```
(defun |pfOr?| (pf)
  (|pfAbSynOp?| pf '|Or|))
```

defun Return the Left part of an Or node

— defun pfOrLeft 0 —

```
(defun |pfOrLeft| (pf)
  (cadr pf))
```

defun Return the Right part of an Or node

— defun pfOrRight 0 —

```
(defun |pfOrRight| (pf)
  (caddr pf))
```

defun Return the part of a parenthesised expression

— defun pfParen —

```
(defun |pfParen| (a part)
  (declare (ignore a))
  part)
```

defun pfPretend

[pfTree p252]

— defun pfPretend —

```
(defun |pfPretend| (pfexpr pftype)
  (|pfTree| '|Pretend| (list pfexpr pftype)))
```

defun Is this a Pretend node?

[pfAbSynOp? p[412](#)]

— defun pfPretend? —

```
(defun |pfPretend?| (pf)
  (|pfAbSynOp?| pf '|Pretend|))
```

defun Return the Expression part of a Pretend node

— defun pfPretendExpr 0 —

```
(defun |pfPretendExpr| (pf)
  (cadr pf))
```

defun Return the Type part of a Pretend node

— defun pfPretendType 0 —

```
(defun |pfPretendType| (pf)
  (caddr pf))
```

defun Construct a QualType node

[pfTree p[252](#)]

— defun pfQualType —

```
(defun |pfQualType| (pftype pfqual)
  (|pfTree| '|QualType| (list pftype pfqual)))
```

defun Construct a Restrict node

[pfTree p252]

```
— defun pfRestrict —

(defun |pfRestrict| (pfexpr pftype)
  (|pfTree| '|Restrict| (list pfexpr pftype)))
```

defun Is this a Restrict node?

[pfAbSynOp? p412]

```
— defun pfRestrict? —

(defun |pfRestrict?| (pf)
  (|pfAbSynOp?| pf '|Restrict|))
```

defun Return the Expr part of a Restrict node

```
— defun pfRestrictExpr 0 —

(defun |pfRestrictExpr| (pf)
  (cadr pf))
```

defun Return the Type part of a Restrict node

```
— defun pfRestrictType 0 —
```

```
(defun |pfRestrictType| (pf)
  (caddr pf))
```

defun Construct a RetractTo node

[pfTree p252]

— defun pfRetractTo —

```
(defun |pfRetractTo| (pfexpr pftype)
  (|pfTree| '|RetractTo| (list pfexpr pftype)))
```

defun Construct a Return node

[pfTree p252]

— defun pfReturn —

```
(defun |pfReturn| (pfexpr pffrom)
  (|pfTree| '|Return| (list pfexpr pffrom)))
```

defun Is this a Return node?

[pfAbSynOp? p412]

— defun pfReturn? —

```
(defun |pfReturn?| (pf)
  (|pfAbSynOp?| pf '|Return|))
```

defun Return the Expr part of a Return node

— defun pfReturnExpr 0 —

```
(defun |pfReturnExpr| (pf)
  (cadr pf))
```

defun pfReturnNoName

[pfReturn p284]
[pfNothing p245]

— defun pfReturnNoName —

```
(defun |pfReturnNoName| (|value|)
  (|pfReturn| |value| (|pfNothing|)))
```

defun Construct a ReturnTyped node

[pfTree p252]

— defun pfReturnTyped —

```
(defun |pfReturnTyped| (type body)
  (|pfTree| '|returntyped| (list type body)))
```

defun Construct a Rule node

[pfTree p252]

— defun pfRule —

```
(defun |pfRule| (pflhsitems pfrhs)
  (|pfTree| '|Rule| (list pflhsitems pfrhs)))
```

defun Return the Lhs of a Rule node

```

— defun pfRuleLhsItems 0 —

(defun |pfRuleLhsItems| (pf)
  (cadr pf))

```

defun Return the Rhs of a Rule node

```

— defun pfRuleRhs 0 —

(defun |pfRuleRhs| (pf)
  (caddr pf))

```

defun Is this a Rule node?

```

[|pfAbSynOp?| p412]

— defun pfRule? —

(defun |pfRule?| (pf)
  (|pfAbSynOp?| pf '|Rule|))

```

defun pfSecond

```

— defun pfSecond 0 —

(defun |pfSecond| (form)
  (caddr form))

```

defun Construct a Sequence node

[pfTree p252]

— defun pfSequence —

```
(defun |pfSequence| (pfargs)
  (|pfTree| ' |Sequence| (list pfargs)))
```

—————

defun Return the Args of a Sequence node

— defun pfSequenceArgs 0 —

```
(defun |pfSequenceArgs| (pf)
  (cadr pf))
```

—————

defun Is this a Sequence node?

[pfAbSynOp? p412]

— defun pfSequence? —

```
(defun |pfSequence?| (pf)
  (|pfAbSynOp?| pf ' |Sequence|))
```

—————

defun Return the parts of the Args of a Sequence node

[pfParts p249]

[pfSequenceArgs p287]

— defun pf0SequenceArgs —

```
(defun |pf0SequenceArgs| (pf)
  (|pfParts| (|pfSequenceArgs| pf)))
```

—————

defun Create a Suchthat node

[pfTree p252]

— defun pfSuchthat —

```
(defun |pfSuchthat| (pfcond)
  (|pfTree| '|Suchthat| (list pfcond)))
```

—————

defun Is this a SuchThat node?

[pfAbSynOp? p412]

— defun pfSuchthat? —

```
(defun |pfSuchthat?| (pf)
  (|pfAbSynOp?| pf '|Suchthat|))
```

—————

defun Return the Cond part of a SuchThat node

— defun pfSuchthatCond 0 —

```
(defun |pfSuchthatCond| (pf)
  (cadr pf))
```

—————

defun Create a Tagged node

[pfTree p252]

— defun pfTagged —

```
(defun |pfTagged| (pftag pfexpr)
  (|pfTree| '|Tagged| (list pftag pfexpr)))
```

—————

defun Is this a Tagged node?

[pfAbSynOp? p412]

— defun pfTagged? —

```
(defun |pfTagged?| (pf)
  (|pfAbSynOp?| pf '|Tagged|))
```

—————

defun Return the Expression portion of a Tagged node

— defun pfTaggedExpr 0 —

```
(defun |pfTaggedExpr| (pf)
  (caddr pf))
```

—————

defun Return the Tag of a Tagged node

— defun pfTaggedTag 0 —

```
(defun |pfTaggedTag| (pf)
  (cadr pf))
```

—————

defun pfTaggedToTyped

```
[pfTagged? p289]
[pfTaggedExpr p289]
[pfNothing p245]
[pfTaggedTag p289]
[pfId? p246]
[pfId p246]
[pfTyped p290]
[pfSuch p244]
[pfInfApplication p271]
```

— defun pfTaggedToTyped —

```
(defun |pfTaggedToTyped| (arg)
  (let (a form rt)
    (if (|pfTagged?| arg)
        (setq rt (|pfTaggedExpr| arg))
        (setq rt (|pfNothing|)))
    (if (|pfTagged?| arg)
        (setq form (|pfTaggedTag| arg))
        (setq form arg))
    (cond
     ((null (|pfId?| form))
      (setq a (|pfId| (gensym)))
      (|pfTyped| (|pfSuch| a (|pfInfApplication| (|pfId| '=) a form)) rt))
     (t (|pfTyped| form rt)))))
```

—————

defun pfTweakIf

[pfIfElse p270]
 [pfNothing? p245]
 [pfListOf p245]
 [pfTree p252]
 [pfIfCond p270]
 [pfIfThen p270]

— defun pfTweakIf —

```
(defun |pfTweakIf| (form)
  (let (b a)
    (setq a (|pfIfElse| form))
    (setq b (if (|pfNothing?| a) (|pfListOf| NIL) a))
    (|pfTree| '|WIf| (list (|pfIfCond| form) (|pfIfThen| form) b))))
```

—————

defun Construct a Typed node

[pfTree p252]

— defun pfTyped —

```
(defun |pfTyped| (pfid pftype)
```

```
(|pfTree| ' |Typed| (list pfid pftype)))
```

defun Is this a Typed node?

[pfAbSynOp? p412]

— defun pfTyped? —

```
(defun |pfTyped?| (pf)
  (|pfAbSynOp?| pf ' |Typed|))
```

defun Return the Type of a Typed node

— defun pfTypedType 0 —

```
(defun |pfTypedType| (pf)
  (caddr pf))
```

defun Return the Id of a Typed node

— defun pfTypedId 0 —

```
(defun |pfTypedId| (pf)
  (cadr pf))
```

defun Construct a Typing node

[pfTree p252]

— defun pfTyping —

```
(defun |pfTyping| (pfitems)
  (|pfTree| '|Typing| (list pfitems)))
```

defun Return a Tuple node

[pfTree p252]

— defun pfTuple —

```
(defun |pfTuple| (pfparts)
  (|pfTree| '|Tuple| (list pfparts)))
```

defun Return a Tuple from a List

[pfTuple p292]

[pfListOf p245]

— defun pfTupleListOf —

```
(defun |pfTupleListOf| (pfparts)
  (|pfTuple| (|pfListOf| pfparts)))
```

defun Is this a Tuple node?

[pfAbSynOp? p412]

— defun pfTuple? —

```
(defun |pfTuple?| (pf)
  (|pfAbSynOp?| pf '|Tuple|))
```

defun Return the Parts of a Tuple node

— defun pfTupleParts 0 —

```
(defun |pfTupleParts| (pf)
  (cadr pf))
```

—————

defun Return the parts of a Tuple

```
[pfParts p249]
[pfTupleParts p293]
```

— defun pf0TupleParts —

```
(defun |pf0TupleParts| (pf)
  (|pfParts| (|pfTupleParts| pf)))
```

—————

defun Return a list from a Sequence node

```
[pfSequence? p287]
[pfAppend p255]
[pf0SequenceArgs p287]
[pfListOf p245]
```

— defun pfUnSequence —

```
(defun |pfUnSequence| (x)
  (if (|pfSequence?| x)
      (|pfListOf| (|pfAppend| (|pf0SequenceArgs| x)))
      (|pfListOf| x)))
```

—————

defun The comment is attached to all signatutres

```
[pfWDeclare p294]
[pfParts p249]
```

— defun pfWDec —

```
(defun |pfWDec| (doc name)
  (mapcar #'(lambda (i) (|pfWDeclare| i doc)) (|pfParts| name)))
```

—————→

defun Construct a WDeclare node

[pfTree p252]

— defun pfWDeclare —

```
(defun |pfWDeclare| (pfsignature pfdoc)
  (|pfTree| '|WDeclare| (list pfsignature pfdoc)))
```

—————→

defun Construct a Where node

[pfTree p252]

— defun pfWhere —

```
(defun |pfWhere| (pfcontext pfexpr)
  (|pfTree| '|Where| (list pfcontext pfexpr)))
```

—————→

defun Is this a Where node?

[pfAbSynOp? p412]

— defun pfWhere? —

```
(defun |pfWhere?| (pf)
  (|pfAbSynOp?| pf '|Where|))
```

—————→

defun Return the parts of the Context of a Where node

```
[pfParts p249]
[pfWhereContext p295]

— defun pf0WhereContext —

(defun |pf0WhereContext| (pf)
  (|pfParts| (|pfWhereContext| pf)))
```

defun Return the Context of a Where node

```
— defun pfWhereContext 0 —

(defun |pfWhereContext| (pf)
  (cadr pf))
```

defun Return the Expr part of a Where node

```
— defun pfWhereExpr 0 —

(defun |pfWhereExpr| (pf)
  (caddr pf))
```

defun Construct a While node

```
[pfTree p252]

— defun pfWhile —

(defun |pfWhile| (pfcond)
  (|pfTree| '|While| (list pfcond)))
```

defun Is this a While node?

[pfAbSynOp? p412]

— defun pfWhile? —

```
(defun |pfWhile?| (pf)
  (|pfAbSynOp?| pf '|While|))
```

—————

defun Return the Cond part of a While node

— defun pfWhileCond 0 —

```
(defun |pfWhileCond| (pf)
  (cadr pf))
```

—————

defun Construct a With node

[pfTree p252]

— defun pfWith —

```
(defun |pfWith| (pfbase pfwithin pfwithon)
  (|pfTree| '|With| (list pfbase pfwithin pfwithon)))
```

—————

defun Create a Wrong node

[pfTree p252]

— defun pfWrong —

```
(defun |pfWrong| (pfwhy pfrubble)
  (|pfTree| '|Wrong| (list pfwhy pfrubble)))
```

—————

defun Is this a Wrong node?

[pfAbSynOp? p[412](#)]

— defun pfWrong? —

```
(defun |pfWrong?| (pf)
  (|pfAbSynOp?| pf 'Wrong!))
```

—————

Chapter 8

Pftree to s-expression translation

Pftree to s-expression translation. Used to interface the new parser technology to the interpreter. The input is a parseTree and the output is an old-parser-style s-expression.

defun Pftree to s-expression translation

```
[pf2Sex1 p300]  
[$insideSEQ p??]  
[$insideApplication p??]  
[$insideRule p??]  
[$QuietCommand p45]
```

— defun pf2Sex —

```
(defun |pf2Sex| (pf)  
  (let (|$insideSEQ| |$insideApplication| |$insideRule|)  
    (declare (special |$insideSEQ| |$insideApplication| |$insideRule|  
                      |$QuietCommand|))  
    (setq |$QuietCommand| nil)  
    (setq |$insideRule| nil)  
    (setq |$insideApplication| nil)  
    (setq |$insideSEQ| nil)  
    (|pf2Sex1| pf)))
```

—————

defun Pftree to s-expression translation inner function

```

[pfNothing? p245]
[pfSymbol? p252]
[pfSymbolSymbol p252]
[pfLiteral? p248]
[pfLiteral2Sex p304]
[pfIdSymbol p247]
[pfApplication? p255]
[pfApplication2Sex p305]
[pfTuple? p292]
[pf2Sex1 p300]
[pf0TupleParts p293]
[pfIf? p269]
[pfIfCond p270]
[pfIfThen p270]
[pfIfElse p270]
[pfTagged? p289]
[pfTaggedTag p289]
[pfTaggedExpr p289]
[pfCoerceto? p259]
[pfCoercetoExpr p259]
[pfCoercetoType p259]
[pfPretend? p282]
[pfPretendExpr p282]
[pfPretendType p282]
[pfFromdom? p268]
[opTran p323]
[pfFromdomWhat p268]
[pfFromdomDomain p269]
[pfSequence? p287]
[pfSequence2Sex p310]
[pfExit? p263]
[pfExitCond p263]
[pfExitExpr p264]
[pfLoop? p276]
[loopIters2Sex p311]
[pf0LoopIterators p276]
[pfCollect? p260]
[pfCollect2Sex p314]
[pfForin? p266]
[pf0ForinLhs p267]
[pfForinWhole p267]
[pfWhile? p296]
[pfWhileCond p296]
[pfSuchthat? p288]

```

[keyedSystemError p??]
 [pfSuchthatCond p288]
 [pfDo? p262]
 [pfDoBody p262]
 [pfTyped? p291]
 [pfTypedType p291]
 [pfTypedId p291]
 [pfAssign? p256]
 [pf0AssignLhsItems p256]
 [pfAssignRhs p256]
 [pfDefinition? p261]
 [pfDefinition2Sex p315]
 [pfLambda? p273]
 [pfLambda2Sex p317]
 [pfMLambda? p278]
 [pfRestrict? p283]
 [pfRestrictExpr p283]
 [pfRestrictType p283]
 [pfFree? p265]
 [pf0FreeItems p266]
 [pfLocal? p274]
 [pf0LocalItems p275]
 [pfWrong? p297]
 [spadThrow p??]
 [pfAnd? p254]
 [pfAndLeft p254]
 [pfAndRight p255]
 [pfOr? p280]
 [pfOrLeft p281]
 [pfOrRight p281]
 [pfNot? p279]
 [pfNotArg p279]
 [pfNovalue? p280]
 [pfNovalueExpr p280]
 [pfRule? p286]
 [pfRule2Sex p318]
 [pfBreak? p258]
 [pfBreakFrom p258]
 [pfMacro? p277]
 [pfReturn? p284]
 [pfReturnExpr p284]
 [pfIterate? p271]
 [pfWhere? p294]
 [pf0WhereContext p295]
 [pfWhereExpr p295]
 [pfAbSynOp p412]

[tokPart p413]
 [\$insideSEQ p??]
 [\$insideRule p??]
 [\$QuietCommand p45]

— defun pf2Sex1 —

```
(defun |pf2Sex1| (pf)
  (let (args idList type op tagPart tag s)
    (declare (special |$insideSEQ| |$insideRule| |$QuietCommand|))
    (cond
      ((|pfNothing?| pf) '|noBranch|)
      ((|pfSymbol?| pf)
        (if (eq |$insideRule| '|left|)
          (progn
            (setq s (|pfSymbolSymbol| pf))
            (list '|constant| (list 'quote s)))
          (list 'quote (|pfSymbolSymbol| pf))))
      ((|pfLiteral?| pf) (|pfLiteral2Sex| pf))
      ((|pfId?| pf)
        (if |$insideRule|
          (progn
            (setq s (|pfIdSymbol| pf))
            (if (member s '(|%pi| |%e| |%i|))
              s
              (list 'quote s)))
          (|pfIdSymbol| pf))))
      ((|pfApplication?| pf) (|pfApplication2Sex| pf))
      ((|pfTuple?| pf) (cons '|Tuple| (mapcar #'|pf2Sex1| (|pf0TupleParts| pf)))))
      ((|pfIf?| pf)
        (list 'if (|pf2Sex1| (|pfIfCond| pf))
              (|pf2Sex1| (|pfIfThen| pf))
              (|pf2Sex1| (|pfIfElse| pf)))))
      ((|pfTagged?| pf)
        (setq tag (|pfTaggedTag| pf))
        (setq tagPart
          (if (|pfTuple?| tag)
            (cons '|Tuple| (mapcar #'|pf2Sex1| (|pf0TupleParts| tag)))
            (|pf2Sex1| tag)))
        (list '|:| tagPart (|pf2Sex1| (|pfTaggedExpr| pf)))))
      ((|pfCoerceto?| pf)
        (list '|::| (|pf2Sex1| (|pfCoercetoExpr| pf))
              (|pf2Sex1| (|pfCoercetoType| pf)))))
      ((|pfPretend?| pf)
        (list '|pretend| (|pf2Sex1| (|pfPretendExpr| pf))
              (|pf2Sex1| (|pfPretendType| pf)))))
      ((|pfFromdom?| pf)
        (setq op (|opTran| (|pf2Sex1| (|pfFromdomWhat| pf))))
        (when (eq op '|braceFromCurly|) (setq op 'seq))
```

```

(list '$elt| (|pf2Sex1| (|pfFromdomDomain| pf)) op))
((|pfSequence?| pf) (|pfSequence2Sex| pf))
((|pfExit?| pf)
 (if |$insideSEQ|
  (list 'exit| (|pf2Sex1| (|pfExitCond| pf))
        (|pf2Sex1| (|pfExitExpr| pf)))
  (list 'if (|pf2Sex1| (|pfExitCond| pf))
        (|pf2Sex1| (|pfExitExpr| pf)) 'noBranch|)))
((|pfLoop?| pf) (cons 'repeat (|loopIters2Sex| (|pf0LoopIterators| pf))))
((|pfCollect?| pf) (|pfCollect2Sex| pf))
((|pfForin?| pf)
 (cons 'in
  (append (mapcar #'|pf2Sex1| (|pf0ForinLhs| pf))
    (list (|pf2Sex1| (|pfForinWhole| pf))))))
((|pfWhile?| pf) (list 'while (|pf2Sex1| (|pfWhileCond| pf))))
((|pfSuchthat?| pf)
 (if (eq |$insideRule| 'left|)
  (|keyedSystemError| "S2GE0017" (list "pf2Sex1: pfSuchThat"))
  (list '||| (|pf2Sex1| (|pfSuchthatCond| pf))))))
((|pfDo?| pf) (|pf2Sex1| (|pfDoBody| pf)))
((|pfTyped?| pf)
 (setq type (|pfTypedType| pf))
 (if (|pfNothing?| type)
  (|pf2Sex1| (|pfTypedId| pf))
  (list '|:| (|pf2Sex1| (|pfTypedId| pf)) (|pf2Sex1| (|pfTypedType| pf))))))
((|pfAssign?| pf)
 (setq idList (mapcar #'|pf2Sex1| (|pf0AssignLhsItems| pf)))
 (if (not (eql (length idList) 1))
  (setq idList (cons '|Tuple| idList))
  (setq idList (car idList)))
 (list 'let idList (|pf2Sex1| (|pfAssignRhs| pf))))
((|pfDefinition?| pf) (|pfDefinition2Sex| pf))
((|pfLambda?| pf) (|pfLambda2Sex| pf))
((|pfMLambda?| pf) 'throwAway|)
((|pfRestrict?| pf)
 (list '@ (|pf2Sex1| (|pfRestrictExpr| pf))
        (|pf2Sex1| (|pfRestrictType| pf))))
((|pfFree?| pf) (cons '|free| (mapcar #'|pf2Sex1| (|pf0FreeItems| pf))))
((|pfLocal?| pf) (cons '|local| (mapcar #'|pf2Sex1| (|pf0LocalItems| pf))))
((|pfWrong?| pf) (|spadThrow|))
((|pfAnd?| pf)
 (list '|and| (|pf2Sex1| (|pfAndLeft| pf))
        (|pf2Sex1| (|pfAndRight| pf))))
((|pfOr?| pf)
 (list '|or| (|pf2Sex1| (|pfOrLeft| pf))
        (|pf2Sex1| (|pfOrRight| pf))))
((|pfNot?| pf) (list '|not| (|pf2Sex1| (|pfNotArg| pf))))
((|pfNovalue?| pf)
 (setq |$QuietCommand| t)
 (list 'seq (|pf2Sex1| (|pfNovalueExpr| pf))))

```



```

((|pfRule?| pf) (|pfRule2Sex| pf))
((|pfBreak?| pf) (list '|break| (|pfBreakFrom| pf)))
((|pfMacro?| pf) '|/throwAway|)
((|pfReturn?| pf) (list '|return| (|pf2Sex1| (|pfReturnExpr| pf))))
((|pfIterate?| pf) (list '|iterate|))
((|pfWhere?| pf)
 (setq args (mapcar #'|pf2Sex1| (|pf0WhereContext| pf)))
 (if (eql (length args) 1)
     (cons '|where| (cons (|pf2Sex1| (|pfWhereExpr| pf)) args))
     (list '|where| (|pf2Sex1| (|pfWhereExpr| pf)) (cons 'seq args))))
; -- under strange circumstances/piling, system commands can wind
; -- up in expressions. This just passes it through as a string for
; -- the user to figure out what happened.
((eq (|pfAbSynOp| pf) '|command|) (|tokPart| pf))
(t (|keyedSystemError| "S2GE0017" (list "pf2Sex1"))))

```

defun Convert a Literal to an S-expression

```

[|pfLiteralClass| p248]
[|pfLiteralString| p249]
[|float2Sex| p305]
[|pfSymbolSymbol| p252]
[|pfLeafToken| p248]
[keyedSystemError p??]
[$insideRule p??]

```

— defun pfLiteral2Sex —

```

(defun |pfLiteral2Sex| (pf)
  (let (s type)
    (declare (special |$insideRule|))
    (setq type (|pfLiteralClass| pf))
    (cond
      ((eq type '|integer|) (read-from-string (|pfLiteralString| pf)))
      ((or (eq type '|string|) (eq type '|char|))
       (|pfLiteralString| pf))
      ((eq type '|float|) (|float2Sex| (|pfLiteralString| pf)))
      ((eq type '|symbol|)
       (if |$insideRule|
          (progn
            (setq s (|pfSymbolSymbol| pf))
            (list 'quote s))
          (|pfSymbolSymbol| pf)))
      ((eq type '|expression|) (list 'quote (|pfLeafToken| pf)))
      (t

```

```
(|keyedSystemError| 'S2GE0017 (list "pfLiteral2Sex: unexpected form"))))))
```

defun Convert a float to an S-expression

[[\\$useBFasDefault](#) p??]

— defun float2Sex —

```
(defun |float2Sex| (num)
  (let (exp frac bfForm fracPartString intPart dotIndex expPart mantPart eIndex)
    (declare (special |$useBFasDefault|))
    (setq eIndex (search "e" num))
    (if eIndex
      (setq mantPart (subseq num 0 eIndex))
      (setq mantPart num))
    (if eIndex
      (setq expPart (read-from-string (subseq num (+ eIndex 1))))
      (setq expPart 0))
    (setq dotIndex (search "." mantPart))
    (if dotIndex
      (setq intPart (read-from-string (subseq mantPart 0 dotIndex)))
      (setq intPart (read-from-string mantPart)))
    (if dotIndex
      (setq fracPartString (subseq mantPart (+ dotIndex 1)))
      (setq fracPartString 0))
    (setq bfForm
      (make-float intPart (read-from-string fracPartString)
                  (length fracPartString) expPart))
    (if |$useBFasDefault|
      (progn
        (setq frac (cadr bfForm))
        (setq exp (caddr bfForm))
        (list (list '|$elt| (list '|Float|) '|float|) frac exp 10))
      bfForm)))
```

defun Change an Application node to an S-expression

[[pfOp2Sex](#) p308]

[[pfApplicationOp](#) p254]

[[opTran](#) p323]

[[pf0TupleParts](#) p293]

[pfApplicationArg p254]
 [pfTuple? p292]
 [pf2Sex1 p300]
 [pf2Sex p299]
 [pfSuchThat2Sex p307]
 [hasOptArgs? p309]
 [\$insideApplication p??]
 [\$insideRule p??]

— defun pfApplication2Sex —

```
(defun |pfApplication2Sex| (pf)
  (let (|$insideApplication| x val realOp tmp1 qt argSex typeList args op)
    (declare (special |$insideApplication| |$insideRule|))
    (setq |$insideApplication| t)
    (setq op (|pfOp2Sex| (|pfApplicationOp| pf)))
    (setq op (|opTran| op))
    (cond
      ((eq op '->)
        (setq args (|pf0TupleParts| (|pfApplicationArg| pf)))
        (if (|pfTuple?| (car args))
          (setq typeList (mapcar #'|pf2Sex1| (|pf0TupleParts| (car args))))
          (setq typeList (list (|pf2Sex1| (car args)))))
        (setq args (cons (|pf2Sex1| (cadr args)) typeList))
        (cons '|Mapping| args))
      ((and (eq op '|:|) (eq |$insideRule| '|left|))
        (list '|multiple| (|pf2Sex| (|pfApplicationArg| pf))))
      ((and (eq op '|?|) (eq |$insideRule| '|left|))
        (list '|optional| (|pf2Sex| (|pfApplicationArg| pf))))
      (t
        (setq args (|pfApplicationArg| pf))
        (cond
          ((|pfTuple?| args)
            (if (and (eq op '|\\|') (eq |$insideRule| '|left|))
              (|pfSuchThat2Sex| args)
              (progn
                (setq argSex (cdr (|pf2Sex1| args)))
                (cond
                  ((eq op '>') (list '<' (cadr argSex) (car argSex)))
                  ((eq op '>=') (list '|not| (list '<' (car argSex) (cadr argSex))))
                  ((eq op '<=') (list '|not| (list '<' (cadr argSex) (car argSex))))
                  ((eq op '&') (list '|and| (car argSex) (cadr argSex)))
                  ((eq op '|or|) (list '|or| (car argSex) (cadr argSex)))
                  ((eq op '|Iterate|) (list '|iterate|))
                  ((eq op '|by|) (cons 'by argSex))
                  ((eq op '|braceFromCurly|)
                    (if (and (consp argSex) (eq (car argSex) 'seq))
                      argSex
                      (cons 'seq argSex))))
                (cons 'seq argSex))))
          (t
            (list '|multiple| (|pf2Sex| (|pfApplicationArg| pf))))
        ))
    ))
```

```

((and (consp op)
      (progn
        (setq qt (car op))
        (setq tmp1 (cdr op))
        (and (consp tmp1)
              (eq (cdr tmp1) nil)
              (progn
                (setq realOp (car tmp1))
                t)))
        (eq qt 'quote))
      (cons '|applyQuote| (cons op argSex)))
((setq val (|hasOptArgs?| argSex)) (cons op val))
(t (cons op argSex))))))
((and (consp op)
      (progn
        (setq qt (car op))
        (setq tmp1 (cdr op))
        (and (consp tmp1)
              (eq (cdr tmp1) NIL)
              (progn
                (setq realOp (car tmp1))
                t)))
        (eq qt 'quote))
      (list '|applyQuote| op (|pf2Sex1| args)))
((eq op '|braceFromCurly|)
 (setq x (|pf2Sex1| args))
 (if (and (consp x) (eq (car x) 'seq))
     x
     (list 'seq x)))
((eq op '|by|) (list 'by (|pf2Sex1| args)))
(t (list op (|pf2Sex1| args))))))

```

defun Convert a SuchThat node to an S-expression

```

[|pf0TupleParts p293|
 |pf2Sex1 p300|
 |pf2Sex p299|
 |$predicateList p??|

```

— defun pfSuchThat2Sex —

```

(defun |pfSuchThat2Sex| (args)
  (let (rhsSex lhsSex argList name)
    (declare (special |$predicateList|))
    (setq name (gentemp))

```

```

(setq argList (|pf0TupleParts| args))
(setq lhsSex (|pf2Sex1| (car argList)))
(setq rhsSex (|pf2Sex| (cadr argList)))
(setq |$predicateList|
  (cons (cons name (cons lhsSex rhsSex)) |$predicateList|))
name))

```

defun pfOp2Sex

```

[|pf2Sex1| p300]
[|pmDontQuote?| p309]
[|pfSymbol?| p252]
[$quotedOpList p??]
[$insideRule p??]

```

— defun pfOp2Sex —

```

(defun |pfOp2Sex| (pf)
  (let (realOp tmp1 op alreadyQuoted)
    (declare (special |$quotedOpList| |$insideRule|))
    (setq alreadyQuoted (|pfSymbol?| pf))
    (setq op (|pf2Sex1| pf))
    (cond
      ((and (consp op)
            (eq (car op) 'quote)
            (progn
              (setq tmp1 (cdr op))
              (and (consp tmp1)
                    (eq (cdr tmp1) nil)
                    (progn
                     (setq realOp (car tmp1)) t))))
        (cond
          ((eq |$insideRule| '|left|) realOp)
          ((eq |$insideRule| '|right|)
            (cond
              ((|pmDontQuote?| realOp) realOp)
              (t
               (setq |$quotedOpList| (cons op |$quotedOpList|))
               op)))
          ((eq realOp '|\\|) realOp)
          ((eq realOp '|:|) realOp)
          ((eq realOp '|?) realOp)
          (t op)))
      (t op))))

```

defun pmDontQuote?

— defun pmDontQuote? 0 —

```
(defun |pmDontQuote?| (sy)
  (member sy
    '(+ - * ** ^ / |log| |exp| |pi| |sqrt| |ei| |li| |erf| |ci|
      |si| |dilog| |sin| |cos| |tan| |cot| |sec| |csc| |asin|
      |acos| |atan| |acot| |asec| |acsc| |sinh| |cosh| |tanh|
      |coth| |sech| |csch| |asinh| |acosh| |atanh| |acoth|
      |asech| |acsc|)))
```

defun hasOptArgs?

— defun hasOptArgs? 0 —

```
(defun |hasOptArgs?| (argSex)
  (let (rhs lhs opt nonOpt tmp1 tmp2)
    (dolist (arg argSex)
      (cond
        ((and (consp arg)
              (eq (car arg) 'optarg)
              (progn
                (setq tmp1 (cdr arg))
                (and (consp tmp1)
                     (progn
                      (setq lhs (car tmp1))
                      (setq tmp2 (cdr tmp1))
                      (and (consp tmp2)
                          (eq (cdr tmp2) nil)
                          (progn
                           (setq rhs (car tmp2))
                           t)))))))
          (setq opt (cons (list lhs rhs) opt)))
        (t (setq nonOpt (cons arg nonOpt)))))
    (when opt
      (nconc (nreverse nonOpt) (list (cons '|construct| (nreverse opt)))))))
```

defun Convert a Sequence node to an S-expression

```
[pf2Sex1 p300]
[pf0SequenceArgs p287]
[$insideSEQ p??]

— defun pfSequence2Sex —

(defun |pfSequence2Sex| (pf)
  (let (|$insideSEQ| tmp1 ruleList seq)
    (declare (special |$insideSEQ|))
    (setq |$insideSEQ| t)
    (setq seq (|pfSequence2Sex0| (mapcar #'|pf2Sex1| (|pf0SequenceArgs| pf))))
    (cond
      ((and (consp seq)
            (eq (car seq) 'seq)
            (progn (setq ruleList (cdr seq)) 't)
            (consp ruleList)
            (progn
              (setq tmp1 (car ruleList))
              (and (consp tmp1) (eq (car tmp1) '|rule|))))
        (list '|ruleset| (cons '|construct| ruleList)))
      (t seq))))
```

defun pfSequence2Sex0

TPDHERE: rewrite this using (dolist (item seqList)...)

```
;pfSequence2Sex0 seqList ==
; null seqList => "noBranch"
; seqTranList := []
; while seqList ^= nil repeat
;   item := first seqList
;   item is ["exit", cond, value] =>
;     item := ["IF", cond, value, pfSequence2Sex0 rest seqList]
;   seqTranList := [item, :seqTranList]
;   seqList := nil
;   seqTranList := [item, :seqTranList]
;   seqList := rest seqList
; #seqTranList = 1 => first seqTranList
; ["SEQ", :nreverse seqTranList]
```

```
[pfSequence2Sex0 p310]
```

— defun pfSequence2Sex0 —

```

(defun |pfSequence2Sex0| (seqList)
  (let (value tmp2 cond tmp1 item seqTranList)
    (if (null seqList)
      '|noBranch|
      (progn
        ((lambda ()
          (loop
            (if (not seqList)
              (return nil)
              (progn
                (setq item (car seqList))
                (cond
                  ((and (consp item)
                       (eq (car item) '|exit|))
                   (progn
                     (setq tmp1 (cdr item))
                     (and (consp tmp1)
                          (progn
                            (setq cond (car tmp1))
                            (setq tmp2 (cdr tmp1))
                            (and (consp tmp2)
                                 (eq (cdr tmp2) nil)
                                 (progn
                                  (setq value (car tmp2))
                                  t)))))))
                  (t)
                  (setq item
                        (list 'if cond value (|pfSequence2Sex0| (cdr seqList))))
                  (setq seqTranList (cons item seqTranList))
                  (setq seqList nil)))
          (t
            (progn
              (setq seqTranList (cons item seqTranList))
              (setq seqList (cdr seqList))))))))))
    (if (eql (length seqTranList) 1)
      (car seqTranList)
      (cons 'seq (nreverse seqTranList)))))

```

defun Convert a loop node to an S-expression

TPDHERE: rewrite using dsetq

```

;loopIters2Sex iterList ==
; result := nil
; for iter in iterList repeat
;   sex := pf2Sex1 iter
;   sex is ['IN, var, ['SEGMENT, i, ["BY", incr]] =>

```


[pf2Sex1 p300]

```
(defun |loopIters2Sex| (iterList)
(let (j incr i var sex result tmp1 tmp2 tmp3 tmp4 tmp5 tmp6 tmp7 tmp8)
(dolist (iter iterList (nreverse result))
(setq sex (|pf2Sex1| iter))
(cond
((and (consp sex)
(eq (car sex) 'in)
(progn
(setq tmp1 (cdr sex))
(and (consp tmp1)
(progn
(setq var (car tmp1))
(setq tmp2 (cdr tmp1))
(and (consp tmp2)
(eq (cdr tmp2) nil)
(progn
(setq tmp3 (car tmp2))
(and (consp tmp3)
(eq (car tmp3) 'segment)
(progn
(setq tmp4 (cdr tmp3))
(and (consp tmp4)
(progn
(setq i (car tmp4))
(setq tmp5 (cdr tmp4))
(and (consp tmp5)
(eq (cdr tmp5) nil)
(progn
(setq tmp6 (car tmp5))
(and (consp tmp6)
(eq (car tmp6) 'by)
(progn
(setq tmp7 (cdr tmp6))
(and (consp tmp7)
(eq (cdr tmp7) nil)
(progn
(setq incr (car tmp7))
t)))))))))))))))))))
```

```

(setq result (cons (list 'step var i incr) result)))
((and (consp sex)
      (eq (car sex) 'in)
      (progn
        (setq tmp1 (cdr sex))
        (and (consp tmp1)
              (progn
                (setq var (car tmp1))
                (setq tmp2 (cdr tmp1))
                (and (consp tmp2)
                      (eq (cdr tmp2) nil)
                      (progn
                        (setq tmp3 (car tmp2))
                        (and (consp tmp3)
                              (eq (car tmp3) 'by)
                              (progn
                                (setq tmp4 (cdr tmp3))
                                (and (consp tmp4)
                                      (progn
                                        (setq tmp5 (car tmp4))
                                        (and (consp tmp5)
                                              (eq (car tmp5) 'segment)
                                              (progn
                                                (setq tmp6 (cdr tmp5))
                                                (and (consp tmp6)
                                                      (progn
                                                        (setq i (car tmp6))
                                                        (setq tmp7 (cdr tmp6))
                                                        (and (consp tmp7)
                                                                (eq (cdr tmp7) nil)
                                                                (progn
                                                                  (setq j (car tmp7))
                                                                  t))))))))))
                                          (progn
                                            (setq tmp8 (cdr tmp4))
                                            (and (consp tmp8)
                                                  (eq (cdr tmp8) nil)
                                                  (progn
                                                    (setq incr (car tmp8))
                                                    t))))))))))))))
      (setq result (cons (list 'step var i incr j) result)))
((and (consp sex)
      (eq (car sex) 'in)
      (progn
        (setq tmp1 (cdr sex))
        (and (consp tmp1)
              (progn
                (setq var (car tmp1))
                (setq tmp2 (cdr tmp1))
                (and (consp tmp2)
                      (eq (cdr tmp2) nil)
                      (progn
                        (setq tmp3 (car tmp2))
                        (and (consp tmp3)
                              (eq (car tmp3) 'by)
                              (progn
                                (setq tmp4 (cdr tmp3))
                                (and (consp tmp4)
                                      (progn
                                        (setq tmp5 (car tmp4))
                                        (and (consp tmp5)
                                              (eq (car tmp5) 'segment)
                                              (progn
                                                (setq tmp6 (cdr tmp5))
                                                (and (consp tmp6)
                                                      (progn
                                                        (setq i (car tmp6))
                                                        (setq tmp7 (cdr tmp6))
                                                        (and (consp tmp7)
                                                                (eq (cdr tmp7) nil)
                                                                (progn
                                                                  (setq j (car tmp7))
                                                                  t))))))))))
                                          (progn
                                            (setq tmp8 (cdr tmp4))
                                            (and (consp tmp8)
                                                  (eq (cdr tmp8) nil)
                                                  (progn
                                                    (setq incr (car tmp8))
                                                    t))))))))))))))
      (setq result (cons (list 'step var i incr j) result)))

```

```

(eq (cdr tmp2) nil)
(progn
  (setq tmp3 (car tmp2))
  (and (consp tmp3)
    (eq (car tmp3) 'segment)
    (progn
      (setq tmp4 (cdr tmp3))
      (and (consp tmp4)
        (progn
          (setq i (car tmp4))
          (setq tmp5 (cdr tmp4))
          (and (consp tmp5)
            (eq (cdr tmp5) nil)
            (progn
              (setq j (car tmp5))
              t))))))))))
  (setq result (cons (list 'step var i 1 j) result)))
(t (setq result (cons sex result))))))

```

defun Change a Collect node to an S-expression

[\[loopIters2Sex p311\]](#)
[\[pfParts p249\]](#)
[\[pfCollectIterators p260\]](#)
[\[pf2Sex1 p300\]](#)
[\[pfCollectBody p260\]](#)

— defun pfCollect2Sex —

```

(defun |pfCollect2Sex| (pf)
  (let (var cond sex tmp1 tmp2 tmp3 tmp4)
    (setq sex
      (cons 'collect
        (append (|loopIters2Sex| (|pfParts| (|pfCollectIterators| pf)))
          (list (|pf2Sex1| (|pfCollectBody| pf))))))
    (cond
      ((and (consp sex)
        (eq (car sex) 'collect)
        (progn
          (setq tmp1 (cdr sex))
          (and (consp tmp1)
            (progn
              (setq tmp2 (car tmp1))
              (and (consp tmp2)
                (eq (car tmp2) '|\\|\\|\\|))

```

```

      (progn
        (setq tmp3 (cdr tmp2))
        (and (consp tmp3)
              (eq (cdr tmp3) nil)
              (progn
                (setq cond (car tmp3))
                t))))))
    (progn
      (setq tmp4 (cdr tmp1))
      (and (consp tmp4)
            (eq (cdr tmp4) nil)
            (progn (setq var (car tmp4)) t))))))
  (symbolp var))
(list '|\\| var cond))
(t sex))))

```

defun Convert a Definition node to an S-expression

```

[pf2Sex1 p300]
[pf0DefinitionLhsItems p262]
[pfDefinitionRhs p261]
[systemError p??]
[pfLambdaTran p316]
[$insideApplication p??]

```

— defun pfDefinition2Sex —

```

(defun |pfDefinition2Sex| (pf)
  (let (body argList tmp1 rhs id idList)
    (declare (special |$insideApplication|))
    (if |$insideApplication|
        (list 'optarg
              (|pf2Sex1| (car (|pf0DefinitionLhsItems| pf)))
              (|pf2Sex1| (|pfDefinitionRhs| pf)))
        (progn
          (setq idList (mapcar #'|pf2Sex1| (|pf0DefinitionLhsItems| pf)))
          (if (not (eql (length idList) 1))
              (|systemError|
               "lhs of definition must be a single item in the interpreter")
              (progn
                (setq id (car idList))
                (setq rhs (|pfDefinitionRhs| pf))
                (setq tmp1 (|pfLambdaTran| rhs))
                (setq argList (car tmp1))
                (setq body (cdr tmp1))

```

```
(cons 'def
  (cons
    (if (eq argList '|id|)
      id
      (cons id argList))
    body))))))
```

defun Convert a Lambda node to an S-expression

```
[pfLambda? p273]
[pf0LambdaArgs p274]
[pfTyped? p291]
[pfCollectArgTran p317]
[pfTypedId p291]
[pfNothing? p245]
[pfTypedType p291]
[pf2Sex1 p300]
[systemError p??]
[pfLambdaRets p273]
[pfLambdaBody p273]
```

— defun pfLambdaTran —

```
(defun |pfLambdaTran| (pf)
  (let (retType argList argTypeList)
    (cond
      ((|pfLambda?| pf)
       (dolist (arg (|pf0LambdaArgs| pf))
         (if (|pfTyped?| arg)
             (progn
              (setq argList
                (cons (|pfCollectArgTran| (|pfTypedId| arg)) argList))
              (if (|pfNothing?| (|pfTypedType| arg))
                  (setq argTypeList (cons nil argTypeList))
                  (setq argTypeList
                    (cons (|pf2Sex1| (|pfTypedType| arg)) argTypeList))))
              (|systemError| "definition args should be typed")))
         (setq argList (nreverse argList))
         (unless (|pfNothing?| (|pfLambdaRets| pf))
           (setq retType (|pf2Sex1| (|pfLambdaRets| pf))))
         (setq argTypeList (cons retType (nreverse argTypeList)))
         (cons argList
           (list argTypeList
             (mapcar #'(lambda (x) (declare (ignore x)) nil) argTypeList)
             (|pf2Sex1| (|pfLambdaBody| pf))))))
```

```
(t (cons '|id| (list '(nil) '(nil) (|pf2Sex1| pf))))))
```

defun pfCollectArgTran

```
[pfCollect? p260]
[pf2sex1 p??]
[pfParts p249]
[pfCollectIterators p260]
[pfCollectBody p260]
```

— defun pfCollectArgTran —

```
(defun |pfCollectArgTran| (pf)
  (let (cond tmp2 tmp1 id conds)
    (cond
      ((|pfCollect?| pf)
       (setq conds (mapcar #'|pf2sex1| (|pfParts| (|pfCollectIterators| pf))))
       (setq id (|pf2Sex1| (|pfCollectBody| pf)))
       (cond
         ((and (consp conds) ; conds is [ "|", cond ]
              (eq (cdr conds) nil)
              (progn
                (setq tmp1 (car conds))
                (and (consp tmp1)
                     (eq (car tmp1) '|\\|)
                     (progn
                      (setq tmp2 (cdr tmp1))
                      (and (consp tmp2)
                           (eq (cdr tmp2) nil)
                           (progn
                            (setq cond (car tmp2))
                            t))))))
              (list '|\\| id cond))
          (t (cons id conds))))
      (t (|pf2Sex1| pf)))))
```

defun Convert a Lambda node to an S-expression

```
[pfLambdaTran p316]
```

— defun pfLambda2Sex —

```
(defun |pfLambda2Sex| (pf)
  (let (body argList tmp1)
    (setq tmp1 (|pfLambdaTran| pf))
    (setq argList (car tmp1))
    (setq body (cdr tmp1))
    (cons 'adeft (cons argList body))))
```

defun Convert a Rule node to an S-expression

```
[pfLhsRule2Sex p318]
[pfRuleLhsItems p286]
[pfRhsRule2Sex p319]
[pfRuleRhs p286]
[ruleLhsTran p322]
[rulePredicateTran p319]
[$multiVarPredicateList p??]
[$predicateList p??]
[$quotedOpList p??]
```

— defun pfRule2Sex —

```
(defun |pfRule2Sex| (pf)
  (let (|multiVarPredicateList| |predicateList| |quotedOpList| rhs lhs)
    (declare (special |multiVarPredicateList| |predicateList| |quotedOpList|))
    (setq |quotedOpList| nil)
    (setq |predicateList| nil)
    (setq |multiVarPredicateList| nil)
    (setq lhs (|pfLhsRule2Sex| (|pfRuleLhsItems| pf)))
    (setq rhs (|pfRhsRule2Sex| (|pfRuleRhs| pf)))
    (setq lhs (|ruleLhsTran| lhs))
    (|rulePredicateTran|
     (if |quotedOpList|
        (list '|rule| lhs rhs (cons '|construct| |quotedOpList|))
        (list '|rule| lhs rhs)))))
```

defun Convert the Lhs of a Rule to an S-expression

```
[pf2Sex1 p300]
[$insideRule p??]
```

— defun pfLhsRule2Sex —

```
(defun |pfLhsRule2Sex| (lhs)
  (let (|$insideRule|)
    (declare (special |$insideRule|))
    (setq |$insideRule| '|left|)
    (|pf2Sex1| lhs)))
```

defun Convert the Rhs of a Rule to an S-expression

[pf2Sex1 p300]
[\$insideRule p??]

— defun pfRhsRule2Sex —

```
(defun |pfRhsRule2Sex| (rhs)
  (let (|$insideRule|)
    (declare (special |$insideRule|))
    (setq |$insideRule| '|right|)
    (|pf2Sex1| rhs)))
```

defun Convert a Rule predicate to an S-expression

```
;rulePredicateTran rule ==
; null $multiVarPredicateList => rule
; varList := patternVarsOf [rhs for [.,.,:rhs] in $multiVarPredicateList]
; predBody :=
;   CDR $multiVarPredicateList =>
;     ['AND, :[:pvarPredTran(rhs, varList) for [.,.,:rhs] in
;       $multiVarPredicateList]]
;   [ [.,.,:rhs],:] := $multiVarPredicateList
;   pvarPredTran(rhs, varList)
; ['suchThat, rule,
;   ['construct, :[ ["QUOTE", var] for var in varList]],
;   ['ADEF, '(predicateVariable),
;   '((Boolean) (List (Expression (Integer))))), '(() ()),
;   predBody]]
```

[patternVarsOf p321]
[pvarPredTran p322]
[\$multiVarPredicateList p??]

— defun rulePredicateTran —


```
(defun |rulePredicateTran| (rule)
  (let (predBody varList rhs tmp1 result)
    (declare (special |$multiVarPredicateList|))
    (if (null |$multiVarPredicateList|)
        rule
        (progn
          (setq varList
                (|patternVarsOf|
                 ((lambda (t1 t2 t3)
                    (loop
                     (cond
                      ((or (atom t2)
                           (progn
                            (setq t3 (car t2))
                            nil))
                      (return (nreverse t1)))
                     (t
                      (and (consp t3)
                           (progn
                            (setq tmp1 (cdr t3))
                            (and (consp tmp1)
                                 (progn
                                  (setq rhs (cdr tmp1))
                                  t)))
                           (setq t1 (cons rhs t1))))
                      (setq t2 (cdr t2))))
                    nil |$multiVarPredicateList| nil)))
          (setq predBody
                (cond
                 ((cdr |$multiVarPredicateList|)
                  (cons 'and
                       ((lambda (t4 t5 t6)
                          (loop
                           (cond
                            ((or (atom t5)
                                 (progn
                                 (setq t6 (car t5))
                                 nil))
                            (return (nreverse t4)))
                           (t
                            (and (consp t6)
                                 (progn
                                  (setq tmp1 (cdr t6))
                                  (and (consp tmp1)
                                       (progn
                                        (setq rhs (cdr tmp1))
                                        t)))
                                  (setq t4
                                        (append (reverse (|pvarPredTran| rhs varList))
                                                t4))))))
                  ))
                 (t
                  (setq result
                        (|rulePredicateTran|
                         (|patternVarsOf|
                          ((lambda (t1 t2 t3)
                             (loop
                              (cond
                               ((or (atom t2)
                                      (progn
                                      (setq t3 (car t2))
                                      nil))
                               (return (nreverse t1)))
                              (t
                               (and (consp t3)
                                    (progn
                                     (setq tmp1 (cdr t3))
                                     (and (consp tmp1)
                                          (progn
                                           (setq rhs (cdr tmp1))
                                           t)))
                                     (setq t1 (cons rhs t1))))
                               (setq t2 (cdr t2))))
                             nil |$multiVarPredicateList| nil)))
                        (cons 'and
                             ((lambda (t4 t5 t6)
                                (loop
                                 (cond
                                  ((or (atom t5)
                                       (progn
                                       (setq t6 (car t5))
                                       nil))
                                  (return (nreverse t4)))
                                 (t
                                  (and (consp t6)
                                       (progn
                                        (setq tmp1 (cdr t6))
                                        (and (consp tmp1)
                                             (progn
                                              (setq rhs (cdr tmp1))
                                              t)))
                                        (setq t4
                                              (append (reverse (|pvarPredTran| rhs varList))
                                                      t4))))))
                                ))
                        result)))
          (return result))
        (return result)))
```

```

      (setq t5 (cdr t5)))
    nil |$multiVarPredicateList| nil)))
  (t
    (progn
      (setq rhs (cddar |$multiVarPredicateList|))
      (|pvarPredTran| rhs varList))))))
  (dolist (var varList) (push (list 'quote var) result))
  (list '|suchThat| rule
    (cons '|construct| (nreverse result))
    (list 'adeft '(|predicateVariable|
      '((|Boolean|
        (|List| (|Expression| (|Integer|))))
      '(nil nil) predBody))))))

```

defun patternVarsOf

[patternVarsOf1 p321]

— defun patternVarsOf —

```

(defun |patternVarsOf| (expr)
  (|patternVarsOf1| expr nil))

```

defun patternVarsOf1

[patternVarsOf1 p321]

— defun patternVarsOf1 —

```

(defun |patternVarsOf1| (expr varList)
  (let (argl op)
    (cond
      ((null expr) varList)
      ((atom expr)
        (cond
          ((null (symbolp expr)) varList)
          ((member expr varList) varList)
          (t (cons expr varList))))
      ((and (consp expr)
        (progn
          (setq op (car expr))

```

```

      (setq arg1 (cdr expr))
      t))
    (progn
      (dolist (arg arg1)
        (setq varList (|patternVarsOf1| arg varList)))
        varList))
    (t varList))))

```

defun pvarPredTran

— defun pvarPredTran —

```

(defun |pvarPredTran| (rhs varList)
  (let ((i 0))
    (dolist (var varList rhs)
      (setq rhs (nsbst (list '|elt| '|predicateVariable| (incf i)) var rhs)))))

```

defun Convert the Lhs of a Rule node to an S-expression

[patternVarsOf p321]
 [nsbst p??]
 [\$predicateList p??]
 [\$multiVarPredicateList p??]

— defun ruleLhsTran —

```

(defun |ruleLhsTran| (ruleLhs)
  (let (predicate var vars predRhs predLhs name)
    (declare (special |$predicateList| |$multiVarPredicateList|))
    (dolist (pred |$predicateList|)
      (setq name (car pred))
      (setq predLhs (cadr pred))
      (setq predRhs (cddr pred))
      (setq vars (|patternVarsOf| predRhs))
      (cond
        ((cdr vars)
         (setq ruleLhs (nsbst predLhs name ruleLhs))
         (setq |$multiVarPredicateList| (cons pred |$multiVarPredicateList|)))
        (t
         (setq var (cadr predLhs))

```

```
(setq predicate
  (list '|suchThat| predLhs (list 'adeq (list var)
    '((|Boolean|) (|Expression| (|Integer|))) '(nil nil) predRhs)))
(setq ruleLhs (nsbst predicate name ruleLhs))))
ruleLhs))
```

defvar \$dotdot

— initvars —

```
(defvar |$dotdot| '|..|)
```

defun Translate ops into internal symbols

[[\\$dotdot](#) p323]

— defun opTran 0 —

```
(defun |opTran| (op)
  (declare (special |$dotdot|))
  (cond
    ((equal op |$dotdot|) 'segment)
    ((eq op '[]) 'construct)
    ((eq op '{}) 'braceFromCurly)
    ((eq op 'is) 'is)
    (t op)))
```

Chapter 9

Keyed Message Handling

Throughout the interpreter there are messages printed using a symbol for a database lookup. This was done to enable translation of these messages languages other than English.

Axiom messages are read from a flat file database and returned as one long string. They are preceded in the database by a key and this is how they are referenced from code. For example, one key is S2IL0001 which means:

S2	Scratchpad II designation
I	from the interpreter
L	originally from LISPLIB BOOT
0001	a sequence number

Each message may contain formatting codes and and parameter codes. The formatting codes are:

%b	turn on bright printing
%ceoff	turn off centering
%ceon	turn on centering
%d	turn off bright printing
%f	user defined printing
%i	start indentation of 3 more spaces
%l	start a new line
%m	math-print an expression
%rjoff	turn off right justification (actually ragged left)
%rjon	turn on right justification (actually ragged left)
%s	pretty-print as an S-expression
%u	unindent 3 spaces
%x#	insert # spaces

The parameter codes look like %1, %2b, %3p, %4m, %5bp, %6s where the digit is the parameter number and the letters following indicate additional formatting. You can indicate as many additional formatting qualifiers as you like, to the degree they make sense.

- The “p” code means to call `prefix2String` on the parameter, a standard way of printing abbreviated types.
- The “P” operator maps `prefix2String` over its arguments.
- The “o” operation formats the argument as an operation name.
- The “b” means to print that parameter in a bold (bright) font.
- The “c” means to center that parameter on a new line.
- The “r” means to right justify (ragged left) the argument.
- The “f” means that the parameter is a list `[fn, :args]` and that “fn” is to be called on “args” to get the text.

Look in the file with the name defined in `$defaultMsgDatabaseName` above for examples.

defvar \$cacheMessages

This is used for debugging

— **initvars** —

```
(defvar |$cacheMessages| t)
```

—————

defvar \$msgAlist

— **initvars** —

```
(defvar |$msgAlist| nil)
```

—————

defvar \$testingErrorPrefix

— **initvars** —

```
(defvar |$testingErrorPrefix| "Daly Bug")
```

—————

defvar \$texFormatting

— initvars —

```
(defvar |$texFormatting| nil)
```

—————

defvar \$*msghash*

— initvars —

```
(defvar *msghash* nil "hash table keyed by msg number")
```

—————

defvar \$msgdbPrims

— initvars —

```
(defvar |$msgdbPrims|
  '(|%b| |%d| |%l| |%i| |%u| %U |%n| |%x| |%ce| |%rj| "%U" "%b" "%d"
    "%l" "%i" "%u" "%U" "%n" "%x" "%ce" "%rj"))
```

—————

defvar \$msgdbPunct

— initvars —

```
(defvar |$msgdbPunct|
  '(|.| |,| |!| |:| |;| |?| |)| |."| |,"| |!"| |:"| |;"| |?"| |]"| |"))
```

—————

defvar \$msgdbNoBlanksBeforeGroup

— initvars —

```
(defvar |$msgdbNoBlanksBeforeGroup|
  '(" " | | "%" % ,@|$msgdbPrims| ,@|$msgdbPunct|))
```

—————

defvar \$msgdbNoBlanksAfterGroup

— initvars —

```
(defvar |$msgdbNoBlanksAfterGroup|
  '(" " | | "%" % ,@|$msgdbPrims| [ |(| "[" "("))
```

—————

defun Fetch a message from the message database

If the `*msghash*` hash table is empty we call `cacheKeyedMsg` to fill the table, otherwise we do a key lookup in the hash table. [object2Identifier p??]

[cacheKeyedMsg p328]

[\$defaultMsgDatabaseName p6]

[*msghash* p327]

— defun fetchKeyedMsg —

```
(defun |fetchKeyedMsg| (key ignore)
  (declare (ignore ignore) (special *msghash* |$defaultMsgDatabaseName|))
  (setq key (|object2Identifier| key))
  (unless *msghash*
    (setq *msghash* (make-hash-table))
    (cacheKeyedMsg |$defaultMsgDatabaseName|))
  (gethash key *msghash*))
```

—————

defun Cache messages read from message database

[done p??]

[done p??]

[*msghash* p327]

— defun cacheKeyedMsg —

```
(defun cacheKeyedMsg (file)
  (let ((line "") (msg "") key)
    (declare (special *msghash*))
    (with-open-file (in file)
      (catch 'done
        (loop
          (setq line (read-line in nil nil))
          (cond
            ((null line)
             (when key (setf (gethash key *msghash*) msg))
             (throw 'done nil))
            ((= (length line) 0))
            ((char= (schar line 0) #\S)
             (when key (setf (gethash key *msghash*) msg))
             (setq key (intern line "BOOT"))
             (setq msg ""))
            ('else
             (setq msg (concatenate 'string msg line))))))))))
```

—————

defun getKeyedMsg

[fetchKeyedMsg p328]

— defun getKeyedMsg —

```
(defun |getKeyedMsg| (key) (|fetchKeyedMsg| key nil))
```

—————

defun Say a message using a keyed lookup

[sayKeyedMsgLocal p330]

[\$texFormatting p327]

— defun sayKeyedMsg —

```
(defun |sayKeyedMsg| (key args)
  (let (|$texFormatting|)
    (declare (special |$texFormatting|))
```

```
(setq |$texFormatting| nil)
(|sayKeyedMsgLocal| key args)))
```

defun Handle msg formatting and print to file

```
[segmentKeyedMsg p330]
[getKeyedMsg p329]
[substituteSegmentedMsg p??]
[flowSegmentedMsg p??]
[sayMSG2File p331]
[sayMSG p331]
[$printMsgsToFile p740]
[$linelength p774]
[$margin p774]
[$displayMsgNumber p746]
```

— defun sayKeyedMsgLocal —

```
(defun |sayKeyedMsgLocal| (key args)
  (let (msg msgp)
    (declare (special |$printMsgsToFile| $linelength $margin |$displayMsgNumber|))
    (setq msg (|segmentKeyedMsg| (|getKeyedMsg| key)))
    (setq msg (|substituteSegmentedMsg| msg args))
    (when |$displayMsgNumber| (setq msg ("%b" ,key |:| "%d" . ,msg)))
    (setq msgp (|flowSegmentedMsg| msg $linelength $margin))
    (when |$printMsgsToFile| (|sayMSG2File| msgp))
    (|sayMSG| msgp)))
```

defun Break a message into words

```
[string2Words p??]
```

— defun segmentKeyedMsg —

```
(defun |segmentKeyedMsg| (msg) (|string2Words| msg))
```

defun Write a msg into spadmsg.listing file

```
[makePathname p1042]
[defiostream p982]
[sayBrightly1 p1049]
[shut p982]
```

— defun sayMSG2File —

```
(defun |sayMSG2File| (msg)
  (let (file str)
    (setq file (|makePathname| '|spadmsg| '|listing| 'a))
    (setq str (defiostream '((mode . output) (file . ,file)) 255 0))
    (sayBrightly1 msg str)
    (shut str)))
```

—————

defun sayMSG

```
[saybrightly1 p??]
[$algebraOutputStream p762]
```

— defun sayMSG —

```
(defun |sayMSG| (x)
  (declare (special |$algebraOutputStream|))
  (when x (sayBrightly1 x |$algebraOutputStream|)))
```

—————

Chapter 10

Stream Utilities

The input stream is parsed into a large s-expression by repeated calls to Delay. Delay takes a function `f` and an argument `x` and returns a list consisting of `("nonnullstream" f x)`. Eventually multiple calls are made and a large list structure is created that consists of `("nonnullstream" f x ("nonnullstream" f1 x1 ("nonnullstream" f2 x2...))`.

This delay structure is given to StreamNull which walks along the list looking at the head. If the head is “nonnullstream” then the function is applied to the argument.

So, in effect, the input is “zipped up” into a Delay data structure which is then evaluated by calling StreamNull. This “zippered stream” parser was a research project at IBM and Axiom was the testbed (which explains the strange parsing technique).

defun npNull

[StreamNull p333]

— defun npNull —

```
(defun |npNull| (x) (|StreamNull| x))
```

defun StreamNull

[eqcar p??]

— defun StreamNull 0 —

```
(defun |StreamNull| (x)
```

```
(let (st)
  (cond
    ((or (null x) (eqcar x '|nullstream|)) t)
    (t
     ((lambda nil
        (loop
         (cond
           ((not (eqcar x '|nonnullstream|)) (return nil))
           (t
            (setq st (apply (cadr x) (cddr x)))
            (rplaca x (car st))
            (rplacd x (cdr st)))))))
      (eqcar x '|nullstream|))))
```

Chapter 11

Code Piles

The `insertpile` function converts a line-list to a line-forest where a line is a token-dequeue and has a column which is an integer. An A-forest is an A-tree-list. An A-tree has a root which is an A, and subtrees which is an A-forest.

A forest with more than one tree corresponds to a Scratchpad pile structure (t1;t2;t3;...;tn), and a tree corresponds to a pile item. The (; and) tokens are inserted into a `z1`-forest, otherwise the root of the first tree is concatenated with its forest. column t is the number of spaces before the first non-space in line t

defun insertpile

[npNull p333]

[pilePlusComment p336]

[pilePlusComments p336]

[pileTree p337]

[pileCforest p340]

— **defun insertpile** —

```
(defun |insertpile| (s)
  (let (stream a t1 h1 t2 h tmp1)
    (cond
      ((|npNull| s) (list nil 0 nil s))
      (t
       (setq tmp1 (list (car s) (cdr s)))
       (setq h (car tmp1))
       (setq t2 (cadr tmp1))
       (cond
         ((|pilePlusComment| h)
          (setq tmp1 (|pilePlusComments| s))
          (setq h1 (car tmp1))
```



```

      (setq t1 (cadr tmp1))
      (setq a (|pileTree| (- 1) t1))
      (cons (list (|pileCforest|
                  (append h1 (cons (elt a 2) nil))))
            (elt a 3)))
    (t
     (setq stream (cadar s))
     (setq a (|pileTree| -1 s))
     (cons (list (list (elt a 2) stream)) (elt a 3))))))

```

defun pilePlusComment

[tokType p413]
 [npNull p333]
 [pilePlusComment p336]
 [pilePlusComments p336]

— defun pilePlusComment —

```

(defun |pilePlusComment| (arg)
  (eq (|tokType| (caar arg)) '|comment|))

```

defun pilePlusComments

— defun pilePlusComments —

```

(defun |pilePlusComments| (s)
  (let (t1 h1 t2 h tmp1)
    (cond
      ((|npNull| s) (list nil s))
      (t
       (setq tmp1 (list (car s) (cdr s)))
       (setq h (car tmp1))
       (setq t2 (cadr tmp1))
       (cond
         ((|pilePlusComment| h)
          (setq tmp1 (|pilePlusComments| t2))
          (setq h1 (car tmp1))
          (setq t1 (cadr tmp1))
          (list (cons h h1) t1))

```

```
(t
  (list nil s))))))
```

defun pileTree

[npNull p333]
 [pileColumn p337]
 [pileForests p337]

— defun pileTree —

```
(defun |pileTree| (n s)
  (let (hh t1 h tmp1)
    (cond
      ((|npNull| s) (list nil n nil s))
      (t
       (setq tmp1 (list (car s) (cdr s)))
       (setq h (car tmp1))
       (setq t1 (cadr tmp1))
       (setq hh (|pileColumn| (car h)))
       (cond
         ((< n hh) (|pileForests| (car h) hh t1))
         (t (list nil n nil s)))))))
```

defun pileColumn

[tokPosn p413]

— defun pileColumn —

```
(defun |pileColumn| (arg)
  (cdr (|tokPosn| (caar arg))))
```

defun pileForests

[pileForest p338]
 [npNull p333]

[pileForests p337]
 [pileCtree p340]

— **defun pileForests** —

```
(defun |pileForests| (h n s)
  (let (t1 h1 tmp1)
    (setq tmp1 (|pileForest| n s))
    (setq h1 (car tmp1))
    (setq t1 (cadr tmp1))
    (cond
     ((|npNull| h1) (list t n h s))
     (t (|pileForests| (|pileCtree| h h1) n t1))))))
```

—————

defun pileForest

[pileTree p337]
 [pileForest1 p338]

— **defun pileForest** —

```
(defun |pileForest| (n s)
  (let (t1 h1 t2 h hh b tmp)
    (setq tmp (|pileTree| n s))
    (setq b (car tmp))
    (setq hh (cadr tmp))
    (setq h (caddr tmp))
    (setq t2 (caddr tmp))
    (cond
     (b
      (setq tmp (|pileForest1| hh t2))
      (setq h1 (car tmp))
      (setq t1 (cadr tmp))
      (list (cons h h1) t1))
     (t
      (list nil s)))))
```

—————

defun pileForest1

[eqpileTree p339]
 [pileForest1 p338]

— defun pileForest1 —

```
(defun |pileForest1| (n s)
  (let (t1 h1 t2 h n1 b tmp)
    (setq tmp (|eqpileTree| n s))
    (setq b (car tmp))
    (setq n1 (cadr tmp))
    (setq h (caddr tmp))
    (setq t2 (caddrdr tmp))
    (cond
      (b
       (setq tmp (|pileForest1| n t2))
       (setq h1 (car tmp))
       (setq t1 (cadr tmp))
       (list (cons h h1) t1))
      (t (list nil s)))))
```

—————

defun eqpileTree

[npNull p333]
 [pileColumn p337]
 [pileForests p337]

— defun eqpileTree —

```
(defun |eqpileTree| (n s)
  (let (hh t1 h tmp)
    (cond
      ((|npNull| s) (list nil n nil s))
      (t
       (setq tmp (list (car s) (cdr s)))
       (setq h (car tmp))
       (setq t1 (cadr tmp))
       (setq hh (|pileColumn| (car h)))
       (cond
         ((equal hh n) (|pileForests| (car h) hh t1))
         (t (list nil n nil s)))))))
```

—————

defun pileCtree

[dqAppend p344]
[pileCforest p340]

— defun pileCtree —

```
(defun |pileCtree| (x y)
  (|dqAppend| x (|pileCforest| y)))
```

—————

defun pileCforest

Only enpiles forests with ≥ 2 trees [tokPart p413]
[enPile p340]
[separatePiles p341]

— defun pileCforest —

```
(defun |pileCforest| (x)
  (let (f)
    (cond
      ((null x) nil)
      ((null (cdr x)) (setq f (car x)))
      (cond
        ((eq (|tokPart| (caar f)) 'if) (|enPile| f))
        (t f)))
    (t (|enPile| (|separatePiles| x))))))
```

—————

defun enPile

[dqConcat p343]
[dqUnit p343]
[tokConstruct p411]
[firstTokPosn p341]
[lastTokPosn p341]

— defun enPile —

```
(defun |enPile| (x)
  (|dqConcat|
```

```
(list
  (|dqUnit| (|tokConstruct| ' |key| 'settab (|firstTokPosn| x)))
  x
  (|dqUnit| (|tokConstruct| ' |key| 'backtab (|lastTokPosn| x))))))
```

defun firstTokPosn

[tokPosn p413]

— defun firstTokPosn —

```
(defun |firstTokPosn| (arg) (|tokPosn| (caar arg)))
```

defun lastTokPosn

[tokPosn p413]

— defun lastTokPosn —

```
(defun |lastTokPosn| (arg) (|tokPosn| (cadr arg)))
```

defun separatePiles

[dqUnit p343]

[tokConstruct p411]

[lastTokPosn p341]

[dqConcat p343]

[separatePiles p341]

— defun separatePiles —

```
(defun |separatePiles| (x)
  (let (semicolon a)
    (cond
      ((null x) nil)
      ((null (cdr x)) (car x))
```

```
(t
  (setq a (car x))
  (setq semicolon
    (|dqUnit| (|tokConstruct| 'key| 'backset (|lastTokPosn| a))))
  (|dqConcat| (list a semicolon (|separatePiles| (cdr x))))))
```

—————→

Chapter 12

Dequeue Functions

The dqUnit makes a unit dq i.e. a dq with one item, from the item

defun dqUnit

— defun dqUnit 0 —

```
(defun |dqUnit| (s)
  (let (a)
    (setq a (list s))
    (cons a a)))
```

—————

defun dqConcat

The dqConcat function concatenates a list of dq's, destroying all but the last [dqAppend p344]

[dqConcat p343]

— defun dqConcat —

```
(defun |dqConcat| (ld)
  (cond
    ((null ld) nil)
    ((null (cdr ld)) (car ld))
    (t (|dqAppend| (car ld) (|dqConcat| (cdr ld))))))
```

—————

defun dqAppend

The dqAppend function appends 2 dq's, destroying the first

— **defun dqAppend 0** —

```
(defun |dqAppend| (x y)
  (cond
    ((null x) y)
    ((null y) x)
    (t
     (rplacd (cdr x) (car y))
     (rplacd x (cdr y)) x)))
```

—————

defun dqToList

— **defun dqToList 0** —

```
(defun |dqToList| (s)
  (when s (car s)))
```

—————

Chapter 13

Message Handling

13.1 The Line Object

defun Line object creation

This is called in only one place, the `incLine1` function.

— defun `lnCreate` 0 —

```
(defun |lnCreate| (extraBlanks string globalNum &rest optFileStuff)
  (let ((localNum (first optFileStuff))
        (filename (second optFileStuff)))
    (unless localNum (setq localNum 0))
    (list extraBlanks string globalNum localNum filename)))
```

—————

defun Line element 0; Extra blanks

— defun `lnExtraBlanks` 0 —

```
(defun |lnExtraBlanks| (lineObject) (elt lineObject 0))
```

—————

defun Line element 1; String

— defun `lnString` 0 —

```
(defun |lnString| (lineObject) (elt lineObject 1))
```

defun Line element 2; Global number

— defun lnGlobalNum 0 —

```
(defun |lnGlobalNum| (lineObject) (elt lineObject 2))
```

defun Line element 2; Set Global number

— defun lnSetGlobalNum 0 —

```
(defun |lnSetGlobalNum| (lineObject num)
  (setf (elt lineObject 2) num))
```

defun Line elemnt 3; Local number

— defun lnLocalNum 0 —

```
(defun |lnLocalNum| (lineObject) (elt lineObject 3))
```

defun Line element 4; Place of origin

— defun lnPlaceOfOrigin 0 —

```
(defun |lnPlaceOfOrigin| (lineObject) (elt lineObject 4))
```

defun Line element 4: Is it a filename?

[lnFileName? p347]

— defun lnImmediate? 0 —

```
(defun |lnImmediate?| (lineObject) (null (|lnFileName?| lineObject)))
```

—————

defun Line element 4: Is it a filename?

— defun lnFileName? 0 —

```
(defun |lnFileName?| (lineObject)
  (let (filename)
    (when (consp (setq filename (elt lineObject 4))) filename)))
```

—————

defun Line element 4; Get filename

[lnFileName? p347]

[ncBug p368]

— defun lnFileName —

```
(defun |lnFileName| (lineObject)
  (let (fN)
    (if (setq fN (|lnFileName?| lineObject))
        fN
        ([ncBug| "there is no file name in %1" (list lineObject)])))
```

—————

13.2 Messages**defun msgCreate**

```
msgObject  tag -- catagory of msg
            -- attributes as a-list
```

```

'imPr => dont save for list processing
toWhere, screen or file
'norep => only display once in list
pos -- position with possible FROM/TO tag
key -- key for message database
argL -- arguments to be placed in the msg test
prefix -- things like "Error: "
text -- the actual text

```

```

[setMsgForcedAttrList p364]
[putDatabaseStuff p365]
[initImPr p367]
[initToWhere p368]

```

— defun msgCreate —

```

(defun |msgCreate| (tag posWTag key argL optPre &rest optAttr)
  (let (msg)
    (when (consp key) (setq tag '|old|))
    (setq msg (list tag posWTag key argL optPre nil))
    (when (car optAttr) (|setMsgForcedAttrList| msg (car optAttr)))
    (|putDatabaseStuff| msg)
    (|initImPr| msg)
    (|initToWhere| msg)
    msg))

```

defun getMsgPosTagOb

— defun getMsgPosTagOb 0 —

```

(defun |getMsgPosTagOb| (msg) (elt msg 1))

```

defun getMsgKey

— defun getMsgKey 0 —

```

(defun |getMsgKey| (msg) (elt msg 2))

```

defun getMsgArgL

— **defun** getMsgArgL 0 —

```
(defun |getMsgArgL| (msg) (elt msg 3))
```

—————

defun getMsgPrefix

— **defun** getMsgPrefix 0 —

```
(defun |getMsgPrefix| (msg) (elt msg 4))
```

—————

defun setMsgPrefix

— **defun** setMsgPrefix 0 —

```
(defun |setMsgPrefix| (msg val) (setf (elt msg 4) val))
```

—————

defun getMsgText

— **defun** getMsgText 0 —

```
(defun |getMsgText| (msg) (elt msg 5))
```

—————

defun setMsgText

— **defun** setMsgText 0 —

```
(defun |setMsgText| (msg val)
  (setf (elt msg 5) val))
```

defun getMsgPrefix?

— defun getMsgPrefix? 0 —

```
(defun |getMsgPrefix?| (msg)
  (let ((pre (|getMsgPrefix| msg)))
    (unless (eq pre '|noPre|) pre)))
```

defun getMsgTag

The valid message tags are: line, old, error, warn, bug, unimple, remark, stat, say, debug
[ncTag p415]

— defun getMsgTag 0 —

```
(defun |getMsgTag| (msg) (|ncTag| msg))
```

defun getMsgTag?

```
[IFCAR p??]  
[getMsgTag p350]
```

— defun getMsgTag? 0 —

```
(defun |getMsgTag?| (|msg|)
  (ifcar (member (|getMsgTag| |msg|)
    (list '|line| '|old| '|error| '|warn| '|bug|
          '|unimple| '|remark| '|stat| '|say| '|debug|))))
```

defun line?

[getMsgTag p350]

— defun line? —

```
(defun |line?| (msg) (eq (|getMsgTag| msg) '|line|))
```

defun leader?

[getMsgTag p350]

— defun leader? —

```
(defun |leader?| (msg) (eq (|getMsgTag| msg) '|leader|))
```

defun toScreen?

[getMsgToWhere p363]

— defun toScreen? —

```
(defun |toScreen?| (msg) (not (eq (|getMsgToWhere| msg) '|fileOnly|)))
```

defun ncSoftError

Messages for the USERS of the compiler. The program being compiled has a minor error. Give a message and continue processing. [desiredMsg p352]

[processKeyedError p353]

[msgCreate p347]

[\$newcompErrorCount p26]

— defun ncSoftError —

```
(defun |ncSoftError| (pos erMsgKey erArgL &rest optAttr)
  (declare (special |$newcompErrorCount|))
```



```
(setq |$newcompErrorCount| (+ |$newcompErrorCount| 1))
(when (|desiredMsg| erMsgKey)
  (|processKeyedError|
    (|msgCreate| '|error| pos erMsgKey erArgL
      "Error" optAttr))))
```

defun ncHardError

The program being compiled is seriously incorrect. Give message and throw to a recovery point. [desiredMsg p352]

[processKeyedError p353]

[msgCreate p347]

[ncError p67]

[\$newcompErrorCount p26]

— defun ncHardError —

```
(defun |ncHardError| (pos erMsgKey erArgL &rest optAttr)
  (let (erMsg)
    (declare (special |$newcompErrorCount|))
    (setq |$newcompErrorCount| (+ |$newcompErrorCount| 1))
    (if (|desiredMsg| erMsgKey)
      (setq erMsg
        (|processKeyedError|
          (|msgCreate| '|error| pos erMsgKey erArgL "Error" optAttr)))
      (|ncError|))))
```

defun desiredMsg

— defun desiredMsg 0 —

```
(defun |desiredMsg| (erMsgKey &rest optCatFlag)
  (declare (ignore erMsgKey))
  (cond
    ((null (null optCatFlag)) (car optCatFlag))
    (t t)))
```

defun processKeyedError

[getMsgTag? p350]
 [getMsgKey p348]
 [getMsgPrefix? p350]
 [sayBrightly p??]
 [CallerName p??]
 [msgImPr? p358]
 [msgOutputter p353]
 [\$ncMsgList p25]

— defun processKeyedError —

```
(defun |processKeyedError| (msg)
  (prog (pre erMsg)
    (declare (special |$ncMsgList|))
    (cond
      ((eq (|getMsgTag?| msg) '|old|)
        (setq erMsg (|getMsgKey| msg))
        (cond
          ((setq pre (|getMsgPrefix?| msg))
            (setq erMsg (cons '|%b| (cons pre (cons '|%d| erMsg))))))
          (|sayBrightly| (cons "old msg from " (cons (|CallerName| 4) erMsg))))
        ((|msgImPr?| msg) (|msgOutputter| msg))
        (t (setq |$ncMsgList| (cons msg |$ncMsgList|))))))
```

—————

defun msgOutputter

[getStFromMsg p354]
 [leader? p351]
 [line? p351]
 [toScreen? p351]
 [flowSegmentedMsg p??]
 [sayBrightly p??]
 [toFile? p363]
 [alreadyOpened? p363]
 [\$linelength p774]

— defun msgOutputter —

```
(defun |msgOutputter| (msg)
  (let (alreadyOpened shouldFlow st)
    (declare (special $linelength))
    (setq st (|getStFromMsg| msg))
```

```
(setq shouldFlow (null (or (|leader?| msg) (|line?| msg))))
(when (|toScreen?| msg)
  (when shouldFlow (setq st (|flowSegmentedMsg| st $linelength 0)))
  (|sayBrightly| st))
(when (|toFile?| msg)
  (when shouldFlow (setq st (|flowSegmentedMsg| st (- $linelength 6) 0)))
  (setq alreadyOpened (|alreadyOpened?| msg)))))
```

defun listOutputter

[msgOutputter p353]

— defun listOutputter —

```
(defun |listOutputter| (outputList)
  (dolist (msg outputList)
    (|msgOutputter| msg)))
```

defun getStFromMsg

[getPreStL p355]
 [getMsgPrefix? p350]
 [getMsgTag p350]
 [getMsgText p349]
 [getPosStL p356]
 [getMsgKey? p362]
 [pname p1045]
 [getMsgLitSym p362]
 [tabbing p362]

— defun getStFromMsg —

```
(defun |getStFromMsg| (msg)
  (let (st posStL preStL)
    (setq preStL (|getPreStL| (|getMsgPrefix?| msg)))
    (cond
      ((eq (|getMsgTag| msg) '|line|)
        (cons ""
          (cons "%x1" (append preStL (cons (|getMsgText| msg) nil))))))
    (t
```

```
(setq posStL (|getPosStL| msg))
(setq st
  (cons posStL
    (cons (|getMsgLitSym| msg)
      (cons ""
        (append preStL
          (cons (|tabbing| msg)
            (|getMsgText| msg))))))))))
```

defvar \$preLength

— initvars —

```
(defvar |$preLength| 11)
```

defun getPreStL

```
[size p1045]
[$preLength p355]
```

— defun getPreStL 0 —

```
(defun |getPreStL| (optPre)
  (let (spses extraPlaces)
    (declare (special |$preLength|))
    (cond
      ((null optPre) (list " "))
      (t
        (setq spses
          (cond
            ((< 0 (setq extraPlaces (- (- |$preLength| (size optPre)) 3)))
            (make-string extraPlaces)
            (t "")))
          (list '|%b| optPre spses ":" '|%d|))))))
```

defun getPosStL

```
[showMsgPos? p357]
[getMsgPos p359]
[msgImPr? p358]
[decideHowMuch p359]
[listDecideHowMuch p361]
[ppos p357]
[remLine p362]
[remFile p357]
[$lastPos p??]
```

— defun getPosStL —

```
(defun |getPosStL| (msg)
  (let (printedOrigin printedLineNum printedFileName fullPrintedPos howMuch
        msgPos)
    (declare (special |$lastPos|))
    (cond
      ((null (|showMsgPos?| msg)) "")
      (t
       (setq msgPos (|getMsgPos| msg))
       (setq howMuch
              (if (|msgImPr?| msg)
                  (|decideHowMuch| msgPos |$lastPos|)
                  (|listDecideHowMuch| msgPos |$lastPos|)))
       (setq |$lastPos| msgPos)
       (setq fullPrintedPos (|ppos| msgPos))
       (setq printedFileName
              (cons "%x2" (cons "[" (append (|remLine| fullPrintedPos) (cons "]" nil))))))
       (setq printedLineNum
              (cons "%x2" (cons "[" (append (|remFile| fullPrintedPos) (cons "]" nil))))))
       (setq printedOrigin
              (cons "%x2" (cons "[" (append fullPrintedPos (cons "]" nil))))))
      (cond
        ((eq howMuch 'org)
         (cons "" (append printedOrigin (cons '|%l| nil))))
        ((eq howMuch 'line)
         (cons "" (append printedLineNum (cons '|%l| nil))))
        ((eq howMuch 'file)
         (cons "" (append printedFileName (cons '|%l| nil))))
        ((eq howMuch 'all)
         (cons ""
          (append printedFileName
                   (cons '|%l|
                    (append printedLineNum
                             (cons '|%l| nil)))))))
      (t ""))))))
```

defun ppos

```
[pfNoPosition? p412]
[pfImmediate? p??]
[pfCharPosn p235]
[pfLinePosn p235]
[porigin p87]
[pfFileName p236]
```

— defun ppos —

```
(defun |ppos| (p)
  (let (org lpos cpos)
    (cond
      ((|pfNoPosition?| p) (list "no position"))
      ((|pfImmediate?| p) (list "console"))
      (t
       (setq cpos (|pfCharPosn| p))
       (setq lpos (|pfLinePosn| p))
       (setq org (|porigin| (|pfFileName| p)))
       (list org " " "line" " " lpos)))))
```

defun remFile

```
[IFCDR p??]
[IFCAR p??]
```

— defun remFile —

```
(defun |remFile| (positionList) (ifcdr (ifcdr positionList)))
```

defun showMsgPos?

```
[msgImPr? p358]
[leader? p351]
```

```
[SerMsgToss p??]
```

```
— defun showMsgPos? 0 —
```

```
(defun |showMsgPos?| (msg)
  (declare (special |SerMsgToss|))
  (or |SerMsgToss| (and (null (|msgImPr?| msg)) (null (|leader?| msg)))))
```

```
—————
```

defvar \$imPrGuys

```
— initvars —
```

```
(defvar |$imPrGuys| (list '|imPr|))
```

```
—————
```

defun msgImPr?

```
[getMsgCatAttr p358]
```

```
— defun msgImPr? —
```

```
(defun |msgImPr?| (msg)
  (eq (|getMsgCatAttr| msg '|$imPrGuys|) '|imPr|))
```

```
—————
```

defun getMsgCatAttr

```
[ifcdr p??]
[qassq p??]
[ncAlist p415]
```

```
— defun getMsgCatAttr —
```

```
(defun |getMsgCatAttr| (msg cat)
  (ifcdr (qassq cat (|ncAlist| msg))))
```

```
—————
```

defun getMsgPos

[getMsgFTTag? p359]
 [getMsgPosTagOb p348]

— defun getMsgPos —

```
(defun |getMsgPos| (msg)
  (if (|getMsgFTTag?| msg)
      (cadr (|getMsgPosTagOb| msg))
      (|getMsgPosTagOb| msg)))
```

—————

defun getMsgFTTag?

[ifcar p??]
 [getMsgPosTagOb p348]

— defun getMsgFTTag? —

```
(defun |getMsgFTTag?| (msg)
  (ifcar (member (ifcar (|getMsgPosTagOb| msg)) (list 'from 'to 'fromto))))
```

—————

defun decideHowMuch

When printing a msg, we wish not to show pos information that was shown for a previous msg with identical pos info. org prints out the word nosition or console [poNopos? p360]

[poPosImmediate? p360]
 [poFileName p360]
 [poLinePosn p361]

— defun decideHowMuch —

```
(defun |decideHowMuch| (pos oldPos)
  (cond
    ((or (and (|poNopos?| pos) (|poNopos?| oldPos))
         (and (|poPosImmediate?| pos) (|poPosImmediate?| oldPos)))
        'none)
    ((or (|poNopos?| pos) (|poPosImmediate?| pos)) 'org)
    ((or (|poNopos?| oldPos) (|poPosImmediate?| oldPos)) 'all)
    ((not (equal (|poFileName| oldPos) (|poFileName| pos))) 'all))
```



```
((not (equal (|poLinePosn| oldPos) (|poLinePosn| pos))) 'line)
(t 'none)))
```

defun poNopos?

— defun poNopos? 0 —

```
(defun |poNopos?| (posn)
  (equal posn (list '|no-position|)))
```

defun poPosImmediate?

```
[poNopos? p360]
[lnImmediate? p347]
[poGetLineObject p361]
```

— defun poPosImmediate? —

```
(defun |poPosImmediate?| (txp)
  (unless (|poNopos?| txp) (|lnImmediate?| (|poGetLineObject| txp))))
```

defun poFileName

```
[lnFileName p347]
[poGetLineObject p361]
```

— defun poFileName —

```
(defun |poFileName| (posn)
  (if posn
    (|lnFileName| (|poGetLineObject| posn))
    (caar posn)))
```

defun poGetLineObject

— defun poGetLineObject 0 —

```
(defun |poGetLineObject| (posn)
  (car posn))
```

defun poLinePosn

[lnLocalNum p346]
[poGetLineObject p361]

— defun poLinePosn —

```
(defun |poLinePosn| (posn)
  (if posn
    (|lnLocalNum| (|poGetLineObject| posn))
    (cdar posn)))
```

defun listDecideHowMuch

[poNopos? p360]
[poPosImmediate? p360]
[poGlobalLinePosn p70]

— defun listDecideHowMuch —

```
(defun |listDecideHowMuch| (pos oldPos)
  (cond
    ((or (and (|poNopos?| pos) (|poNopos?| oldPos))
         (and (|poPosImmediate?| pos) (|poPosImmediate?| oldPos)))
     'none)
    ((|poNopos?| pos) 'org)
    ((|poNopos?| oldPos) 'none)
    ((< (|poGlobalLinePosn| pos) (|poGlobalLinePosn| oldPos))
     (if (|poPosImmediate?| pos) 'org 'line))
    (t 'none)))
```

defun remLine

— defun remLine 0 —

```
(defun |remLine| (positionList) (list (ifcar positionList)))
```

—————

defun getMsgKey?

[identp p[1046](#)]

— defun getMsgKey? 0 —

```
(defun |getMsgKey?| (msg)
  (let ((val (|getMsgKey| msg)))
    (when (identp val) val)))
```

—————

defun getMsgLitSym

[getMsgKey? p[362](#)]

— defun getMsgLitSym —

```
(defun |getMsgLitSym| (msg)
  (if (|getMsgKey?| msg) " " "*"))
```

—————

defun tabbing

[getMsgPrefix? p[350](#)]

[\$preLength p[355](#)]

— defun tabbing —

```
(defun |tabbing| (msg)
  (let (chPos)
    (declare (special |$preLength|)))
```

```
(setq chPos 2)
(when (|getMsgPrefix?| msg) (setq chPos (- (+ chPos |$preLength|) 1)))
(cons '|%t| chPos))
```

defvar \$toWhereGuys

— initvars —

```
(defvar |$toWhereGuys| (list '|fileOnly| '|screenOnly|))
```

defun getMsgToWhere

[getMsgCatAttr p358]

— defun getMsgToWhere —

```
(defun |getMsgToWhere| (msg) (|getMsgCatAttr| msg '|$toWhereGuys|))
```

defun toFile?

[getMsgToWhere p363]

[\$fn p??]

— defun toFile? —

```
(defun |toFile?| (msg)
  (declare (special |$fn|))
  (and (consp |$fn|) (not (eq (|getMsgToWhere| msg) '|screenOnly|))))
```

defun alreadyOpened?

[msgImPr? p358]

— defun alreadyOpened? —

```
(defun |alreadyOpened?| (msg) (null (|msgImPr?| msg)))
```

defun setMsgForcedAttrList

```
[setMsgForcedAttr p364]
[whichCat p365]
```

— defun setMsgForcedAttrList —

```
(defun |setMsgForcedAttrList| (msg attrlist)
  (dolist (attr attrlist)
    (|setMsgForcedAttr| msg (|whichCat| attr) attr)))
```

defun setMsgForcedAttr

```
[setMsgCatlessAttr p365]
[ncPutQ p416]
```

— defun setMsgForcedAttr —

```
(defun |setMsgForcedAttr| (msg cat attr)
  (if (eq cat '|catless|)
    (|setMsgCatlessAttr| msg attr)
    (|ncPutQ| msg cat attr)))
```

defvar \$attrCats

— initvars —

```
(defvar |$attrCats| (list '|$imPrGuys| '|$toWhereGuys| '|$repGuys|))
```

defun whichCat

[ListMember? p??]
 [\$attrCats p364]

— defun whichCat —

```
(defun |whichCat| (attr)
  (let ((found '|catless|) done)
    (declare (special |$attrCats|))
    (loop for cat in |$attrCats| do
      (when (|ListMember?| attr (eval cat))
        (setq found cat)
        (setq done t))
      until done)
    found))
```

—————

defun setMsgCatlessAttr

TPDHERE: Changed from —catless— to '—catless— [ncPutQ p416]
 [ifcdr p??]
 [qassq p??]
 [ncAlist p415]

— defun setMsgCatlessAttr —

```
(defun |setMsgCatlessAttr| (msg attr)
  (|ncPutQ| msg '|catless|
    (cons attr (ifcdr (qassq |catless| (|ncAlist| msg))))))
```

—————

defun putDatabaseStuff

TPDHERE: The variable al is undefined [getMsgInfoFromKey p366]
 [setMsgUnforcedAttrList p366]
 [setMsgText p349]

— defun putDatabaseStuff —

```
(defun |putDatabaseStuff| (msg)
  (let (attributes text tmp)
```

```
(setq tmp (|getMsgInfoFromKey| msg))
(setq text (car tmp))
(setq attributes (cadr tmp))
(when attributes (|setMsgUnforcedAttrList| msg al))
(|setMsgText| msg text)))
```

defun getMsgInfoFromKey

```
[getMsgKey? p362]
[getErFromDbL p??]
[getMsgKey p348]
[segmentKeyedMsg p330]
[removeAttributes p??]
[substituteSegmentedMsg p??]
[getMsgArgL p349]
[$msgDatabaseName p7]
```

— defun getMsgInfoFromKey —

```
(defun |getMsgInfoFromKey| (msg)
  (let (|$msgDatabaseName| attributes tmp msgText msgKey)
    (declare (special |$msgDatabaseName|))
    (setq |$msgDatabaseName| nil)
    (setq msgText
      (cond
        ((setq msgKey (|getMsgKey?| msg))
         (|fetchKeyedMsg| msgKey nil))
        (t (|getMsgKey| msg))))
    (setq msgText (|segmentKeyedMsg| msgText))
    (setq tmp (|removeAttributes| msgText))
    (setq msgText (car tmp))
    (setq attributes (cadr tmp))
    (setq msgText (|substituteSegmentedMsg| msgText (|getMsgArgL| msg)))
    (list msgText attributes)))
```

defun setMsgUnforcedAttrList

```
[setMsgUnforcedAttr p367]
[whichCat p365]
```

— defun setMsgUnforcedAttrList —

```
(defun |setMsgUnforcedAttrList| (msg attrlist)
  (dolist (attr attrlist)
    (|setMsgUnforcedAttr| msg (|whichCat| attr) attr)))
```

defun setMsgUnforcedAttr

```
[setMsgCatlessAttr p365]
[qassq p??]
[ncAlist p415]
[ncPutQ p416]
```

— defun setMsgUnforcedAttr —

```
(defun |setMsgUnforcedAttr| (msg cat attr)
  (cond
    ((eq cat '|catless|) (|setMsgCatlessAttr| msg attr))
    ((null (qassq cat (|ncAlist| msg))) (|ncPutQ| msg cat attr))))
```

defvar \$imPrTagGuys

— initvars —

```
(defvar |$imPrTagGuys| (list '|unimple| '|bug| '|debug| '|say| '|warn|))
```

defun initImPr

```
[getMsgTag p350]
[setMsgUnforcedAttr p367]
[$imPrTagGuys p367]
[$erMsgToss p??]
```

— defun initImPr —

```
(defun |initImPr| (msg)
  (declare (special |$imPrTagGuys| |$erMsgToss|)))
```



```
(when (or |$erMsgToss| (member (|getMsgTag| msg) |$imPrTagGuys|))
      (|setMsgUnforcedAttr| msg '|$imPrGuys| '|imPr|)))
```

defun initToWhere

```
[getMsgCatAttr p358]
[setMsgUnforcedAttr p367]
```

— defun initToWhere —

```
(defun |initToWhere| (msg)
  (if (member '|trace| (|getMsgCatAttr| msg '|catless|))
      (|setMsgUnforcedAttr| msg '|$toWhereGuys| '|screenOnly|)))
```

defun ncBug

Bug in the compiler: something which shouldn't have happened did. [processKeyedError p353]

```
[msgCreate p347]
[enable-backtrace p??]
[ncAbort p??]
[$nopus p26]
[$newcompErrorCount p26]
```

— defun ncBug —

```
(defun |ncBug| (erMsgKey erArgL &rest optAttr)
  (let (erMsg)
    (declare (special |$nopus| |$newcompErrorCount|))
    (setq |$newcompErrorCount| (+ |$newcompErrorCount| 1))
    (setq erMsg
      (|processKeyedError|
        (|msgCreate| '|bug| |$nopus| erMsgKey erArgL "Bug!" optAttr)))
    (break)
    (|ncAbort|)))
```

defun processMsgList

[erMsgSort p369]
 [makeMsgFromLine p371]
 [poGlobalLinePosn p70]
 [getMsgPos p359]
 [queueUpErrors p372]
 [listOutputter p354]
 [\$noRepList p??]
 [\$outputList p??]

— defun processMsgList —

```
(defun |processMsgList| (erMsgList lineList)
  (let (|$noRepList| |$outputList| st globalNumOfLine msgLine)
    (declare (special |$noRepList| |$outputList|))
    (setq |$outputList| nil)
    (setq |$noRepList| nil)
    (setq erMsgList (|erMsgSort| erMsgList))
    (dolist (line lineList)
      (setq msgLine (|makeMsgFromLine| line))
      (setq |$outputList| (cons msgLine |$outputList|))
      (setq globalNumOfLine (|poGlobalLinePosn| (|getMsgPos| msgLine)))
      (setq erMsgList (|queueUpErrors| globalNumOfLine erMsgList)))
    (setq |$outputList| (append erMsgList |$outputList|))
    (setq st "-----SOURCE-TEXT-&-ERRORS-----")
    (|listOutputter| (reverse |$outputList|))))
```

—————

defun erMsgSort

[erMsgSep p370]
 [listSort p??]

— defun erMsgSort —

```
(defun |erMsgSort| (erMsgList)
  (let (msgWOPos msgWPos tmp)
    (setq tmp (|erMsgSep| erMsgList))
    (setq msgWPos (car tmp))
    (setq msgWOPos (cadr tmp))
    (setq msgWPos (|listSort| #'|erMsgCompare| msgWPos))
    (setq msgWOPos (reverse msgWOPos))
    (append msgWPos msgWOPos)))
```

defun erMsgCompare

[compareposns p370]
 [getMsgPos p359]

— defun erMsgCompare —

```
(defun |erMsgCompare| (ob1 ob2)
  (|compareposns| (|getMsgPos| ob2) (|getMsgPos| ob1)))
```

defun compareposns

[poGlobalLinePosn p70]
 [poCharPosn p377]

— defun compareposns —

```
(defun |compareposns| (a b)
  (let (c d)
    (setq c (|poGlobalLinePosn| a))
    (setq d (|poGlobalLinePosn| b))
    (if (equal c d)
        (not (< (|poCharPosn| a) (|poCharPosn| b)))
        (not (< c d)))))
```

defun erMsgSep

[poNopos? p360]
 [getMsgPos p359]

— defun erMsgSep —

```
(defun |erMsgSep| (erMsgList)
  (let (msgWOPos msgWPos)
    (dolist (msg erMsgList)
      (if (|poNopos?| (|getMsgPos| msg))
          (setq msgWOPos (cons msg msgWOPos))
```

```
(setq msgWPos (cons msg msgWPos))))
(list msgWPos msgWOPos))
```

defun makeMsgFromLine

```
[getLinePos p372]
[getLineText p372]
[poGlobalLinePosn p70]
[poLinePosn p361]
[strconc p??]
[rep p371]
[char p??]
[size p1045]
[$preLength p355]
```

— defun makeMsgFromLine —

```
(defun |makeMsgFromLine| (line)
  (let (localNumOfLine stNum globalNumOfLine textOfLine posOfLine)
    (declare (special |$preLength|))
    (setq posOfLine (|getLinePos| line))
    (setq textOfLine (|getLineText| line))
    (setq globalNumOfLine (|poGlobalLinePosn| posOfLine))
    (setq stNum (princ-to-string (|poLinePosn| posOfLine)))
    (setq localNumOfLine
      (strconc (|rep| #\space (- |$preLength| 7 (size stNum))) stNum))
    (list '|line| posOfLine nil nil (strconc "Line" localNumOfLine) textOfLine)))
```

defun rep

TPDHERE: This function should be replaced by fillerspaces

— defun rep 0 —

```
(defun |rep| (c n)
  (if (< 0 n)
    (make-string n :initial-element (character c))
    ""))
```

defun getLinePos

```

— defun getLinePos 0 —

(defun |getLinePos| (line) (car line))

```

defun getLineText

```

— defun getLineText 0 —

(defun |getLineText| (line) (cdr line))

```

defun queueUpErrors

```

;queueUpErrors(globalNumOfLine,msgList)==
;   thisPosMsgs := []
;   notThisLineMsgs := []
;   for msg in msgList _
;     while thisPosIsLess(getMsgPos msg,globalNumOfLine) repeat
;       --these are msgs that refer to positions from earlier compilations
;       if not redundant (msg,notThisPosMsgs) then
;         notThisPosMsgs := [msg,:notThisPosMsgs]
;       msgList := rest msgList
;   for msg in msgList _
;     while thisPosIsEqual(getMsgPos msg,globalNumOfLine) repeat
;       if not redundant (msg,thisPosMsgs) then
;         thisPosMsgs := [msg,:thisPosMsgs]
;       msgList := rest msgList
;   if thisPosMsgs then
;     thisPosMsgs := processChPosesForOneLine thisPosMsgs
;     $outputList := NCONC(thisPosMsgs,$outputList)
;   if notThisPosMsgs then
;     $outputList := NCONC(notThisPosMsgs,$outputList)
;   msgList

```

[processChPosesForOneLine p376]
 [\$outputList p??]

```

— defun queueUpErrors —

```

```

(DEFUN |queueUpErrors| (|globalNumOfLine| |msgList|)
  (PROG (|notThisPosMsgs| |notThisLineMsgs| |thisPosMsgs|)
    (DECLARE (SPECIAL |$outputList|))
    (RETURN
      (PROGN
        (SETQ |thisPosMsgs| NIL)
        (SETQ |notThisLineMsgs| NIL)
        ((LAMBDA (|bfVar#7| |msg|)
          (LOOP
            (COND
              ((OR (ATOM |bfVar#7|)
                (PROGN (SETQ |msg| (CAR |bfVar#7|)) NIL)
                (NOT (|thisPosIsLess| (|getMsgPos| |msg|)
                                      |globalNumOfLine|)))
              (RETURN NIL))
            'T
            (PROGN
              (COND
                ((NULL (|redundant| |msg| |notThisPosMsgs|))
                 (SETQ |notThisPosMsgs|
                       (CONS |msg| |notThisPosMsgs|))))
                (SETQ |msgList| (CDR |msgList|))))
              (SETQ |bfVar#7| (CDR |bfVar#7|))))
          |msgList| NIL)
        ((LAMBDA (|bfVar#8| |msg|)
          (LOOP
            (COND
              ((OR (ATOM |bfVar#8|)
                (PROGN (SETQ |msg| (CAR |bfVar#8|)) NIL)
                (NOT (|thisPosIsEqual| (|getMsgPos| |msg|)
                                      |globalNumOfLine|)))
              (RETURN NIL))
            'T
            (PROGN
              (COND
                ((NULL (|redundant| |msg| |thisPosMsgs|))
                 (SETQ |thisPosMsgs| (CONS |msg| |thisPosMsgs|))))
                (SETQ |msgList| (CDR |msgList|))))
              (SETQ |bfVar#8| (CDR |bfVar#8|))))
          |msgList| NIL)
        (COND
          (|thisPosMsgs|
            (SETQ |thisPosMsgs|
                  (|processChPosesForOneLine| |thisPosMsgs|))
            (SETQ |$outputList| (NCONC |thisPosMsgs| |$outputList|))))
          (COND
            (|notThisPosMsgs|
              (SETQ |$outputList|
                    (NCONC |notThisPosMsgs| |$outputList|))))
            |msgList|))))

```

defun thisPosIsLess

[poNopos? p360]
[poGlobalLinePosn p70]

— defun thisPosIsLess —

```
(defun |thisPosIsLess| (pos num)
  (unless (|poNopos?| pos) (< (|poGlobalLinePosn| pos) num)))
```

defun thisPosIsEqual

[poNopos? p360]
[poGlobalLinePosn p70]

— defun thisPosIsEqual —

```
(defun |thisPosIsEqual| (pos num)
  (unless (|poNopos?| pos) (equal (|poGlobalLinePosn| pos) num)))
```

defun redundant

```
redundant(msg,thisPosMsgs) ==
  found := NIL
  if msgNoRep? msg then
    for item in $noRepList repeat
      sameMsg?(msg,item) => return (found := true)
    $noRepList := [msg,$noRepList]
  found or MEMBER(msg,thisPosMsgs)
```

[msgNoRep? p375]
[sameMsg? p376]
[\$noRepList p??]

— defun redundant —

```
(defun |redundant| (msg thisPosMsgs)
  (prog (found)
    (declare (special |$noRepList|))
    (return
      (progn
        (cond
          ((|msgNoRep?| msg)
            ((lambda (Var9 item)
              (loop
                (cond
                  ((or (atom Var9) (progn (setq item (car Var9)) nil))
                    (return nil))
                  (t
                     (cond
                      ((|sameMsg?| msg item) (return (setq found t))))
                    (setq Var9 (cdr Var9))))
                |$noRepList| nil)
              (setq |$noRepList| (list msg |$noRepList|)))
            (or found (member msg thisPosMsgs))))))
```

defvar \$repGuys

— initvars —

```
(defvar |$repGuys| (list '|noRep| '|rep|))
```

defun msgNoRep?

[getMsgCatAttr [p358](#)]

— defun msgNoRep? —

```
(defun |msgNoRep?| (msg) (eq (|getMsgCatAttr| msg '|$repGuys|) '|noRep|))
```

defun sameMsg?

```
[getMsgKey p348]
[getMsgArgL p349]
```

— defun sameMsg? —

```
(defun |sameMsg?| (msg1 msg2)
  (and (equal (|getMsgKey| msg1) (|getMsgKey| msg2))
        (equal (|getMsgArgL| msg1) (|getMsgArgL| msg2))))
```

defun processChPosesForOneLine

```
[posPointers p378]
[getMsgFTTag? p359]
[putFTText p379]
[poCharPosn p377]
[getMsgPos p359]
[getMsgPrefix p349]
[setMsgPrefix p349]
[strconc p??]
[size p1045]
[makeLeaderMsg p377]
[$preLength p355]
```

— defun processChPosesForOneLine —

```
(defun |processChPosesForOneLine| (msgList)
  (let (leaderMsg oldPre posLetter chPosList)
    (declare (special |$preLength|))
    (setq chPosList (|posPointers| msgList))
    (dolist (msg msgList)
      (when (|getMsgFTTag?| msg) (|putFTText| msg chPosList))
      (setq posLetter (cdr (assoc (|poCharPosn| (|getMsgPos| msg)) chPosList)))
      (setq oldPre (|getMsgPrefix| msg))
      (|setMsgPrefix| msg
        (strconc oldPre
          (make-string (- |$preLength| 4 (size oldPre)) posLetter)))
      (setq leaderMsg (|makeLeaderMsg| chPosList))
      (nconc msgList (list leaderMsg))))
```

defun poCharPosn

— defun poCharPosn 0 —

```
(defun |poCharPosn| (posn)
  (cdr posn))
```

—————

defun makeLeaderMsg

```
makeLeaderMsg chPosList ==
  st := MAKE_-FULL_-CVEC ($preLength- 3)
  oldPos := -1
  for [posNum, posLetter] in reverse chPosList repeat
    st := STRCONC(st, _
      rep(char ".", (posNum - oldPos - 1)), posLetter)
    oldPos := posNum
  ['leader, $nopus, 'nokey, NIL, NIL, [st] ]
```

[[\\$nopus p26](#)]
 [[\\$preLength p355](#)]

— defun makeLeaderMsg —

```
(defun |makeLeaderMsg| (chPosList)
  (let (posLetter posNum oldPos st)
    (declare (special |$nopus| |$preLength|))
    (setq st (make-string (- |$preLength| 3)))
    (setq oldPos -1)
    ((lambda (Var15 Var14)
      (loop
        (cond
          ((or (atom Var15) (progn (setq Var14 (car Var15)) nil))
            (return nil))
          (t
            (and (consp Var14)
              (progn
                (setq posNum (car Var14))
                (setq posLetter (cdr Var14))
                t)
              (progn
                (setq st
                  (strconc st (|rep| #\. (- posNum oldPos 1)) posLetter))
                (setq oldPos posNum))))))
      (setq Var15 (cdr Var15))))))
```

```
(reverse chPosList) nil)
(list '|leader| |$nopo| '|nokey| nil nil (list st))))
```

defun posPointers

TPDHERE: getMsgFTTag is nonsense [poCharPosn p377]
 [getMsgPos p359]
 [IFCAR p??]
 [getMsgPos2 p378]
 [insertPos p379]
 [getMsgFTTag p??]

— defun posPointers —

```
(defun |posPointers| (msgList)
  (let (posLetterList pos ftPosList posList increment pointers)
    (declare (special |getMsgFTTag|))
    (setq pointers "ABCDEFGHJKLMNOPQRS")
    (setq increment 0)
    (dolist (msg msgList)
      (setq pos (|poCharPosn| (|getMsgPos| msg)))
      (unless (equal pos (ifcar posList))
        (setq posList (cons pos posList)))
      ; this should probably read TPDHERE
      ; (when (eq (|getMsgPosTagOb| msg) 'fromto))
      (when (eq |getMsgFTTag| 'fromto)
        (setq ftPosList (cons (|poCharPosn| (|getMsgPos2| msg)) ftPosList)))
      (dolist (toPos ftPosList)
        (setq posList (|insertPos| toPos posList)))
      (dolist (pos posList)
        (setq posLetterList
          (cons (cons pos (elt pointers increment)) posLetterList))
        (setq increment (+ increment 1)))
      posLetterList))
```

defun getMsgPos2

[getMsgFTTag? p359]
 [getMsgPosTagOb p348]
 [ncBug p368]

— defun getMsgPos2 —

```
(defun |getMsgPos2| (msg)
  (if (|getMsgFTTag?| msg)
      (caddr (|getMsgPosTagOb| msg))
      (|ncBug| "not a from to" nil)))
```

defun insertPos

This function inserts a position in the proper place of a position list. This is used for the 2nd pos of a fromto [done p??]

— defun insertPos 0 —

```
(defun |insertPos| (newPos posList)
  (let (pos top bot done)
    (setq bot (cons 0 posList))
    (do () (done)
      (setq top (cons (car bot) top))
      (setq bot (cdr bot))
      (setq pos (car bot))
      (setq done
        (cond
          ((< pos newPos) nil)
          ((equal pos newPos) t)
          ((< newPos pos)
           (setq top (cons newPos top))
           t))))
    (cons (cdr (reverse top)) bot)))
```

defun putFTText

```
[getMsgFTTag? p359]
[poCharPosn p377]
[getMsgPos p359]
[setMsgText p349]
[getMsgText p349]
[getMsgPos2 p378]
```

— defun putFTText —

```
(defun |putFText| (msg chPosList)
  (let (charMarker2 pos2 markingText charMarker pos tag)
    (setq tag (|getMsgFTextTag?| msg))
    (setq pos (|poCharPosn| (|getMsgPos| msg)))
    (setq charMarker (cdr (assoc pos chPosList)))
    (cond
      ((eq tag 'from)
        (setq markingText (list "(from " charMarker " and on) "))
        (|setMsgText| msg (append markingText (|getMsgText| msg))))
      ((eq tag 'to)
        (setq markingText (list "(up to " charMarker " )"))
        (|setMsgText| msg (append markingText (|getMsgText| msg))))
      ((eq tag 'fromto)
        (setq pos2 (|poCharPosn| (|getMsgPos2| msg)))
        (setq charMarker2 (cdr (assoc pos2 chPosList)))
        (setq markingText (list "(from " charMarker " up to " charMarker2 " )"))
        (|setMsgText| msg (append markingText (|getMsgText| msg)))))))
```

defun From

This is called from parameter list of nc message functions

— **defun From 0** —

```
(defun |From| (pos) (list 'from pos))
```

defun To

This is called from parameter list of nc message functions

— **defun To 0** —

```
(defun |To| (pos) (list 'to pos))
```

defun FromTo

This is called from parameter list of nc message functions

— **defun FromTo 0** —

```
(defun |FromTo| (pos1 pos2) (list 'fromto pos1 pos2))
```

Chapter 14

The Interpreter Syntax

14.1 syntax assignment

— assignment.help —

Immediate, Delayed, and Multiple Assignment

=====

Immediate Assignment

=====

A variable in Axiom refers to a value. A variable has a name beginning with an uppercase or lowercase alphabetic character, "%", or "!". Successive characters (if any) can be any of the above, digits, or "?". Case is distinguished. The following are all examples of valid, distinct variable names:

a	tooBig?	a1B2c3%!?
A	%j	numberOfPoints
beta6	%J	numberofpoints

The "!=" operator is the immediate assignment operator. Use it to associate a value with a variable. The syntax for immediate assignment for a single variable is:

variable := expression

The value returned by an immediate assignment is the value of expression.

a := 1
1

Type: PositiveInteger

The right-hand side of the expression is evaluated, yielding 1. The value is then assigned to a.

```
b := a
1
```

Type: PositiveInteger

The right-hand side of the expression is evaluated, yielding 1. This value is then assigned to b. Thus a and b both have the value 1 after the sequence of assignments.

```
a := 2
2
```

Type: PositiveInteger

What is the value of b if a is assigned the value 2?

```
b
1
```

Type: PositiveInteger

The value of b is left unchanged.

This is what we mean when we say this kind of assignment is immediate. The variable b has no dependency on a after the initial assignment. This is the usual notion of assignment in programming languages such as C, Pascal, and Fortran.

```
=====
Delayed Assignment
=====
```

Axiom provides delayed assignment with "==". This implements a delayed evaluation of the right-hand side and dependency checking. The syntax for delayed assignment is

```
variable == expression
```

The value returned by a delayed assignment is the unique value of Void.

```
a == 1
```

Type: Void

```
b == a
```

Type: Void

Using a and b as above, these are the corresponding delayed assignments.

```

a
  Compiling body of rule a to compute value of type PositiveInteger
  1
    Type: PositiveInteger

```

The right-hand side of each delayed assignment is left unevaluated until the variables on the left-hand sides are evaluated.

```

b
  Compiling body of rule b to compute value of type PositiveInteger
  1
    Type: PositiveInteger

```

This gives the same results as before. But if we change a to 2

```

a == 2
  Compiled code for a has been cleared.
  Compiled code for b has been cleared.
  1 old definition(s) deleted for function or rule a
    Type: Void

```

Then a evaluates to 2, as expected

```

a
  Compiling body of rule a to compute value of type PositiveInteger
  2
    Type: PositiveInteger

```

but the value of b reflects the change to a

```

b
  Compiling body of rule b to compute value of type PositiveInteger
  2
    Type: PositiveInteger

```

Multiple Immediate Assignments

It is possible to set several variables at the same time by using a tuple of variables and a tuple of expressions. A tuple is a collection of things separated by commas, often surrounded by parentheses. The syntax for multiple immediate assignment is

```
( var1, var2, ..., varN ) := ( expr1, expr2, ..., exprN )
```

The value returned by an immediate assignment is the value of exprN.

```
( x, y ) := ( 1, 2 )
2
```

Type: PositiveInteger

This sets *x* to 1 and *y* to 2. Multiple immediate assignments are parallel in the sense that the expressions on the right are all evaluated before any assignments on the left are made. However, the order of evaluation of these expressions is undefined.

```
( x, y ) := ( y, x )
```

1

Type: PositiveInteger

x

2

Type: PositiveInteger

The variable *x* now has the previous value of *y*.

y

1

Type: PositiveInteger

The variable *y* now has the previous value of *x*.

There is no syntactic form for multiple delayed assignments.

14.2 syntax blocks

— blocks.help —

```
=====
Blocks
=====
```

A block is a sequence of expressions evaluated in the order that they appear, except as modified by control expressions such as `leave`, `return`, `iterate`, and `if-then-else` constructions. The value of a block is the value of the expression last evaluated in the block.

To leave a block early, use `"=>"`. For example,

```
i < 0 => x
```

The expression before the `"=>"` must evaluate to true or false. The expression following the `"=>"` is the return value of the block.

A block can be constructed in two ways:

1. the expressions can be separated by semicolons and the resulting expression surrounded by parentheses, and
 2. the expressions can be written on succeeding lines with each line indented the same number of spaces (which must be greater than zero).
- A block entered in this form is called a pile

Only the first form is available if you are entering expressions directly to Axiom. Both forms are available in .input files. The syntax for a simple block of expressions entered interactively is

```
( expression1 ; expression2 ; ... ; expressionN )
```

The value returned by a block is the value of an "=>" expression, or expressionN if no "=>" is encountered.

In .input files, blocks can also be written in piles. The examples given here are assumed to come from .input files.

```
a :=
  i := gcd(234,672)
  i := 2*i**5 - i + 1
  1 / i

      1
-----
23323

Type: Fraction Integer
```

In this example, we assign a rational number to a using a block consisting of three expressions. This block is written as a pile. Each expression in the pile has the same indentation, in this case two spaces to the right of the first line.

```
a := ( i := gcd(234,672); i := 2*i**5 - i + 1; 1 / i )

      1
-----
23323

Type: Fraction Integer
```

Here is the same block written on one line. This is how you are required to enter it at the input prompt.

```
( a := 1; b := 2; c := 3; [a,b,c] )
[1,2,3]

Type: List PositiveInteger
```

AAxiom gives you two ways of writing a block and the preferred way in an .input file is to use a pile. Roughly speaking, a pile is a block whose constituent expressions are indented the same amount. You begin a pile by starting a new line for the first expression, indenting it to the right of the previous line. You then enter the second expression on a new line, vertically aligning it with the first line. And so on. If you need to enter an inner pile, further indent its lines to the right of the outer pile. Axiom knows where a pile ends. It ends when a subsequent line is indented to the left of the pile or the end of the file.

Also See:

- o)help if
- o)help repeat
- o)help while
- o)help for
- o)help suchthat
- o)help parallel
- o)help lists

1

14.3 system clef

— clef.help —

Entering printable keys generally inserts new text into the buffer (unless in overwrite mode, see below). Other special keys can be used to modify the text in the buffer. In the description of the keys below, `^n` means Control-n, or holding the CONTROL key down while pressing "n". Errors will ring the terminal bell.

- `^A/^E` : Move cursor to beginning/end of the line.
- `^F/^B` : Move cursor forward/backward one character.
- `^D` : Delete the character under the cursor.
- `^H, DEL` : Delete the character to the left of the cursor.
- `^K` : Kill from the cursor to the end of line.
- `^L` : Redraw current line.
- `^O` : Toggle overwrite/insert mode. Initially in insert mode. Text added in overwrite mode (including yanks) overwrite existing text, while insert mode does not overwrite.
- `^P/^N` : Move to previous/next item on history list.

¹ "if" (14.6 p 395) "repeat" (14.10 p 402) "while" (68.1 p 1039) "for" (14.5 p 391) "suchthat" (14.11 p 406) "parallel" (14.9 p 399) "lists" (?? p ??)

`^R/^S` : Perform incremental reverse/forward search for string on the history list. Typing normal characters adds to the current search string and searches for a match. Typing `^R/^S` marks the start of a new search, and moves on to the next match. Typing `^H` or `DEL` deletes the last character from the search string, and searches from the starting location of the last search. Therefore, repeated `DEL`'s appear to unwind to the match nearest the point at which the last `^R` or `^S` was typed. If `DEL` is repeated until the search string is empty the search location begins from the start of the history list. Typing `ESC` or any other editing character accepts the current match and loads it into the buffer, terminating the search.

`^T` : Toggle the characters under and to the left of the cursor.

`^Y` : Yank previously killed text back at current location. Note that this will overwrite or insert, depending on the current mode.

`^U` : Show help (this text).

`TAB` : Perform command completion based on word to the left of the cursor. Words are deemed to contain only the alphanumeric and the `% ! ? _` characters.

`NL, CR` : returns current buffer to the program.

DOS and ANSI terminal arrow key sequences are recognized, and act like:

up : same as `^P`
 down : same as `^N`
 left : same as `^B`
 right : same as `^F`

14.4 syntax collection

— collection.help —

```
=====
Collection -- Creating Lists and Streams with Iterators
=====
```

All of the loop expressions which do not use the `repeat` `leave` or `iterate` words can be used to create lists and streams. For example:

This creates a simple list of the integers from 1 to 10:

```
list := [i for i in 1..10]
[1,2,3,4,5,6,7,8,9,10]
Type: List PositiveInteger
```

Create a stream of the integers greater than or equal to 1:

```
stream := [i for i in 1..]
[1,2,3,4,5,6,7,...]
Type: Stream PositiveInteger
```

This is a list of the prime numbers between 1 and 10, inclusive:

```
[i for i in 1..10 | prime? i]
[2,3,5,7]
Type: List PositiveInteger
```

This is a stream of the prime integers greater than or equal to 1:

```
[i for i in 1.. | prime? i]
[2,3,5,7,11,13,17,...]
Type: Stream PositiveInteger
```

This is a list of the integers between 1 and 10, inclusive, whose squares are less than 700:

```
[i for i in 1..10 while i*i < 700]
[1,2,3,4,5,6,7,8,9,10]
Type: List PositiveInteger
```

This is a stream of the integers greater than or equal to 1 whose squares are less than 700:

```
[i for i in 1.. while i*i < 700]
[1,2,3,4,5,6,7,...]
Type: Stream PositiveInteger
```

The general syntax of a collection is

```
[ collectExpression iterator1 iterator2 ... iteratorN ]
```

where each iterator is either a for or a while clause. The loop terminates immediately when the end test of any iterator succeeds or when a return expression is evaluated in collectExpression. The value returned by the collection is either a list or a stream of elements, one for each iteration of the collectExpression.

Be careful when you use while to create a stream. By default Axiom tries to compute and display the first ten elements of a stream. If the while condition is not satisfied quickly, Axiom can spend a long (potentially infinite) time trying to compute the elements. Use

```
)set streams calculate
```

to change the defaults to something else. This also affects the number of terms computed and displayed for power series. For the purposes of these examples we have use this system command to display fewer than ten terms.

14.5 syntax for

— for.help —

```
=====
for loops
=====
```

Axiom provide the for and in keywords in repeat loops, allowing you to integrate across all elements of a list, or to have a variable take on integral values from a lower bound to an upper bound. We shall refer to these modifying clauses of repeat loops as for clauses. These clauses can be present in addition to while clauses (See)help while). As with all other types of repeat loops, leave (see)help leave) can be used to prematurely terminate evaluation of the loop.

The syntax for a simple loop using for is

```
for iterator repeat loopbody
```

The iterator has several forms. Each form has an end test which is evaluated before loopbody is evaluated. A for loop terminates immediately when the end test succeeds (evaluates to true) or when a leave or return expression is evaluated in loopbody. The value returned by the loop is the unique value of Void.

```
=====
for i in n..m repeat
=====
```

If for is followed by a variable name, the in keyword and then an integer segment of the form n..m, the end test for this loop is the predicate $i > m$. The body of the loop is evaluated $m-n+1$ times if this number is greater than 0. If this number is less than or equal to 0, the loop body is not evaluated at all.

The variable i has the value n , $n+1$, ..., m for successive iterations of the loop body. The loop variable is a local variable within the loop body. Its value is not available outside the loop body and its value and

type within the loop body completely mask any outer definition of a variable with the same name.

```
for i in 10..12 repeat output(i**3)
1000
1331
1728
```

Type: Void

The loop prints the values of 10^3 , 11^3 , and 12^3 .

```
a := [1,2,3]
[1,2,3]
```

Type: List PositiveInteger

```
for i in 1..#a repeat output(a.i)
1
2
3
```

Type: Void

Iterate across this list using "." to access the elements of a list and the # operation to count its elements.

This type of iteration is applicable to anything that uses ".". You can also use it with functions that use indices to extract elements.

```
m := matrix [ [1,2],[4,3],[9,0] ]
+-      +-
| 1  2 |
| 4  3 |
| 9  0 |
+-      +-
```

Type: Matrix Integer

Define m to be a matrix.

```
for i in 1..nrows(m) repeat output row(m.i)
[1,2]
[4,3]
[9,0]
```

Type: Void

Display the rows of m.

You can iterate with for-loops.

```
for i in 1..5 repeat
  if odd?(i) then iterate
  output(i)
```

```
2
4
```

Type: Void

Display the even integers in a segment.

```
=====
for i in n..m by s repeat
=====
```

By default, the difference between values taken on by a variable in loops such as

```
for i in n..m repeat ...
```

is 1. It is possible to supply another, possibly negative, step value by using the `by` keyword along with `for` and `in`. Like the upper and lower bounds, the step value following the `by` keyword must be an integer. Note that the loop

```
for i in 1..2 by 0 repeat output(i)
```

will not terminate by itself, as the step value does not change the index from its initial value of 1.

```
for i in 1..5 by 2 repeat output(i)
1
3
5
```

Type: Void

This expression displays the odd integers between two bounds.

```
for i in 5..1 by -2 repeat output(i)
5
3
1
```

Type: Void

Use this to display the numbers in reverse order.

```
=====
for i in n.. repeat
=====
```

If the value after the `".."` is omitted, the loop has no end test. A potentially infinite loop is thus created. The variable is given the successive values `n`, `n+1`, `n+2`, ... and the loop is terminated only if a `leave` or `return` expression is evaluated in the loop body. However, you may also add some other modifying clause on the `repeat`, for example,

a while clause, to stop the loop.

```
for i in 15.. while not prime?(i) repeat output(i)
15
16
```

Type: Void

This loop displays the integers greater than or equal to 15 and less than the first prime number greater than 15.

```
=====
for x in l repeat
=====
```

Another variant of the for loop has the form:

```
for x in list repeat loopbody
```

This form is used when you want to iterate directly over the elements of a list. In this form of the for loop, the variable *x* takes on the value of each successive element in *l*. The end test is most simply stated in English: "are there no more *x* in *l*?"

```
l := [0, -5, 3]
[0, -5, 3]
```

Type: List Integer

```
for x in l repeat output(x)
0
-5
3
```

Type: Void

This displays all of the elements of the list *l*, one per line.

Since the list constructing expression

```
expand [n..m]
```

creates the list

```
[n, n+1, ..., m]
```

you might be tempted to think that the loops

```
for i in n..m repeat output(i)
```

and

```
for x in expand [n..m] repeat output(x)
```

are equivalent. The second form first creates the expanded list (no matter how large it might be) and then does the iteration. The first form potentially runs in much less space, as the index variable `i` is simply incremented once per loop and the list is not actually created. Using the first form is much more efficient.

Of course, sometimes you really want to iterate across a specific list. This displays each of the factors of 2400000:

```
for f in factors(factor(2400000)) repeat output(f)
[factor= 2, exponent= 8]
[factor= 3, exponent= 1]
[factor= 5, exponent= 5]
Type: Void
```

14.6 syntax if

— if.help —

```
=====
If-then-else
=====
```

Like many other programming languages, Axiom uses the three keywords `if`, `then`, and `else` to form conditional expressions. The `else` part of the conditional is optional. The expression between the `if` and `then` keywords is a predicate: an expression that evaluates to or is convertible to either true or false, that is, a Boolean.

The syntax for conditional expressions is

```
if predicate then expression1 else expression2
```

where the "else expression2" part is optional. The value returned from a conditional expression is expression1 if the predicate evaluates to true and expression2 otherwise. If no else clause is given, the value is always the unique value of Void.

An if-then-else expression always returns a value. If the else clause is missing then the entire expression returns the unique value of Void. If both clauses are present, the type of the value returned by if is obtained by resolving the types of the values of the two clauses.

The predicate must evaluate to, or be convertible to, an object of type Boolean: true or false. By default, the equal sign "=" creates an equation.

```
x + 1 = y
x + 1 = y
```

Type: Equation Polynomial Integer

This is an equation, not a boolean condition. In particular, it is an object of type Equation Polynomial Integer.

However, for predicates in if expressions, Axiom places a default target type of Boolean on the predicate and equality testing is performed. Thus you need not qualify the "=" in any way. In other contexts you may need to tell Axiom that you want to test for equality rather than create an equation. In these cases, use "@" and a target type of Boolean.

The compound symbol meaning "not equal" in Axiom is "~=". This can be used directly without a package call or a target specification. The expression "a ~= b" is directly translated to "not(a = b)".

Many other functions have return values of type Boolean. These include <, <=, >, >=, ~=, and member?. By convention, operations with names ending in "?" return Boolean values.

The usual rules for files are suspended for conditional expressions. In .input files, the then and else keywords can begin in the same column as the corresponding if by may also appear to the right. Each of the following styles of writing if-then-else expressions is acceptable:

```
if i>0 then output("positive") else output("nonpositive")
```

```
if i>0 then output("positive")
    else output("nonpositive")
```

```
if i>0 then output("positive")
else output("nonpositive")
```

```
if i>0
then output("positive")
else output("nonpositive")
```

```
if i>0
    then output("positive")
    else output("nonpositive")
```

A block can follow the then or else keywords. In the following two assignments to a, the then and else clauses each are followed by two line piles. The value returned in each is the value of the second line.

```
a :=
```

```

if i > 0 then
  j := sin(i * pi())
  exp(j + 1/j)
else
  j := cos(i * 0.5 * pi())
  log(abs(j)**5 + i)

a :=
if i > 0
then
  j := sin(i * pi())
  exp(j + 1/j)
else
  j := cos(i * 0.5 * pi())
  log(abs(j)**5 + i)

```

These are both equivalent to the following:

```

a :=
if i > 0 then (j := sin(i * pi()); exp(j + 1/j))
else (j := cos(i * 0.5 * pi()); log(abs(j)**5 + i))

```

14.7 syntax iterate

— iterate.help —

```

=====
iterate in loops
=====

```

Axiom provides an `iterate` expression that skips over the remainder of a loop body and starts the next loop execution. We first initialize a counter.

```

i := 0
0
                                Type: NonNegativeInteger

```

Display the even integers from 2 to 5:

```

repeat
  i := i + 1
  if i > 5 then leave

```

```

    if odd?(i) then iterate
    output(i)
  2
  4

```

Type: Void

14.8 syntax leave

— leave.help —

```

=====
leave in loops
=====

```

The leave keyword is often more useful in terminating a loop. A leave causes control to transfer to the expression immediately following the loop. As loops always return the unique value of Void, you cannot return a value with leave. That is, leave takes no argument.

```

f() ==
  i := 1
  repeat
    if factorial(i) > 1000 then leave
    i := i + 1
  i

```

Type: Void

This example is a modification of the last example in the previous section. Instead of using return we'll use leave.

```

f()
7

```

Type: PositiveInteger

The loop terminates when factorial(i) gets big enough. The last line of the function evaluates to the corresponding "good" value of i and the function terminates, returning that value.

You can only use leave to terminate the evaluation of one loop. Lets consider a loop within a loop, that is, a loop with a nested loop. First, we initialize two counter variables.

```

(i,j) := (1,1)
1

```

Type: PositiveInteger

```
repeat
  repeat
    if (i + j) > 10 then leave
    j := j + 1
  if (i + j) > 10 then leave
  i := i + 1
```

Type: Void

Nested loops must have multiple leave expressions at the appropriate nesting level. How would you rewrite this so $(i + j) > 10$ is only evaluated once?

```
=====
leave vs => in loop bodies
=====
```

Compare the following two loops:

<pre>i := 1 repeat i := i + 1 i > 3 => i output(i)</pre>	<pre>i := 1 repeat i := i + 1 if i > 3 then leave output(i)</pre>
--	--

In the example on the left, the values 2 and 3 for i are displayed but then the " \Rightarrow " does not allow control to reach the call to output again. The loop will not terminate until you run out of space or interrupt the execution. The variable i will continue to be incremented because the " \Rightarrow " only means to leave the block, not the loop.

In the example on the right, upon reaching 4, the leave will be executed, and both the block and the loop will terminate. This is one of the reasons why both " \Rightarrow " and leave are provided. Using a while clause with the " \Rightarrow " lets you simulate the action of leave.

—

14.9 syntax parallel

— parallel.help —

```
=====
parallel iteration
=====
```


Sometimes you want to iterate across two lists in parallel, or perhaps you want to traverse a list while incrementing a variable.

The general syntax of a repeat loop is

```
iterator1, iterator2, ..., iteratorN repeat loopbody
```

where each iterator is either a for or a while clause. The loop terminates immediately when the end test of any iterator succeeds or when a leave or return expression is evaluated in loopbody. The value returned by the loop is the unique value of Void.

```
l := [1,3,5,7]
    [1,3,5,7]
                                Type: List PositiveInteger

m := [100,200]
    [100,200]
                                Type: List PositiveInteger

sum := 0
    0
                                Type: NonNegativeInteger
```

Here we write a loop to iterate across two lists, computing the sum of the pairwise product of the elements:

```
for x in l for y in m repeat
    sum := sum + x*y
                                Type: Void
```

The last two elements of `l` are not used in the calculation because `m` has two fewer elements than `l`.

```
sum
700
                                Type: NonNegativeInteger
```

This is the "dot product".

Next we write a loop to compute the sum of the products of the loop elements with their positions in the loop.

```
l := [2,3,5,7,11,13,17,19,23,29,31,37]
    [2,3,5,7,11,13,17,19,23,29,31,37]
                                Type: List PositiveInteger

sum := 0
    0
```

Type: NonNegativeInteger

```
for i in 0.. for x in l repeat sum := i * x
Type: Void
```

Here looping stops when the list `l` is exhausted, even though the `for i in 0..` specifies no terminating condition.

```
sum
407
Type: NonNegativeInteger
```

When `"|"` is used to qualify any of the `for` clauses in a parallel iteration, the variables in the predicates can be from an outer scope or from a `for` clause in or to the left of the modified clause.

This is correct:

```
for i in 1..10 repeat
  for j in 200..300 | odd? (i+j) repeat
    output [i,j]
```

But this is not correct. The variable `j` has not been defined outside the inner loop:

```
for i in 1..10 | odd? (i+j) repeat -- wrong, j not defined
  for j in 200..300 repeat
    output [i,j]
```

It is possible to mix several of repeat modifying clauses on a loop:

```
for i in 1..10
  for j in 151..160 | odd? j
    while i + j < 160 repeat
      output [i,j]
[1,151]
[3,153]
Type: Void
```

Here are useful rules for composing loop expressions:

1. while predicates can only refer to variables that are global (or in an outer scope) or that are defined in `for` clauses to the left of the predicate.
2. A "such that" predicate (something following `"|"`) must directly follow a `for` clause and can only refer to variables that are global (or in an outer scope) or defined in the modified `for` clause or any `for` clause to the left.

14.10 syntax repeat

— repeat.help —

```
=====
Repeat Loops
=====
```

A loop is an expression that contains another expression, called the loop body, which is to be evaluated zero or more times. All loops contain the repeat keyword and return the unique value of Void. Loops can contain inner loops to any depth.

The most basic loop is of the form

```
repeat loopbody
```

Unless loopbody contains a leave or return expression, the loop repeats forever. The value returned by the loop is the unique value of Void.

Axiom tries to determine completely the type of every object in a loop and then to translate the loop body to Lisp or even to machine code. This translation is called compilation.

If Axiom decides that it cannot compile the loop, it issues a message stating the problem and then the following message:

```
We will attempt to step through and interpret the code
```

It is still possible that Axiom can evaluate the loop but in interpret-code mode.

```
=====
Return in Loops
=====
```

A return expression is used to exit a function with a particular value. In particular, if a return is in a loop within the function, the loop is terminated whenever the return is evaluated.

```
f() ==
  i := 1
  repeat
    if factorial(i) > 1000 then return i
  i := i + 1
```

Type: Void

f()

Type: Void

When factorial(i) is big enough, control passes from inside the loop all the way outside the function, returning the value of i (so we think). What went wrong? Isn't it obvious that this function should return an integer? Well, Axiom makes no attempt to analyze the structure of a loop to determine if it always returns a value because, in general, this is impossible. So Axiom has this simple rule: the type of the function is determined by the type of its body, in this case a block. The normal value of a block is the value of its last expression, in this case, a loop. And the value of every loop is the unique value of Void. So the return type of f is Void.

There are two ways to fix this. The best way is for you to tell Axiom what the return type of f is. You do this by giving f a declaration

f:() -> Integer

prior to calling for its value. This tells Axiom "trust me -- an integer is returned". Another way is to add a dummy expression as follows.

```
f() ==
  i := 1
  repeat
    if factorial(i) > 1000 then return i
    i := i + 1
  0
```

Type: Void

Note that the dummy expression will never be evaluated but it is the last expression in the function and will determine the return type.

```
f()
7
```

Type: PositiveInteger

```
=====
leave in loops
=====
```

The leave keyword is often more useful in terminating a loop. A leave causes control to transfer to the expression immediately following the loop. As loops always return the unique value of Void, you cannot return a value with leave. That is, leave takes no argument.

```
f() ==
  i := 1
```

```

repeat
  if factorial(i) > 1000 then leave
  i := i + 1
i

```

Type: Void

This example is a modification of the last example in the previous section. Instead of using return we'll use leave.

```

f()
7

```

Type: PositiveInteger

The loop terminates when factorial(i) gets big enough. The last line of the function evaluates to the corresponding "good" value of i and the function terminates, returning that value.

You can only use leave to terminate the evaluation of one loop. Lets consider a loop within a loop, that is, a loop with a nested loop. First, we initialize two counter variables.

```

(i,j) := (1,1)
1

```

Type: PositiveInteger

```

repeat
  repeat
    if (i + j) > 10 then leave
    j := j + 1
  if (i + j) > 10 then leave
  i := i + 1

```

Type: Void

Nested loops must have multiple leave expressions at the appropriate nesting level. How would you rewrite this so (i + j) > 10 is only evaluated once?

```

=====
leave vs => in loop bodies
=====

```

Compare the following two loops:

<pre> i := 1 repeat i := i + 1 i > 3 => i output(i) </pre>	<pre> i := 1 repeat i := i + 1 if i > 3 then leave output(i) </pre>
--	--

In the example on the left, the values 2 and 3 for i are displayed but

then the "`=>`" does not allow control to reach the call to output again. The loop will not terminate until you run out of space or interrupt the execution. The variable `i` will continue to be incremented because the "`=>`" only means to leave the block, not the loop.

In the example on the right, upon reaching 4, the leave will be executed, and both the block and the loop will terminate. This is one of the reasons why both "`=>`" and `leave` are provided. Using a `while` clause with the "`=>`" lets you simulate the action of `leave`.

```
=====
iterate in loops
=====
```

Axiom provides an `iterate` expression that skips over the remainder of a loop body and starts the next loop execution. We first initialize a counter.

```
i := 0
0
Type: NonNegativeInteger
```

Display the even integers from 2 to 5:

```
repeat
  i := i + 1
  if i > 5 then leave
  if odd?(i) then iterate
  output(i)
2
4
Type: Void
```

Also See:

```
o )help blocks
o )help if
o )help while
o )help for
o )help suchthat
o )help parallel
o )help lists
```

2

² "blocks" (14.2 p 386) "if" (14.6 p 395) "while" (68.1 p 1039) "for" (14.5 p 391) "suchthat" (14.11 p 406) "parallel" (14.9 p 399) "lists" (?? p ??)

14.11 syntax suchthat

— suchthat.help —

```
=====
Such that predicates
=====
```

A for loop can be followed by a "|" and then a predicate. The predicate qualifies the use of the values from the iterator that follows the for. Think of the vertical bar "|" as the phrase "such that".

```
for n in 0..4 | odd? n repeat output n
1
3
```

Type: Void

This loop expression prints out the integers n in the given segment such that n is odd.

A for loop can also be written

```
for iterator | predicate repeat loopbody
```

which is equivalent to:

```
for iterator repeat if predicate then loopbody else iterate
```

The predicate need not refer only to the variable in the for clause. Any variable in an outer scope can be part of the predicate.

```
for i in 1..50 repeat
  for j in 1..50 | factorial(i+j) < 25 repeat
    output [i,j]
[1,1]
[1,2]
[1,3]
[2,1]
[2,2]
[3,1]
```

Type: Void

—

14.12 syntax syntax

— syntax.help —

The Axiom Interactive Language has the following features documented here.

More information is available by typing

```
)help feature
```

where feature is one of:

```
assignment -- Immediate and delayed assignments
blocks      -- Blocks of expressions
collection  -- creating lists with iterators
for         -- for loops
if          -- If-then-else statements
iterate     -- using iterate in loops
leave       -- using leave in loops
parallel    -- parallel iterations
repeat      -- repeat loops
suchthat    -- suchthat predicates
while       -- while loops
```

—

14.13 syntax while

— while.help —

```
=====
while loops
=====
```

The repeat in a loop can be modified by adding one or more while clauses. Each clause contains a predicate immediately following the while keyword. The predicate is tested before the evaluation of the body of the loop. The loop body is evaluated whenever the predicate in a while clause is true.

The syntax for a simple loop using while is

```
while predicate repeat loopbody
```


The predicate is evaluated before loopbody is evaluated. A while loop terminates immediately when predicate evaluates to false or when a leave or return expression is evaluated. See `)help repeat` for more information on leave and return.

Here is a simple example of using while in a loop. We first initialize the counter.

```
i := 1
1
                                     Type: PositiveInteger

while i < 1 repeat
  output "hello"
  i := i + 1
                                     Type: Void
```

The steps involved in computing this example are

- (1) set i to 1
- (2) test the condition `i < 1` and determine that it is not true
- (3) do not evaluate the loop body and therefore do not display "hello"

```
(x, y) := (1, 1)
1
                                     Type: PositiveInteger
```

If you have multiple predicates to be tested use the logical and operation to separate them. Axiom evaluates these predicates from left to right.

```
while x < 4 and y < 10 repeat
  output [x,y]
  x := x + 1
  y := y + 2
[1,1]
[2,3]
[3,5]
                                     Type: Void
```

A leave expression can be included in a loop body to terminate a loop even if the predicate in any while clauses are not false.

```
(x, y) := (1, 1)
1
                                     Type: PositiveInteger
```

```
while x < 4 and y < 10 repeat
  if x + y > 7 then leave
```

```
output [x,y]
x := x + 1
y := y + 2
[1,1]
[2,3]
```

Type: Void

Chapter 15

Abstract Syntax Trees (ptrees)

Abstract Syntax Trees

These functions create and examine abstract syntax trees. These are called pform, for short.

!! This file also contains constructors for concrete syntax, although
!! they should be somewhere else.

THE PFORM DATA STRUCTURE

Leaves: [hd, tok, pos]
Trees: [hd, tree, tree, ...]
hd is either an id or (id . alist)

defun Construct a leaf token

The tokConstruct function is a constructor and selectors for leaf tokens. A leaf token looks like [head, token, position] where head is either an id or (id . alist) [ifcar p??]

[pfNoPosition? p[412](#)]

[ncPutQ p[416](#)]

— defun tokConstruct —

```
(defun |tokConstruct| (head token &rest position)
  (let (result)
    (setq result (cons head token))
    (cond
      ((ifcar position)
       (cond
         ((|pfNoPosition?| (car position)) result)
         (t (|ncPutQ| result '|posn| (car position)) result)))
```

```
(t result))))
```

defun Return a part of a node

```
[ifcar p??]
```

— defun pfAbSynOp —

```
(defun |pfAbSynOp| (form)
  (let (hd)
    (setq hd (car form))
    (or (ifcar hd) hd)))
```

defun Compare a part of a node

```
[eqcar p??]
```

— defun pfAbSynOp? —

```
(defun |pfAbSynOp?| (form op)
  (let (hd)
    (setq hd (car form))
    (or (eq hd op) (eqcar hd op))))
```

defun pfNoPosition?

```
[poNoPosition? p413]
```

— defun pfNoPosition? —

```
(defun |pfNoPosition?| (pos)
  (|poNoPosition?| pos))
```

defun poNoPosition?

```
[eqcar p??]
```

```
— defun poNoPosition? 0 —
```

```
(defun |poNoPosition?| (pos)
  (eqcar pos '|noPosition|))
```

```
—————
```

defun tokType

```
[ncTag p415]
```

```
— defun tokType —
```

```
(defun |tokType| (x) (|ncTag| x))
```

```
—————
```

defun tokPart

```
— defun tokPart 0 —
```

```
(defun |tokPart| (x) (cdr x))
```

```
—————
```

defun tokPosn

```
[qassq p??]
```

```
[ncAlist p415]
```

```
[pfNoPosition p414]
```

```
— defun tokPosn —
```

```
(defun |tokPosn| (x)
  (let (a)
    (setq a (qassq '|posn| (|ncAlist| x)))
    (cond
```

```
(a (cdr a))
(t (|pfNoPosition|))))))
```

defun pfNoPosition

[poNoPosition p414]

— defun pfNoPosition —

```
(defun |pfNoPosition| () (|poNoPosition|))
```

defun poNoPosition

[\$npos p26]

— defun poNoPosition 0 —

```
(defun |poNoPosition| ()
  (declare (special |$npos|))
  |$npos|)
```

Chapter 16

Attributed Structures

For objects which are pairs where the CAR field is either just a tag (an identifier) or a pair which is the tag and an association list.

defun ncTag

Pick off the tag [ncBug p368]

[qcar p??]

[identp p1046]

— defun ncTag —

```
(defun |ncTag| (x)
  (cond
    ((null (consp x)) (|ncBug| 's2cb0031 nil))
    (t
     (setq x (qcar x))
     (cond
      ((identp x) x)
      ((null (consp x)) (|ncBug| 's2cb0031 nil))
      (t (qcar x))))))
```

—————

defun ncAlist

Pick off the property list [ncBug p368]

[qcar p??]

[identp p1046]

[qcdr p??]

— defun ncAlist —

```
(defun |ncAlist| (x)
  (cond
    ((null (consp x)) (|ncBug| 's2cb0031 nil))
    (t
     (setq x (qcar x))
     (cond
       ((identp x) nil)
       ((null (consp x)) (|ncBug| 's2cb0031 nil))
       (t (qcdr x))))))
```

defun ncEltQ

Get the entry for key k on x's association list [qassq p??]
 [ncAlist p[415](#)]
 [ncBug p[368](#)]

— defun ncEltQ —

```
(defun |ncEltQ| (x k)
  (let (r)
    (setq r (qassq k (|ncAlist| x)))
    (cond
      ((null r) (|ncBug| 's2cb0007 (list k)))
      (t (cdr r)))))
```

defun ncPutQ

```
-- Put (k . v) on the association list of x and return v
-- case1: ncPutQ(x,k,v) where k is a key (an identifier), v a value
--       put the pair (k . v) on the association list of x and return v
-- case2: ncPutQ(x,k,v) where k is a list of keys, v a list of values
--       equivalent to [ncPutQ(x,key,val) for key in k for val in v]
ncPutQ(x,k,v) ==
;   LISTP k =>
;     for key in k for val in v repeat ncPutQ(x,key,val)
;     v
;   r := QASSQ(k,ncAlist x)
;   if NULL r then
```

```

;      r := CONS( CONS(k,v), ncAlist x)
;      RPLACA(x,CONS(ncTag x,r))
;  else
;      RPLACD(r,v)
;  v

```

```

[qassq p??]
[ncAlist p415]
[ncTag p415]

```

— defun ncPutQ —

```

(defun |ncPutQ| (x k v)
  (let (r)
    (cond
      ((listp k)
       ((lambda (Var1 key Var2 val)
          (loop
            (cond
              ((or (atom Var1)
                   (progn (setq key (car Var1)) nil)
                   (atom Var2)
                   (progn (setq val (car Var2)) nil))
               (return nil))
              (t
               (|ncPutQ| x key val)))
            (setq Var1 (cdr Var1))
            (setq Var2 (cdr Var2))))
        k nil v nil)
      (v)
      (t
       (setq r (qassq k (|ncAlist| x)))
       (cond
         ((null r)
          (setq r (cons (cons k v) (|ncAlist| x)))
          (rplaca x (cons (|ncTag| x) r)))
         (t
          (rplacd r v)))
       v))))

```

—————

Chapter 17

Function Selection

New Selection of Modemaps

selection of applicable modemaps is done in two steps:

first it tries to find a modemap inside an argument domain, and if this fails, by evaluation of pattern modemaps the result is a list of functions with signatures, which have the following form:

[sig,elt,cond] where

sig is the signature gained by evaluating the modemap condition

elt is the slot number to get the implementation

cond are runtime checks which are the results of evaluating the modemap condition

the following flags are used:

\$Coerce is NIL, if function selection is done which requires exact matches (e.g. for coercion functions)

if \$SubDom is true, then runtime checks have to be compiled

defun ofCategory

[identp p1046]

[ofCategory p419]

[hasCaty p420]

[\$Subst p??]

[\$hope p??]

— defun ofCategory —

```
(defun |ofCategory| (dom cat)
  (let (|$Subst| |$hope|)
    (declare (special |$Subst| |$hope|))
```

```
(cond
  ((identp dom) nil)
  ((and (listp cat) (eq (car cat) '|Join|))
   (every #'(lambda (c) (|ofCategory| dom c)) (cdr cat)))
  (t (not (eq (|hasCaty| dom cat nil) '|failed|))))))
```

defun isPartialMode

The `isPartialMode` function tests whether `m` contains `$EmptyMode`. The constant `$EmptyMode` evaluates to `|$EmptyMode|`. This constant is inserted in a modemap during compile time if the modemap is not yet complete. `[contained p??]`
`[$EmptyMode p??]`

— defun isPartialMode —

```
(defun |isPartialMode| (m)
  (declare (special |$EmptyMode|))
  (contained |$EmptyMode| m))
```

defun hasCaty

This calls `hasCat`, which looks up a hashtable and returns:

1. T, NIL or a `(has x1 x2)` condition, if `cat` is not parameterized
2. a list of pairs `(argument to cat,condition)` otherwise

then the substitution `sl` is augmented, or the result is 'failed `[hasAttSig p426]`

```
[subCopy p??]
[constructSubst p434]
[hasSig p423]
[hasAtt p424]
[hasCat p??]
[opOf p??]
[kdr p??]
[mkDomPvar p433]
[domArg p422]
[augmentSub p??]
[domArg2 p422]
[unifyStruct p428]
[hasCaty1 p432]
```

[[\\$domPvar p47](#)]

— defun hasCaty —

```
(defun |hasCaty| (d cat s1)
  (let (x y S z cond sp dom zp s1 ncond i)
    (declare (special |$domPvar|))
    (cond
      ((and (consp cat) (eq (qcar cat) 'category) (consp (qcdr cat)))
        (|hasAttSig| d (|subCopy| (qcddr cat) (|constructSubst| d)) s1))
      ((and (consp cat) (eq (qcar cat) 'signature) (consp (qcdr cat))
        (consp (qcddr cat)) (eq (qcdddr cat) nil))
        (|hasSig| d (qcadr cat) (|subCopy| (qcaddr cat) (|constructSubst| d)) s1))
      ((and (consp cat) (eq (qcar cat) 'attribute)
        (consp (qcdr cat)) (eq (qcddr cat) nil))
        (|hasAtt| d (|subCopy| (qcadr cat) (|constructSubst| d)) s1))
      ((setq x (|hasCat| (|opOf| d) (|opOf| cat)))
        (cond
          ((setq y (kdr cat))
            (setq s (|constructSubst| d))
            (do ((next x (cdr next)) (endtest nil (null (eq s1 '|failed|))))
              ((or (atom next) endtest) nil)
              (setq z (caar next))
              (setq cond (cdar next))
              (setq sp
                (loop for item in s
                  collect (cons (car item) (|mkDomPvar| (car item) (cdr item) z y))))
              (when |$domPvar|
                (setq i -1)
                (setq dom
                  (cons (car d)
                    (loop for arg in (rest d)
                      collect (|domArg| arg (incf i) z y))))
                (setq s1 (|augmentSub| |$domPvar| dom (copy s))))
            (setq zp
              (loop for a in z
                collect (|domArg2| a s sp)))
            (setq s1 (|unifyStruct| y zp (copy s1)))
            (cond
              ((null (eq s1 '|failed|))
                (setq s1
                  (cond
                    ((atom cond) s1)
                    (t
                     (setq ncond (|subCopy| cond s))
                     (cond
                       ((and (consp ncond) (eq (qcar ncond) '|has|)
                        (consp (qcdr ncond)) (equal (qcadr ncond) d)
                        (consp (qcddr ncond)) (eq (qcdddr ncond) nil)
                        (equal (qcaddr ncond) cat))
```

```

      '|failed|)
      (t (|hasCaty1| ncond s1))))))
    (t nil)))
  s1)
  ((atom x) s1)
  (t
    (setq ncond (|subCopy| x (|constructSubst| d)))
    (cond
      ((and (consp ncond) (eq (qcar ncond) '|has|) (consp (qcdr ncond))
        (equal (qcadr ncond) d) (consp (qcddr ncond))
        (eq (qcddr ncond) nil) (equal (qcaddr ncond) cat))
        '|failed|)
      (t (|hasCaty1| ncond s1))))))
  (t '|failed|)))

```

defun domArg

[*\$FormalMapVariableList* *p??*]

— defun domArg —

```

(defun |domArg| (type i subs y)
  (let (p)
    (declare (special |$FormalMapVariableList|))
    (if (setq p (member (elt |$FormalMapVariableList| i) subs))
        (elt y (- (|#| subs) (|#| p)))
        type)))

```

defun domArg2

[*isSharpVar* *p*⁸⁸⁶]
 [*subCopy* *p??*]
 [*\$domPvar* *p*⁴⁷]

— defun domArg2 —

```

(defun |domArg2| (arg s11 s12)
  (declare (special |$domPvar|))
  (cond
    ((|isSharpVar| arg) (|subCopy| arg s11))
    ((and (eq arg '$) |$domPvar|) |$domPvar|)

```

```
(t (|subCopy| arg s12)))
```

defun hasSig

The function hasSig tests whether domain dom has function foo with signature sig under substitution sl. [constructor? p??]

```
[constructSubst p??]
[assq p1050]
[getOperationAlistFromLisplib p??]
[hasCate p433]
[subCopy p??]
[hasSigAnd p425]
[hasSigOr p426]
[keyedSystemError p??]
[unifyStruct p428]
[$domPvar p47]
```

— defun hasSig —

```
(defun |hasSig| (dom foo sig sl)
  (let (|$domPvar| fun s0 p x cond s)
    (declare (special |$domPvar|))
    (cond
      ((setq fun (|constructor?| (car dom)))
       (setq s0 (|constructSubst| dom))
       (cond
         ((setq p (assq foo (|getOperationAlistFromLisplib| (car dom))))
          (do ((next (cdr p) (cdr next))
              (endtest nil (null (eq s '|failed|))))
              ((or (atom next) endtest) nil)
           (setq x (caar next))
           (setq cond (caddr next))
           (setq s
            (cond
              ((atom cond) (copy sl))
              ((and (consp cond) (eq (qcar cond) '|has|)
               (consp (qcdr cond)) (consp (qcddr cond))
               (eq (qcdr (qcddr cond)) nil))
               (|hasCate| (|subCopy| (qcadr cond) s0)
                (|subCopy| (qcaddr cond) s0)
                (copy sl)))
              ((and (consp cond)
               (or (eq (qcar cond) '|and|) (eq (qcar cond) '|and|)))
               (|hasSigAnd| (qcdr cond) s0 sl))
              ((and (consp cond)
```



```

      (or (eq (qcar cond) 'or) (eq (qcar cond) '|or|)))
      (|hasSigOr| (qcdr cond) s0 sl))
    (t
      (|keyedSystemError| 'S2GE0016
        (list "hasSig" "unexpected condition for signature"))))
    (unless (eq s '|failed|)
      (setq s (|unifyStruct| (|subCopy| x s0) sig s))))
  s)
(t '|failed|)))
(t '|failed|)))

```

defun hasAtt

The hasAtt function tests whether dom has attribute att under sl needs s0 similar to hasSig.

[subCopy p??]
 [getdatabase p1010]
 [constructSubst p434]
 [getInfovec p??]
 [unifyStruct p428]
 [hasCatExpression p427]
 [\$domPvar p47]

— defun hasAtt —

```

(defun |hasAtt| (dom att sl)
  (let (|$domPvar| fun atts u x cond s)
    (declare (special |$domPvar|))
    (cond
      ((setq fun (car dom))
        (cond
          ((setq atts
            (|subCopy| (getdatabase fun 'attributes) (|constructSubst| dom)))
            (cond
              ((consp (setq u (|getInfovec| (car dom))))
                (do ((next atts (cdr next))
                    (endtest nil (null (eq s '|failed|))))
                  ((or (atom next) endtest) nil)
                  (setq x (caar next))
                  (setq cond (cdar next))
                  (setq s (|unifyStruct| x att (copy sl)))
                  (cond
                    ((and (null (atom cond)) (null (eq s '|failed|)))
                     (setq s (|hasCatExpression| cond s))))
                s)
              (t

```

```

      (do ((next atts (cdr next))
            (endtest nil (null (eq s '|failed|))))
          ((or (atom next) endtest) nil)
          (setq x (caar next))
          (setq cond (cadar next))
          (setq s (|unifyStruct| x att (copy sl)))
          (cond
            ((and (null (atom cond)) (null (eq s '|failed|)))
              (setq s (|hasCatExpression| cond s))))))
      s)))
    (t '|failed|)))
  (t '|failed|)))

```

defun hasSigAnd

[hasCate p433]
 [subCopy p??]
 [keyedSystemError p??]

— defun hasSigAnd —

```

(defun |hasSigAnd| (andCls s0 sl)
  (let (sa dead)
    (setq sa '|failed|)
    (loop for cls in andCls
      do
        (when dead (return))
        (setq sa
          (cond
            ((atom cls) (copy sl))
            ((and (consp cls) (eq (qcar cls) '|has|) (consp (qcdr cls))
              (consp (qcddr cls)) (eq (qcdddr cls) nil))
              (|hasCate| (|subCopy| (qcadr cls) s0)
                (|subCopy| (qcaddr cls) s0)
                (copy sl)))
            (t
              (|keyedSystemError| 'S2GE0016
                (list "hasSigAnd" "unexpected condition for signature")))))
          (when (eq sa '|failed|) (setq dead t)))
    sa))

```

defun hasSigOr

[hasCate p433]
 [hasSigAnd p425]
 [keyedSystemError p??]

— defun hasSigOr —

```
(defun |hasSigOr| (orCls s0 s1)
  (let (sa found)
    (setq sa '|failed|)
    (loop for cls in orCls
      until found
      do
        (setq sa
          (cond
            ((atom cls) (copy s1))
            ((and (consp cls) (eq (qcar cls) '|has|) (consp (qcdr cls))
              (consp (qcddr cls)) (eq (qcdddr cls) nil))
              (|hasCate| (|subCopy| (qcadr cls) s0)
                (|subCopy| (qcaddr cls) s0)
                (copy s1)))
            ((and (consp cls)
              (or (eq (qcar cls) '|and|) (eq (qcar cls) '|and|)))
              (|hasSigAnd| (qcdr cls) s0 s1))
            (t
              (|keyedSystemError| 'S2GE0016
                (list "hasSigOr" "unexpected condition for signature")))))
          (unless (eq sa '|failed|) (setq found t)))
    sa))
```

—————

defun hasAttSig

The argument d is domain, x is a list of attributes and signatures. The result is an augmented SL, if d has x, 'failed otherwise. [hasAtt p424]

[hasSig p423]
 [keyedSystemError p??]

— defun hasAttSig —

```
(defun |hasAttSig| (d x s1)
  (loop for y in x
    until (eq s1 '|failed|)
    do
      (setq s1
```

```

(cond
  ((and (consp y) (eq (qcar y) 'attribute)
        (consp (qcdr y)) (eq (qcddr y) nil))
    (|hasAtt| d (qcadr y) sl))
  ((and (consp y) (eq (qcar y) 'signature)
        (consp (qcdr y)) (consp (qcddr y)) (eq (qcdddr y) nil))
    (|hasSig| d (qcadr y) (qcaddr y) sl))
  (t
   (|keyedSystemError| 'S2GE0016
    (list "hasAttSig" "unexpected form of unnamed category")))))
sl)

```

defun hasCate1

[hasCate p433]
 [\$domPvar p47]

— defun hasCate1 —

```

(defun |hasCate1| (dom cat sl domPvar)
  (let (|$domPvar|)
    (declare (special |$domPvar|))
    (setq |$domPvar| domPvar)
    (|hasCate| dom cat sl)))

```

defun hasCatExpression

[hasCatExpression p427]
 [hasCate p433]
 [keyedSystemError p??]

— defun hasCatExpression —

```

(defun |hasCatExpression| (cond sl)
  (let (y)
    (cond
      ((and (consp cond) (eq (qcar cond) 'or))
       (when
        (let (result)
          (loop for x in (qcdr cond)
                do (setq result

```

```

      (or result
        (not (eq (setq y (|hasCatExpression| x s1)) '|failed|))))
    result)
  y))
((and (consp cond) (eq (qcar cond) 'and))
 (when
  (let ((result t))
    (loop for x in (qcdr cond)
      do (setq result
        (and result
          (not (eq (setq s1 (|hasCatExpression| x s1)) '|failed|))))))
    result)
  s1))
((and (consp cond) (eq (qcar cond) '|has|)
  (consp (qcdr cond)) (consp (qcddr cond)) (eq (qcdddr cond) nil))
 (|hasCate| (qcadr cond) (qcaddr cond) s1))
(t
 (|keyedSystemError| 'S2GE0016
  (list "hasSig" "unexpected condition for attribute")))))

```

defun unifyStruct

[isPatternVar p431]
 [unifyStructVar p429]
 [unifyStruct p428]

— defun unifyStruct —

```

(defun |unifyStruct| (s1 s2 s1)
  (declare (special |$domPvar| |$hope| |$Coerce| |$Subst|))
  (cond
    ((equal s1 s2) s1)
    (t
     (when (and (consp s1) (eq (qcar s1) '|:|)
       (consp (qcdr s1)) (consp (qcddr s1)) (eq (qcdddr s1) nil))
       (setq s1 (qcadr s1)))
     (when (and (consp s2) (eq (qcar s2) '|:|)
       (consp (qcdr s2)) (consp (qcddr s2)) (eq (qcdddr s2) nil))
       (setq s2 (qcadr s2)))
     (when (and (null (atom s1)) (eq (car s1) '|#|))
       (setq s1 (length (cadr s1))))
     (when (and (null (atom s2)) (eq (car s2) '|#|))
       (setq s2 (length (cadr s2))))
     (cond
       ((equal s1 s2) s1)

```

```

((|isPatternVar| s1) (|unifyStructVar| s1 s2 s1))
((|isPatternVar| s2) (|unifyStructVar| s2 s1 s1))
((or (atom s1) (atom s2)) '|failed|)
(t
 (loop until (or (null s1) (null s2) (eq s1 '|failed|))
  do
    (setq s1 (|unifyStruct| (car s1) (car s2) s1))
    (setq s1 (cdr s1))
    (setq s2 (cdr s2)))
 (if (or s1 s2) '|failed| s1))))))

```

defun unifyStructVar

The first argument is a pattern variable, which is not substituted by `sl` [contained `p??`]

```

[lassoc p??]
[unifyStruct p428]
[constructor? p??]
[subCopy p??]
[containsVars p430]
[canCoerce p??]
[resolveTT p??]
[isPatternVar p431]
[augmentSub p??]
[$domPvar p47]
[$Coerce p??]
[$Subst p??]
[$hope p??]

```

— defun unifyStructVar —

```

(defun |unifyStructVar| (v ss sl)
  (let (ps s1 s0 s ns0 ns1 s3)
    (declare (special |$domPvar| |$hope| |$Coerce| |$Subst|))
    (cond
      ((contained v ss) '|failed|)
      (t
       (setq ps (lassoc ss sl))
       (setq s1 (if ps ps ss))
       (cond
         ((or (setq s0 (lassoc v sl)) (setq s0 (lassoc v |$Subst|)))
          (setq s (|unifyStruct| s0 s1 (copy sl)))
          (cond
            ((eq s '|failed|)
             (cond

```

```

((and |$Coerce| (null (atom s0)) (|constructor?| (car s0)))
 (cond
  ((or (|containsVars| s0) (|containsVars| s1))
   (setq ns0 (|subCopy| s0 s1))
   (setq ns1 (|subCopy| s1 s1))
   (cond
    ((or (|containsVars| ns0) (|containsVars| ns1))
     (setq |$hope| t)
     '|failed|)
    (t
     (cond
      ((|canCoerce| ns0 ns1) (setq s3 s1))
      ((|canCoerce| ns1 ns0) (setq s3 s0))
      (t (setq s3 nil)))
     (cond
      (s3
       (cond
        ((not (equal s3 s0))
         (setq s1 (|augmentSub| v s3 s1))))
       (cond
        ((and (not (equal s3 s1)) (|isPatternVar| ss))
         (setq s1 (|augmentSub| ss s3 s1))))
        s1)
        (t '|failed|))))))
  (|$domPvar|
   (setq s3 (|resolveTT| s0 s1))
   (cond
    (s3
     (cond
      ((not (equal s3 s0))
       (setq s1 (|augmentSub| v s3 s1))))
     (cond
      ((and (not (equal s3 s1)) (|isPatternVar| ss))
       (setq s1 (|augmentSub| ss s3 s1))))
      s1)
     (t '|failed|)))
   (t '|failed|)))
 (t '|failed|)))
 (t (|augmentSub| v ss s))))
 (t (|augmentSub| v ss s1))))))

```

defun containsVars

The function containsVars tests whether term t contains a * variable. [isPatternVar p431]
[containsVars1 p431]

— defun containsVars —

```
(defun |containsVars| (arg)
  (if (atom arg)
      (|isPatternVar| arg)
      (|containsVars1| arg)))
```

—————

defun isPatternVar

— defun isPatternVar —

```
(defun |isPatternVar| (v)
  (and (identp v)
       (member v
                '(** *1 *2 *3 *4 *5 *6 *7 *8 *9 *10 *11 *12 *13 *14 *15
                  *16 *17 *18 *19 *20))
       t))
```

—————

defun containsVars1

The function containsVars1 tests whether term t contains a * variable. This is a recursive version, which works on a list. [isPatternVar p431]
[containsVars1 p431]

— defun containsVars1 —

```
(defun |containsVars1| (arg)
  (let ((t1 (car arg)) (t2 (cdr arg)))
    (if (atom t1)
        (or (|isPatternVar| t1)
            (if (atom t2) (|isPatternVar| t2) (|containsVars1| t2)))
        (or (|containsVars1| t1)
            (if (atom t2) (|isPatternVar| t2) (|containsVars1| t2))))))
```

—————

defun hasCaty1

The cond is either a (has a b) or an OR clause of such conditions. SL is augmented, if cond is true, otherwise the result is 'failed [hasCate p433]

[hasCaty1 p432]

[keyedSystemError p??]

[\$domPvar p47]

— defun hasCaty1 —

```
(defun |hasCaty1| (cond sl)
  (let (|$domPvar| a s)
    (declare (special |$domPvar|))
    (setq |$domPvar| nil)
    (cond
      ((and (consp cond) (eq (qcar cond) '|has|)
        (consp (qcdr cond)) (consp (qcddr cond)) (eq (qcdddr cond) nil))
        (|hasCate| (qcadr cond) (qcaddr cond) sl))
      ((and (consp cond) (EQ (qcar cond) 'and))
        (loop for x in (qcdr cond)
          while (not (eq s '|failed|))
          do
            (setq s
              (cond
                ((and (consp x) (eq (qcar x) '|has|)
                  (consp (qcdr x)) (consp (qcddr x)) (eq (qcdr (qcddr x)) nil))
                  (|hasCate| (qcadr x) (qcaddr x) sl))
                ((and (consp x) (eq (qcdr x) nil)
                  (consp (qcar x)) (eq (qcaar x) '|has|)
                  (consp (qcdr x)) (consp (qcddr x))
                  (eq (qcdr (qcddr x)) nil))
                  (|hasCate| a (qcaddr x) sl))
                (t (|hasCaty1| x sl))))))
        s)
      ((and (consp cond) (eq (qcar cond) 'or))
        (do ((next (qcdr cond) (cdr next)) (x nil)
          (nextitem nil (null (eq s '|failed|))))
          ((or (atom next)
            (progn (setq x (car next)) nil)
            nextitem)
          nil)
        (setq s
          (cond
            ((and (consp x) (eq (qcar x) '|has|)
              (consp (qcdr x)) (consp (qcddr x)) (eq (qcdddr x) nil))
              (|hasCate| (qcadr x) (qcaddr x) (copy sl)))
            ((and (consp x) (eq (qcdr x) nil) (consp (qcar x))
              (eq (qcaar x) '|has|) (consp (qcdr x)) (consp (qcddr x))
              (eq (qcdddr x) nil))
              (|hasCate| (qcadr x) (qcaddr x) (copy sl))))))
        s)))
```

```

      (|hasCate| (qcadar x) (qcaddar x) (copy sl)))
      (t (|hasCaty1| x (copy sl))))))
s)
(t
  (|keyedSystemError| 'S2GE0016
    (list "hasCaty1" "unexpected condition from category table")))))

```

defun mkDomPvar

```

[domArg p422]
[length p??]
[$FormalMapVariableList p??]

```

— defun mkDomPvar —

```

(defun |mkDomPvar| (p d subs y)
  (let (l)
    (declare (special |$FormalMapVariableList|))
    (if (setq l (member p |$FormalMapVariableList|))
      (|domArg| d (- (|#| |$FormalMapVariableList|) (|#| 1)) subs y)
      d)))

```

defun hasCate

```

[isPatternVar p431]
[hasCate1 p427]
[hasCateSpecial p434]
[containsVariables p??]
[subCopy p??]
[hasCaty p420]
[$EmptyMode p??]
[$Subst p??]
[$hope p??]

```

— defun hasCate —

```

(defun |hasCate| (dom cat sl)
  (let (nsl p s sl1)
    (declare (special |$hope| |$Subst| |$EmptyMode|))
    (cond

```

```

(equal dom |$EmptyMode|) nil)
(|isPatternVar| dom)
(cond
  ((and (setq p (assq dom sl))
        (not (eq (setq nsl (|hasCate| (cdr p) cat sl)) '|failed|)))
   nsl)
  ((or (setq p (assq dom |$Subst|)) (setq p (assq dom sl)))
   (setq s (|hasCate1| (cdr p) cat sl dom))
   (cond
    ((null (eq s '|failed|)) s)
    (t (|hasCateSpecial| dom (cdr p) cat sl))))
  (t
   (when (not (eq sl '|failed|)) (setq |$hope| t))
   '|failed|)))
(t
 (setq sl1
  (loop for item in sl
        when (null (|containsVariables| (cdr item)))
        collect item))
 (when sl1 (setq cat (|subCopy| cat sl1)))
 (|hasCaty| dom cat sl))))

```

defun constructSubst

```

[internal p??]
[stringimage p??]

```

— defun constructSubst —

```

(defun |constructSubst| (d)
  (let (sl (i 0))
    (setq sl (list (cons '$ d)))
    (when (listp d)
      (dolist (x (cdr d))
        (setq i (1+ i))
        (setq sl (cons (cons (internal "#" (stringimage i)) x) sl))))
    sl))

```

defun hasCateSpecial

The variable *v* is a pattern variable, *dom* is its binding under *\$Subst*. We try to change *dom* so that it has category *cat* under *sl*. The result is a substitution list or *'failed*. [eqcar p??]

```

[isSubDomain p??]
[canCoerceFrom p??]
[containsVars p430]
[augmentSub p??]
[hasCate p433]
[hasCaty p420]
[hasCateSpecialNew p436]
[$Integer p??]
[$QuotientField p??]

```

— defun hasCateSpecial —

```

(defun |hasCateSpecial| (v dom cat sl)
  (let (arg d domp nsl)
    (declare (special |$Integer| |$QuotientField|))
    (cond
      ((and (consp dom) (eq (qcar dom) '|FactoredForm|)
            (consp (qcdr dom)) (eq (qcddr dom) nil))
        (setq arg (qcadr dom))
        (when (|isSubDomain| arg |$Integer|) (setq arg |$Integer|))
        (setq d (list '|FactoredRing| arg))
        (setq sl (|hasCate| arg '(|Ring|) (|augmentSub| v d sl)))
        (if (eq sl '|failed|)
            '|failed|
            (|hasCaty| d cat sl)))
      ((or (eqcar cat '|Field|) (eqcar cat '|DivisionRing|))
        (when (|isSubDomain| dom |$Integer|) (setq dom |$Integer|))
        (setq d (list |$QuotientField| dom))
        (|hasCaty| dom '(|IntegralDomain|) (|augmentSub| v d sl)))
      ((and (consp cat) (eq (qcar cat) '|PolynomialCategory|)
            (consp (qcdr cat)))
        (setq domp (cons '|Polynomial| (list (qcadr cat))))
        (and (or (|containsVars| (qcadr cat)) (|canCoerceFrom| dom domp))
            (|hasCaty| domp cat (|augmentSub| v domp sl))))
      ((|isSubDomain| dom |$Integer|)
        (setq nsl (|hasCate| |$Integer| cat (|augmentSub| v |$Integer| sl)))
        (if (eq nsl '|failed|)
            (|hasCateSpecialNew| v dom cat sl)
            (|hasCaty| |$Integer| cat nsl)))
      (t
        (|hasCateSpecialNew| v dom cat sl))))

```

defun hasCateSpecialNew

```

[member p1048]
[eqcar p??]
[augmentSub p??]
[defaultTargetFE p437]
[isEqualOrSubDomain p438]
[underDomainOf p??]
[hasCaty p420]
[$Integer p??]
[$ComplexInteger p??]
[$RationalNumber p??]

```

— **defun hasCateSpecialNew** —

```

(defun |hasCateSpecialNew| (v dom cat sl)
  (let (fe alg fefull d partialResult)
    (declare (special |$RationalNumber| |$ComplexInteger| |$Integer|))
    (setq fe
      (|member| (qcar cat)
        '(|ElementaryFunctionCategory|
          |TrigonometricFunctionCategory|
          |ArcTrigonometricFunctionCategory|
          |HyperbolicFunctionCategory|
          |ArcHyperbolicFunctionCategory|
          |PrimitiveFunctionCategory|
          |SpecialFunctionCategory|
          |Evalable|
          |CombinatorialOpsCategory|
          |TranscendentalFunctionCategory|
          |AlgebraicallyClosedFunctionSpace|
          |ExpressionSpace|
          |LiouvillianFunctionCategory|
          |FunctionSpace|)))
      (setq alg
        (|member| (qcar cat)
          '(|RadicalCategory|
            |AlgebraicallyClosedField|)))
      (setq fefull
        (or fe alg (eqcar cat ' |CombinatorialFunctionCategory|)))
      (setq partialResult
        (cond
          ((or (eqcar dom ' |Variable|) (eqcar dom ' |Symbol|))
            (cond
              ((|member| (car cat)
                '(|SemiGroup|
                  |AbelianSemiGroup|
                  |Monoid|
                  |AbelianGroup|

```

```

      |AbelianMonoid|
      |PartialDifferentialRing|
      |Ring|
      |InputForm|))
    (setq d (list '|Polynomial| |$Integer|))
    (|augmentSub| v d sl))
  ((eqcar cat '|Group|)
   (setq d (list '|Fraction| (list '|Polynomial| |$Integer|))
    (|augmentSub| v d sl))
  (fefull
   (setq d (|defaultTargetFE| dom))
   (|augmentSub| v d sl))
  (t '|failed|)))
((|isEqualOrSubDomain| dom |$Integer|)
 (cond
  (fe
   (setq d (|defaultTargetFE| |$Integer|))
   (|augmentSub| v d sl))
  (alg
   (setq d '(|AlgebraicNumber|))
   (|augmentSub| v d sl))
  (t '|failed|)))
((equal (|underDomainOf| dom) |$ComplexInteger|)
 (setq d (|defaultTargetFE| |$ComplexInteger|))
 (|hasCaty| d cat (|augmentSub| v d sl)))
((and (equal dom |$RationalNumber|) alg)
 (setq d '(|AlgebraicNumber|))
 (|augmentSub| v d sl))
(fefull
 (setq d (|defaultTargetFE| dom))
 (|augmentSub| v d sl))
 (t '|failed|)))
(if (eq partialResult '|failed|)
    '|failed|
    (|hasCaty| d cat partialResult)))

```

defun defaultTargetFE

```

[typeIsASmallInteger p??]
[isEqualOrSubDomain p438]
[ifcar p??]
[defaultTargetFE p437]
[$FunctionalExpression p??]
[$Integer p??]
[$Symbol p??]

```

`[$RationalNumber p??]`

— **defun defaultTargetFE** —

```
(defun |defaultTargetFE| (&rest dom)
  (let (a options)
    (declare (special |$FunctionalExpression| |$Integer| |$Symbol|
                      |$RationalNumber|))
    (setq a (car dom))
    (setq options (cdr dom))
    (cond
      ((or (and (consp a) (eq (qcar a) '|Variable|)
                (consp (qcdr a)) (eq (qcddr a) nil))
           (equal a |$RationalNumber|)
           (member (qcar a) (list (qcar |$Symbol|) '|RationalRadicals| '|Pi)))
         (|typeIsASmallInteger| a)
         (|isEqualOrSubDomain| a |$Integer|)
         (equal a '|AlgebraicNumber|)))
      (if (ifcar options)
          (list |$FunctionalExpression| (list '|Complex| |$Integer|))
          (list |$FunctionalExpression| |$Integer|)))
      ((and (consp a) (eq (qcar a) '|Complex|)
            (consp (qcdr a)) (eq (qcddr a) nil))
         (|defaultTargetFE| (qcadr a) t))
      ((and (consp a) (consp (qcdr a)) (eq (qcddr a) nil)
            (member (qcar a) '|Polynomial| |RationalFunction| |Fraction|)))
         (|defaultTargetFE| (qcadr a) (ifcar options)))
      ((and (consp a) (equal (qcar a) |$FunctionalExpression|)
            (consp (qcdr a)) (eq (qcddr a) nil))
         a)
      ((ifcar options)
         (list |$FunctionalExpression| (list '|Complex| a)))
      (t
         (list |$FunctionalExpression| a))))
```

—————→

defun isEqualOrSubDomain

`[isSubDomain p??]`

— **defun isEqualOrSubDomain** —

```
(defun |isEqualOrSubDomain| (d1 d2)
  (or (equal d1 d2)
      (|isSubDomain| d1 d2)
      (and (atom d1)
```

```

(or (and (consp d2) (eq (qcar d2) '|Variable|)
      (consp (qcdr d2)) (eq (qcddr d2) nil)
      (equal (qcadr d2) d1))
    (and (consp d2) (eq (qcdr d2) nil)
      (equal (qcar d2) d1))))
(and (atom d2)
  (or (and (consp d1) (eq (qcar d1) '|Variable|)
        (consp (qcdr d1)) (eq (qcddr d1) nil)
        (equal (qcadr d1) d2))
      (and (consp d1) (eq (qcdr d1) nil)
        (equal (qcar d1) d2))))))

```

Chapter 18

System Command Handling

The system commands are the top-level commands available in Axiom that can all be invoked by prefixing the symbol with a closed-paren. Thus, to see they copyright you type:

```
)copyright
```

New commands need to be added to this table. The command invoked will be the first entry of the pair and the “user level” of the command will be the second entry.

See:

- The “abbreviations” ([19.2](#) p [483](#)) command
- The “boot” ([4.1](#) p [23](#)) command
- The “browse” (?? p ??) command
- The “cd” (?? p ??) command
- The “clear” ([23.3](#) p [499](#)) command
- The “close” ([24.2](#) p [510](#)) command
- The “compile” (?? p ??) command
- The “copyright” ([26.2](#) p [522](#)) command
- The “credits” ([27.3](#) p [525](#)) command
- The “display” ([29.2](#) p [535](#)) command
- The “edit” ([30.2](#) p [544](#)) command
- The “fin” ([31.1](#) p [548](#)) command

- The “frame” ([32.5](#) p [565](#)) command
- The “help” ([33.2](#) p [572](#)) command
- The “history” ([34.4](#) p [582](#)) command
- The “lisp” ([??](#) p [??](#)) command
- The “library” ([66.1](#) p [1013](#)) command
- The “load” ([38.1](#) p [629](#)) command
- The “ltrace” ([39.1](#) p [632](#)) command
- The “pquit” ([40.2](#) p [634](#)) command
- The “quit” ([41.2](#) p [638](#)) command
- The “read” ([42.1](#) p [642](#)) command
- The “regress” ([??](#) p [??](#)) command
- The “savesystem” ([44.1](#) p [650](#)) command
- The “set” ([45.36](#) p [808](#)) command
- The “show” ([46.1](#) p [814](#)) command
- The “spool” ([??](#) p [??](#)) command
- The “summary” ([48.1](#) p [830](#)) command
- The “synonym” ([49.1](#) p [832](#)) command
- The “system” ([??](#) p [??](#)) command
- The “tangle” ([??](#) p [??](#)) command
- The “trace” ([52.1](#) p [847](#)) command
- The “trademark” ([26.2](#) p [523](#)) command
- The “undo” ([53.4](#) p [922](#)) command
- The “what” ([54.1](#) p [939](#)) command
- The “with” ([55.1](#) p [947](#)) command
- The “workfiles” ([56.1](#) p [949](#)) command
- The “zsystemdevelopment” ([57.1](#) p [953](#)) command

18.1 Variables Used

defvar \$systemCommands

— initvars —

```
(defvar |$systemCommands| nil)
```

—————

— postvars —

```
(eval-when (eval load)
  (setq |$systemCommands|
    '(
      (|abbreviations| . |compiler| )
      (|boot| . |development|)
      (|browse| . |development|)
      (|cd| . |interpreter|)
      (|clear| . |interpreter|)
      (|close| . |interpreter|)
      (|compiler| . |compiler| )
      (|copyright| . |interpreter|)
      (|credits| . |interpreter|)
      (|describe| . |interpreter|)
      (|display| . |interpreter|)
      (|edit| . |interpreter|)
      (|fin| . |development|)
      (|frame| . |interpreter|)
      (|help| . |interpreter|)
      (|history| . |interpreter|)
      (|lisp| . |development|)
      (|library| . |interpreter|)
      (|load| . |interpreter|)
      (|ltrace| . |interpreter|)
      (|pquit| . |interpreter|)
      (|quit| . |interpreter|)
      (|read| . |interpreter|)
      (|regress| . |interpreter|)
      (|savesystem| . |interpreter|)
      (|set| . |interpreter|)
      (|show| . |interpreter|)
      (|spool| . |interpreter|)
      (|summary| . |interpreter|)
      (|synonym| . |interpreter|)
      (|system| . |interpreter|)
```

```

(|tangle| . |interpreter|)
(|trace| . |interpreter|)
(|trademark| . |interpreter|)
(|undo| . |interpreter|)
(|what| . |interpreter|)
(|with| . |interpreter|)
(|workfiles| . |development|)
(|zsystemdevelopment| . |interpreter|)
)))

```

defvar \$syscommands

This table is used to look up a symbol to see if it might be a command.

— **initvars** —

```
(defvar $syscommands nil)
```

— **postvars** —

```

(eval-when (eval load)
  (setq $syscommands (mapcar #'car |$systemCommands|)))

```

defvar \$noParseCommands

This is a list of the commands which have their arguments passed verbatim. Certain functions, such as the lisp function need to be able to handle all kinds of input that will not be acceptable to the interpreter.

— **initvars** —

```
(defvar |$noParseCommands| nil)
```

— **postvars** —

```
(eval-when (eval load)
  (setq |$noParseCommands|
    '(|boot| |copyright| |credits| |fin| |lisp| |pquit| |quit|
      |synonym| |system| |trademark| )))
```

18.2 Functions

defun handleNoParseCommands

The system commands given by the global variable `$noParseCommands` require essentially no preprocessing/parsing of their arguments. Here we dispatch the functions which implement these commands.

There are four standard commands which receive arguments

- boot
- lisp
- synonym
- system

There are six standard commands which do not receive arguments –

- quit
- fin
- pquit
- credits
- copyright
- trademark

As these commands do not necessarily exhaust those mentioned in `$noParseCommands`, we provide a generic dispatch based on two conventions: commands which do not require an argument name themselves, those which do have their names prefixed by “np”. This makes it possible to dynamically define new system commands provided you handle the argument parsing.

defun Handle a top level command

```
[concat p1047]
[expand-tabs p??]
[processSynonyms p31]
[substring p??]
[getFirstWord p469]
[unAbbreviateKeyword p469]
[member p1048]
[handleNoParseCommands p445]
[splitIntoOptionBlocks p447]
[handleTokenSizeSystemCommands p447]
[handleParsedSystemCommands p468]
[$tokenCommands p475]
[$noParseCommands p444]
[line p??]
```

— defun doSystemCommand —

```
(defun |doSystemCommand| (string)
  (let (line tok unab optionList)
    (declare (special line |$tokenCommands| |$noParseCommands|))
    (setq string (concat ") " (expand-tabs string)))
    (setq line string)
    (|processSynonyms|)
    (setq string line)
    (setq string (substring string 1 nil))
    (cond
      ((string= string "") nil)
      (t
       (setq tok (|getFirstWord| string))
       (cond
         (tok
          (setq unab (|unAbbreviateKeyword| tok))
          (cond
            ((|member| unab |$noParseCommands|)
             (|handleNoParseCommands| unab string))
            (t
             (setq optionList (|splitIntoOptionBlocks| string))
             (cond
               ((|member| unab |$tokenCommands|)
                (|handleTokenSizeSystemCommands| unab optionList))
               (t
                (|handleParsedSystemCommands| unab optionList)
                nil))))))
          (t nil))))))
```

defun Split block into option block

[stripSpaces p471]

— defun splitIntoOptionBlocks —

```
(defun |splitIntoOptionBlocks| (str)
  (let (inString block (blockStart 0) (parenCount 0) blockList)
    (dotimes (i (1- (|#| str)))
      (cond
        ((char= (elt str i) #"") (setq inString (null inString)))
        (t
         (when (and (char= (elt str i) #\"()\" ) (null inString))
           (incf parenCount))
         (when (and (char= (elt str i) #\"\\\" ) (null inString))
           (decf parenCount))
         (when
          (and (char= (elt str i) #\"\\\" )
               (null inString)
               (= parenCount -1))
            (setq block (|stripSpaces| (subseq str blockStart i)))
            (setq blockList (cons block blockList))
            (setq blockStart (1+ i))
            (setq parenCount 0))))))
    (setq blockList (cons (|stripSpaces| (subseq str blockStart)) blockList))
    (nreverse blockList)))
```

—

defun Tokenize a system command

[dumbTokenize p467]

[tokTran p467]

[systemCommand p448]

— defun handleTokenizeSystemCommands —

```
(defun |handleTokenizeSystemCommands| (unabr optionList)
  (declare (ignore unabr))
  (let (parcmd)
    (setq optionList (mapcar #'(lambda (x) (|dumbTokenize| x)) optionList))
    (setq parcmd
      (mapcar #'(lambda (opt) (mapcar #'(lambda (tok) (|tokTran| tok)) opt))
              optionList))
    (when parcmd (|systemCommand| parcmd))))
```

—

defun Handle system commands

You can type “)?” and see trivial help information. You can type “)? compile” and see compiler related information [selectOptionLC p479]

```
[helpSpad2Cmd p572]
[selectOption p479]
[commandsForUserLevel p448]
[$options p??]
[$e p??]
[$systemCommands p443]
[$syscommands p444]
[$CategoryFrame p??]
```

— defun systemCommand —

```
(defun |systemCommand| (cmd)
  (let (|$options| |$e| op argl options fun)
    (declare (special |$options| |$e| |$systemCommands| $syscommands
                      |$CategoryFrame|))
    (setq op (caar cmd))
    (setq argl (cdar cmd))
    (setq options (cdr cmd))
    (setq |$options| options)
    (setq |$e| |$CategoryFrame|)
    (setq fun (|selectOptionLC| op $syscommands '|commandError|))
    (if (and argl (eq (elt argl 0) '?)) (not (eq fun '|synonym|)))
        (|helpSpad2Cmd| (cons fun nil))
    (progn
      (setq fun
        (|selectOption| fun (|commandsForUserLevel| |$systemCommands|
                          '|commandUserLevelError|))
      (funcall fun argl))))
```

—————→

defun Select commands matching this user level

The `$UserLevel` contains one of three values: `compiler`, `development`, or `interpreter`. This variable is used to select a subset of commands from the list stored in `$systemCommands`, representing all of the commands that are valid for this level. [satisfiesUserLevel p451]

— defun commandsForUserLevel —

```
(defun |commandsForUserLevel| (arg)
  (let (c)
    (dolist (pair arg)
```

```
(when (|satisfiesUserLevel| (cdr pair))
      (setq c (cons (car pair) c)))
(nreverse c))
```

defun No command begins with this string

[commandErrorMessage p449]

— defun commandError —

```
(defun |commandError| (x u)
  (|commandErrorMessage| ' |command| x u))
```

defun No option begins with this string

[commandErrorMessage p449]

— defun optionError —

```
(defun |optionError| (x u)
  (|commandErrorMessage| ' |option| x u))
```

defvar \$oldline

— initvars —

```
(defvar $oldline nil "used to output command lines")
```

defun No command/option begins with this string

[commandAmbiguityError p452]
[sayKeyedMsg p329]

```
[terminateSystemCommand p452]
[$oldline p449]
[line p??]
```

— **defun commandErrorMessage** —

```
(defun |commandErrorMessage| (kind x u)
  (declare (special $oldline line))
  (setq $oldline line)
  (if u
    (|commandAmbiguityError| kind x u)
    (progn
      (|sayKeyedMsg| 'S2IZ0008 (list kind x))
      (|terminateSystemCommand|))))
```

—————

defun Option not available at this user level

```
[userLevelErrorMessage p450]
```

— **defun optionUserLevelError** —

```
(defun |optionUserLevelError| (x u)
  (|userLevelErrorMessage| ' |option| x u))
```

—————

defun Command not available at this user level

```
[userLevelErrorMessage p450]
```

— **defun commandUserLevelError** —

```
(defun |commandUserLevelError| (x u)
  (|userLevelErrorMessage| ' |command| x u))
```

—————

defun Command not available error message

```
[commandAmbiguityError p452]
[sayKeyedMsg p329]
```

```
[terminateSystemCommand p452]
[$UserLevel p807]
```

— defun userLevelErrorMessage —

```
(defun |userLevelErrorMessage| (kind x u)
  (declare (special |$UserLevel|))
  (if u
    (|commandAmbiguityError| kind x u)
    (progn
      (|sayKeyedMsg| 'S2IZ0007 (list |$UserLevel| kind))
      (|terminateSystemCommand|))))
```

—————

defun satisfiesUserLevel

```
[$UserLevel p807]
```

— defun satisfiesUserLevel 0 —

```
(defun |satisfiesUserLevel| (x)
  (declare (special |$UserLevel|))
  (cond
    ((eq x '|interpreter|) t)
    ((eq |$UserLevel| '|interpreter|) nil)
    ((eq x '|compiler|) t)
    ((eq |$UserLevel| '|compiler|) nil)
    (t t)))
```

—————

defun hasOption

```
[stringPrefix? p??]
[pname p1045]
```

— defun hasOption —

```
(defun |hasOption| (al opt)
  (let ((optPname (pname opt)) found)
    (loop for pair in al do
      (when (|stringPrefix?| (pname (car pair)) optPname) (setq found pair))
      until found)
    found))
```

defun terminateSystemCommand

[tersyscommand p452]

— defun terminateSystemCommand —

```
(defun |terminateSystemCommand| nil (tersyscommand))
```

defun Terminate a system command

[spadThrow p??]

— defun tersyscommand —

```
(defun tersyscommand ()
  (fresh-line)
  (setq chr 'endoflinechr)
  (setq tok 'end_unit)
  (|spadThrow|))
```

defun commandAmbiguityError

[sayKeyedMsg p329]

[sayMSG p331]

[bright p??]

[terminateSystemCommand p452]

— defun commandAmbiguityError —

```
(defun |commandAmbiguityError| (kind x u)
  (|sayKeyedMsg| 's2iz0009 (list kind x))
  (dolist (a u) (|sayMSG| (cons " " (|bright| a))))
  (|terminateSystemCommand|))
```

defun getParserMacroNames

The `$pfMacros` is a list of all of the user-defined macros. [`$pfMacros` p97]

— **defun getParserMacroNames 0** —

```
(defun |getParserMacroNames| ()
  (declare (special |$pfMacros|))
  (remove-duplicates (mapcar #'car |$pfMacros|)))
```

defun clearParserMacro

Note that if a macro is defined twice this will clear the last instance. Thus:

```
a ==> 3
a ==> 4
)d macros
a ==> 4
)clear prop a
)d macros
a ==> 3
)clear prop a
)d macros
nil
```

```
[ifcdr p??]
[assoc p??]
[remalist p??]
[$pfMacros p97]
```

— **defun clearParserMacro** —

```
(defun |clearParserMacro| (macro)
  (declare (special |$pfMacros|))
  (when (ifcdr (|assoc| macro |$pfMacros|))
    (setq |$pfMacros| (remalist |$pfMacros| macro))))
```

defun displayMacro

```
[isInterpMacro p??]
[sayBrightly p??]
```

```
[bright p??]
[strconc p??]
[object2String p??]
[mathprint p??]
[$op p??]
```

— **defun displayMacro** —

```
(defun |displayMacro| (name)
  (let (|$op| m body args)
    (declare (special |$op|))
    (setq m (|isInterpMacro| name))
    (cond
      ((null m)
        (|sayBrightly|
          (cons " " (append (|bright| name)
                           (cons "is not an interpreter macro." nil))))))
      (t
        (setq |$op| (strconc "macro " (|object2String| name)))
        (setq args (car m))
        (setq body (cdr m))
        (setq args
          (cond
            ((null args) nil)
            ((null (cdr args)) (car args))
            (t (cons '|Tuple| args))))
        (|mathprint| (cons 'map (cons (cons args body) nil)))))))
```

—————

defun displayWorkspaceNames

```
[getInterpMacroNames p??]
[getParserMacroNames p453]
[sayMessage p??]
[msort p??]
[getWorkspaceNames p455]
[sayAsManyPerLineAsPossible p??]
[sayBrightly p??]
[setdifference p??]
```

— **defun displayWorkspaceNames** —

```
(defun |displayWorkspaceNames| ()
  (let (pmacs names imacs)
    (setq imacs (|getInterpMacroNames|))
```

```
(setq pmacs (|getParserMacroNames|))
(|sayMessage| "Names of User-Defined Objects in the Workspace:")
(setq names (msort (append (|getWorkspaceNames|) pmacs)))
(if names
  (|sayAsManyPerLineAsPossible| (mapcar #'|object2String| names))
  (|sayBrightly| " * None *"))
(setq imacs (setdifference imacs pmacs))
(when imacs
  (|sayMessage| "Names of System-Defined Objects in the Workspace:")
  (|sayAsManyPerLineAsPossible| (mapcar #'|object2String| imacs))))
```

defun getWorkspaceNames

```
;getWorkspaceNames() ==
; NMSORT [n for [n,::] in CAAR $InteractiveFrame |
;   (n ^= "--macros--" and n^= "--flags--")]
```

```
[seq p??]
[nmsort p??]
[exit p??]
[$InteractiveFrame p??]
```

— defun getWorkspaceNames —

```
(defun |getWorkspaceNames| ()
  (PROG (n)
    (declare (special |$InteractiveFrame|))
    (return
      (seq (nmsort (PROG (G166322)
        (setq G166322 NIL)
        (RETURN
          (DO ((G166329 (CAAR |$InteractiveFrame|)
            (CDR G166329))
              (G166313 NIL))
            ((OR (ATOM G166329)
              (PROGN
                (SETQ G166313 (CAR G166329))
                NIL)
              (PROGN
                (PROGN
                  (setq n (CAR G166313))
                  G166313)
                NIL))
              (NREVERSEO G166322))
            (SEQ (EXIT (COND
```



```
((AND (not (eq n '--macros--|))
      (not (eq n '--flags--|)))
  (SETQ G166322
    (CONS n G166322)))))))))
```

defun fixObjectForPrinting

The `$msgdbPrims` variable is set to:

```
(|%b| |%d| |%l| |%i| |%u| %U |%n| |%x| |%ce| |%rj|
 "%U" "%b" "%d" "%l" "%i" "%u" "%U" "%n" "%x" "%ce" "%rj")
```

```
[object2Identifier p??]
[member p1048]
[strconc p??]
[pname p1045]
[$msgdbPrims p327]
```

— defun fixObjectForPrinting —

```
(defun |fixObjectForPrinting| (v)
  (let (vp)
    (declare (special |$msgdbPrims|))
    (setq vp (|object2Identifier| v))
    (cond
      ((eq vp '%) "\\%")
      ((|member| vp |$msgdbPrims|) (strconc "\\\" (pname vp)))
      (t v))))
```

defun displayProperties,sayFunctionDeps

```
;displayProperties(option,l) ==
; $dependentAlist : local := nil
; $dependeeAlist : local := nil
; [opt,:vl]:= (l or ['properties])
; imacs := getInterpMacroNames()
; pmacs := getParserMacroNames()
; macros := REMDUP append(imacs, pmacs)
; if vl is ['all] or null vl then
;   vl := MSORT append(getWorkspaceNames(),macros)
; if $frameMessages then sayKeyedMsg("S2IZ0065",[$interpreterFrameName])
```

```

; null v1 =>
;   null $frameMessages => sayKeyedMsg("S2IZ0066",NIL)
;   sayKeyedMsg("S2IZ0067",[$interpreterFrameName])
; interpFunctionDepAlists()
; for v in v1 repeat
;   isInternalMapName(v) => 'iterate
;   pl := getIProplist(v)
;   option = 'flags =>      getAndSay(v,"flags")
;   option = 'value =>      displayValue(v,getI(v,'value),nil)
;   option = 'condition => displayCondition(v,getI(v,"condition"),nil)
;   option = 'mode =>       displayMode(v,getI(v,'mode),nil)
;   option = 'type =>       displayType(v,getI(v,'value),nil)
;   option = 'properties =>
;     v = "--flags--" => nil
;     pl is [ ['cacheInfo,:.],:.] => nil
;     v1 := fixObjectForPrinting(v)
;     sayMSG ["Properties of",:bright prefix2String v1,':""]
;     null pl =>
;       v in pmacs =>
;         sayMSG '"    This is a user-defined macro.'
;         displayParserMacro v
;       isInterpMacro v =>
;         sayMSG '"    This is a system-defined macro.'
;         displayMacro v
;       sayMSG '"    none'
; propsSeen:= nil
; for [prop,:val] in pl | ^MEMQ(prop,propsSeen) and val repeat
;   prop in '(alias generatedCode IS_-GENSYM mapBody localVars) =>
;     nil
;   prop = 'condition =>
;     displayCondition(prop,val,true)
;   prop = 'recursive =>
;     sayMSG '"    This is recursive.'
;   prop = 'isInterpreterFunction =>
;     sayMSG '"    This is an interpreter function.'
;     sayFunctionDeps v where
;       sayFunctionDeps x ==
;         if dependents := GETALIST($dependentAlist,x) then
;           null rest dependents =>
;             sayMSG ["    The following function or rule ",
;               '"depends on this:",:bright first dependents]
;             sayMSG
;               '"    The following functions or rules depend on this:"
;             msg := ["%b",'"    "]
;             for y in dependents repeat msg := ['" ",y,:msg]
;             sayMSG [:nreverse msg,"%d"]
;         if dependees := GETALIST($dependeeAlist,x) then
;           null rest dependees =>
;             sayMSG ["    This depends on the following function ",
;               '"or rule:",:bright first dependees]

```

```

;          sayMSG
;          ' " This depends on the following functions or rules:"
;          msg := ["%b"," "]
;          for y in dependees repeat msg := ['" ",y,:msg]
;          sayMSG [:nreverse msg,"%d"]
;      prop = 'isInterpreterRule =>
;          sayMSG ' " This is an interpreter rule."
;          sayFunctionDeps v
;      prop = 'localModemap =>
;          displayModemap(v,val,true)
;      prop = 'mode =>
;          displayMode(prop,val,true)
;      prop = 'value =>
;          val => displayValue(v,val,true)
;          sayMSG ['" ",prop,' ": ",val]
;      propsSeen:= [prop,:propsSeen]
;      sayKeyedMsg("S2IZ0068",[option])
;      terminateSystemCommand()

```

```

[seq p??]
[getalist p??]
[exit p??]
[sayMSG p331]
[bright p??]
[$dependeeAlist p??]
[$dependentAlist p??]

```

— defun displayProperties,sayFunctionDeps —

```

(defun |displayProperties,sayFunctionDeps| (x)
  (prog (dependents dependees msg)
    (declare (special |$dependeeAlist| |$dependentAlist|))
    (return
      (seq
        (if (setq dependents (getalist |$dependentAlist| x))
          (seq
            (if (null (cdr dependents))
              (exit
                (|sayMSG| (cons " The following function or rule "
                              (cons "depends on this:" (|bright| (car dependents)))))))
            (|sayMSG| " The following functions or rules depend on this:")
            (setq msg (cons '|%b| (cons " " nil)))
            (do ((G166397 dependents (cdr G166397)) (y nil))
              ((or (atom G166397) (progn (setq y (car G166397)) nil)) nil)
              (seq (exit (setq msg (cons " " (cons y msg))))))
            (exit (|sayMSG| (append (nreverse msg) (cons '|%d| nil))))))
          nil)
        (exit
          (if (setq dependees (getalist |$dependeeAlist| x))

```

```
(seq
  (if (null (cdr dependees))
    (exit
      (|sayMSG| (cons "    This depends on the following function "
                     (cons "or rule:" (|bright| (car dependees))))))
    (|sayMSG| "    This depends on the following functions or rules:")
    (setq msg (cons '|%b| (cons "    " nil)))
    (do ((G166406 dependees (cdr G166406)) (y nil))
        ((or (atom G166406) (progn (setq y (car G166406)) nil)) nil)
        (seq (exit (setq msg (cons " " (cons y msg))))))
    (exit (|sayMSG| (append (nreverse msg) (cons '|%d| nil))))
    nil))))))
```

defun displayValue

```
[sayMSG p331]
[fixObjectForPrinting p456]
[pname p1045]
[objValUnwrap p??]
[objMode p??]
[displayRule p??]
[strconc p??]
[prefix2String p??]
[objMode p??]
[getdatabase p1010]
[concat p1047]
[form2String p??]
[mathprint p??]
[outputFormat p??]
[objMode p??]
[$op p??]
[$EmptyMode p??]
```

— defun displayValue —

```
(defun |displayValue| (|$op| u omitVariableNameIfTrue)
  (declare (special |$op|))
  (let (expr op rhs label labmode)
    (declare (special |$EmptyMode|))
    (if (null u)
      (|sayMSG|
        (list '|    Value of | (|fixObjectForPrinting| (pname |$op|)) ": (none)"))
      (progn
        (setq expr (|objValUnwrap| u))
```

```

(if (or (and (consp expr) (progn (setq op (qcar expr)) t) (eq op 'map))
      (equal (|objMode| u) |$EmptyMode|))
  (|displayRule| |$op| expr)
  (progn
    (cond
      (omitVariableNameIfTrue
       (setq rhs ": ")
       (setq label "Value (has type ")
       (t
        (setq rhs ": ")
        (setq label (strconc "Value of " (pname |$op|) ": "))))
      (setq labmode (|prefix2String| (|objMode| u)))
      (when (atom labmode) (setq labmode (list labmode)))
      (if (eq (getdatabase expr 'constructorkind) '|domain|)
          (|sayMSG| (|concat| " " label labmode rhs (|form2String| expr)))
          (|mathprint|
           (cons 'concat
                (cons label
                     (append labmode
                             (cons rhs
                                   (cons (|outputFormat| expr (|objMode| u)) nil))))))
          nil))))))

```

defun displayType

[\[sayMSG p331\]](#)
[\[fixObjectForPrinting p456\]](#)
[\[pname p1045\]](#)
[\[prefix2String p??\]](#)
[\[objMode p??\]](#)
[\[concat p1047\]](#)
[\[\\$op p??\]](#)

— defun displayType —

```

(defun |displayType| (|$op| u omitVariableNameIfTrue)
  (declare (special |$op|) (ignore omitVariableNameIfTrue))
  (let (type)
    (if (null u)
        (|sayMSG|
         (list " Type of value of " (|fixObjectForPrinting| (pname |$op|))
              ": (none)"))
        (progn
         (setq type (|prefix2String| (|objMode| u)))
         (when (atom type) (setq type (list type)))

```

```
(|sayMSG|
  (|concat|
    (cons "    Type of value of "
      (cons (|fixObjectForPrinting| (pname |$op|))
        (cons ": " type))))
    nil))))
```

defun getAndSay

```
[getI p??]
[sayMSG p331]
```

— defun getAndSay —

```
(defun |getAndSay| (v prop)
  (let (val)
    (if (setq val (|getI| v prop))
      (|sayMSG| (cons '|      | (cons val (cons '|%1| nil))))
      (|sayMSG| (cons '|      none| (cons '|%1| nil))))))
```

defun displayProperties

```
[getInterpMacroNames p??]
[getParserMacroNames p453]
[remdup p??]
[qcdr p??]
[qcar p??]
[msort p??]
[getWorkspaceNames p455]
[sayKeyedMsg p329]
[interpFunctionDepAlists p465]
[isInternalMapName p??]
[getIProplist p??]
[getAndSay p461]
[displayValue p459]
[getI p??]
[displayCondition p465]
[displayMode p466]
[displayType p460]
[fixObjectForPrinting p456]
```

```

[sayMSG p331]
[bright p??]
[prefix2String p??]
[member p1048]
[displayParserMacro p464]
[isInterpMacro p??]
[displayMacro p453]
[displayProperties,sayFunctionDeps p456]
[displayModemap p466]
[exit p??]
[seq p??]
[terminateSystemCommand p452]
[$dependentAlist p??]
[$dependeeAlist p??]
[$frameMessages p741]
[$interpreterFrameName p??]

```

— defun displayProperties —

```

(defun |displayProperties| (option al)
  (let (|$dependentAlist| |$dependeeAlist| tmp1 opt imacs pmacros macros v1 pl
        tmp2 vone prop val propsSeen)
    (declare (special |$dependentAlist| |$dependeeAlist| |$frameMessages|
                      |$interpreterFrameName|))
    (setq |$dependentAlist| nil)
    (setq |$dependeeAlist| nil)
    (setq tmp1 (or al (cons '|properties| nil)))
    (setq opt (car tmp1))
    (setq v1 (cdr tmp1))
    (setq imacs (|getInterpMacroNames|))
    (setq pmacros (|getParserMacroNames|))
    (setq macros (remdup (append imacs pmacros)))
    (when (or
            (and (consp v1) (eq (qcdr v1) nil) (eq (qcar v1) '|all|))
            (null v1))
      (setq v1 (msort (append (|getWorkspaceNames|) macros))))
    (when |$frameMessages|
      (|sayKeyedMsg| 'S2IZ0065 (cons |$interpreterFrameName| nil)))
    (cond
      ((null v1)
       (if (null |$frameMessages|)
           (|sayKeyedMsg| 'S2IZ0066 nil))
          (|sayKeyedMsg| 'S2IZ0067 (cons |$interpreterFrameName| nil)))
      (t
       (|interpFunctionDepAlists|)
       (do ((G166440 v1 (cdr G166440)) (v nil))
           ((or (atom G166440) (progn (setq v (car G166440)) nil)) nil)
         (seq (exit

```

```

(cond
  ((|isInternalMapName| v) '|iterate|)
  (t
   (setq pl (|getIProplist| v))
   (cond
     ((eq option '|flags|)
      (|getAndSay| v '|flags|))
     ((eq option '|value|)
      (|displayValue| v (|getI| v '|value|) nil))
     ((eq option '|condition|)
      (|displayCondition| v (|getI| v '|condition|) nil))
     ((eq option '|mode|)
      (|displayMode| v (|getI| v '|mode|) nil))
     ((eq option '|type|)
      (|displayType| v (|getI| v '|value|) nil))
     ((eq option '|properties|)
      (cond
        ((eq v '|--flags--|)
         nil)
        ((and (consp pl)
              (progn
               (setq tmp2 (qcar pl))
               (and (consp tmp2) (eq (qcar tmp2) '|cacheInfo|))))
         nil)
        (t
         (setq vone (|fixObjectForPrinting| v))
         (|sayMSG|
          (cons "Properties of"
                (append (|bright| (|prefix2String| vone)) (cons ":" nil))))
         (cond
           ((null pl)
            (cond
              ((|member| v pmacs)
               (|sayMSG| " This is a user-defined macro.")
               (|displayParserMacro| v))
              ((|isInterpMacro| v)
               (|sayMSG| " This is a system-defined macro.")
               (|displayMacro| v))
              (t
               (|sayMSG| " none")))))
           (t
            (setq propsSeen nil)
            (do ((G166451 pl (cdr G166451)) (G166425 nil))
                ((or (atom G166451)
                     (progn (setq G166425 (car G166451)) nil)
                     (progn
                      (setq prop (car G166425))
                      (setq val (cdr G166425))
                      G166425))

```



```

        nil))
      nil)
    (seq (exit
      (cond
        ((and (null (member prop propsSeen)) val)
          (cond
            ((|member| prop
              '(|alias| |generatedCode| IS-GENSYM
                |mapBody| |localVars|))
              nil)
            ((eq prop '|condition|)
              (|displayCondition| prop val t))
            ((eq prop '|recursive|)
              (|sayMSG| "   This is recursive."))
            ((eq prop '|isInterpreterFunction|)
              (|sayMSG| "   This is an interpreter function."))
              (|displayProperties,sayFunctionDeps| v))
            ((eq prop '|isInterpreterRule|)
              (|sayMSG| "   This is an interpreter rule."))
              (|displayProperties,sayFunctionDeps| v))
            ((eq prop '|localModemap|)
              (|displayModemap| v val t))
            ((eq prop '|model|)
              (|displayModel| prop val t))
            (t
              (when (eq prop '|value|)
                (exit
                  (when val
                    (exit (|displayValue| v val t))))
                (|sayMSG| (list "   " prop ": " val))
                (setq propsSeen (cons prop propsSeen))))))))))
      (t
        (|sayKeyedMsg| 'S2IZ0068 (cons option nil))))))
    (|terminateSystemCommand|))))

```

defun displayParserMacro

[pfPrintSrcLines p??]
 [\$pfMacros p97]

— defun displayParserMacro —

```

(defun |displayParserMacro| (m)
  (let ((m (assq m |$pfMacros|)))
    (declare (special |$pfMacros|)

```

```
(when m (|pfPrintSrcLines| (caddr m))))
```

defun displayCondition

```
[bright p??]
[sayBrightly p??]
[concat p1047]
[pred2English p??]
```

— defun displayCondition —

```
(defun |displayCondition| (v condition giveVariableIfNil)
  (let (varPart condPart)
    (when giveVariableIfNil (setq varPart (cons ' | of| (|bright| v))))
    (setq condPart (or condition '|true|))
    (|sayBrightly|
     (|concat| '| condition| varPart '|: | (|pred2English| condPart)))))
```

defun interpFunctionDepAlists

```
[putalist p??]
[getalist p??]
[getFlag p??]
[$e p??]
[$dependeeAlist p??]
[$dependentAlist p??]
[$InteractiveFrame p??]
```

— defun interpFunctionDepAlists —

```
(defun |interpFunctionDepAlists| ()
  (let (|$e|)
    (declare (special |$e| |$dependeeAlist| |$dependentAlist|
                      |$InteractiveFrame|))
    (setq |$e| |$InteractiveFrame|)
    (setq |$dependentAlist| (cons (cons nil nil) nil))
    (setq |$dependeeAlist| (cons (cons nil nil) nil))
    (mapcar #'(lambda (dep)
      (let (dependee dependent)
        (setq dependee (first dep))
```

```

(setq dependent (second dep))
(setq |$dependentAlist|
  (putalist |$dependentAlist| dependee
    (cons dependent (getalist |$dependentAlist| dependee))))
(spadlet |$dependeeAlist|
  (putalist |$dependeeAlist| dependent
    (cons dependee (getalist |$dependeeAlist| dependent))))
(|getFlag| '$dependencies|)))

```

defun displayModemap

```

[bright p??]
[sayBrightly p??]
[concat p1047]
[formatSignature p??]

```

— defun displayModemap —

```

(defun |displayModemap| (v val giveVariableIfNil)
  (labels (
    (g (v mm giveVariableIfNil)
      (let (local signature fn varPart prefix)
        (setq local (caar mm))
        (setq signature (cdar mm))
        (setq fn (cadr mm))
        (unless (eq local '|interpOnly|)
          (spadlet varPart (unless giveVariableIfNil (cons " of" (|bright| v))))
          (spadlet prefix
            (cons '| Compiled function type| (append varPart (cons '|: | nil)))))
        (|sayBrightly| (|concat| prefix (|formatSignature| signature))))))
    (mapcar #'(lambda (x) (g v x giveVariableIfNil)) val)))

```

defun displayMode

```

[bright p??]
[fixObjectForPrinting p456]
[sayBrightly p??]
[concat p1047]
[prefix2String p??]

```

— defun displayMode —

```
(defun |displayMode| (v mode giveVariableIfNil)
  (let (varPart)
    (when mode
      (unless giveVariableIfNil
        (setq varPart (cons '| of| (|bright| (|fixObjectForPrinting| v)))))
      (|sayBrightly|
        (|concat| '| Declared type or mode| varPart '|: |
          (|prefix2String| mode))))))
```

—————

defun Split into tokens delimited by spaces

[stripSpaces p471]

— defun dumbTokenize —

```
(defun |dumbTokenize| (str)
  (let (inString token (tokenStart 0) previousSpace tokenList)
    (dotimes (i (1- (|#| str)))
      (cond
        ((char= (elt str i) #"") ; don't split strings
          (setq inString (null inString))
          (setq previousSpace nil))
        ((and (char= (elt str i) #"space) (null inString))
          (unless previousSpace
            (setq token (|stripSpaces| (subseq str tokenStart i)))
            (setq tokenList (cons token tokenList))
            (setq tokenStart (1+ i))
            (setq previousSpace t)))
        (t
          (setq previousSpace nil))))
    (setq tokenList (cons (|stripSpaces| (subseq str tokenStart)) tokenList))
    (nreverse tokenList))
```

—————

defun Convert string tokens to their proper type

[isIntegerString p468]

— defun tokTran —

```
(defun |tokTran| (tok)
  (let (tmp)
    (if (stringp tok)
      (cond
        ((eql (|#| tok) 0) nil)
        ((setq tmp (|isIntegerString| tok)) tmp)
        ((char= (elt tok 0) #" ") (subseq tok 1 (1- (|#| tok))))
        (t (intern tok)))
      tok)))
```

defun Is the argument string an integer?

— defun isIntegerString 0 —

```
(defun |isIntegerString| (tok)
  (multiple-value-bind (int len) (parse-integer tok :junk-allowed t)
    (when (and int (= len (length tok))) int)))
```

defun Handle parsed system commands

```
[dumbTokenize p467]
[parseSystemCmd p469]
[tokTran p467]
[systemCommand p448]
```

— defun handleParsedSystemCommands —

```
(defun |handleParsedSystemCommands| (unabr optionList)
  (declare (ignore unabr))
  (let (restOptionList parcmd trail)
    (setq restOptionList (mapcar #'|dumbTokenize| (cdr optionList)))
    (setq parcmd (|parseSystemCmd| (car optionList)))
    (setq trail
      (mapcar #'(lambda (opt)
        (mapcar #'(lambda (tok) (|tokTran| tok)) opt)) restOptionList))
    (|systemCommand| (cons parcmd trail))))
```

defun Parse a system command

```
[tokTran p467]
[stripSpaces p471]
[parseFromString p46]
[dumbTokenize p467]
```

— defun parseSystemCmd —

```
(defun |parseSystemCmd| (opt)
  (let (spaceIndex)
    (if (setq spaceIndex (search " " opt))
      (list
        (|tokTran| (|stripSpaces| (subseq opt 0 spaceIndex)))
        (|parseFromString| (|stripSpaces| (subseq opt spaceIndex))))
      (mapcar #'|tokTran| (|dumbTokenize| opt)))))
```

—————

defun Get first word in a string

```
[subseq p??]
[stringSpaces p??]
```

— defun getFirstWord —

```
(defun |getFirstWord| (string)
  (let (spaceIndex)
    (setq spaceIndex (search " " string))
    (if spaceIndex
      (|stripSpaces| (subseq string 0 spaceIndex))
      string)))
```

—————

defun Unabbreviate keywords in commands

```
[selectOptionLC p479]
[selectOption p479]
[commandsForUserLevel p448]
[$systemCommands p443]
[$currentLine p??]
[$syscommands p444]
[line p??]
```

— defun unAbbreviateKeyword —

```
(defun |unAbbreviateKeyword| (x)
  (let (xp)
    (declare (special |$systemCommands| |$currentLine| $syscommands line))
    (setq xp (|selectOptionLC| x $syscommands '|commandErrorIfAmbiguous|))
    (cond
      ((null xp)
        (setq xp '|system|)
        (setq line (concat ")system " (substring line 1 (1- (|#| line)))))
      (spadlet |$currentLine| line)))
    (|selectOption| xp (|commandsForUserLevel| |$systemCommands|)
      '|commandUserLevelError|)))
```

—————

defun The command is ambiguous error

```
[commandAmbiguityError p452]
[$oldline p449]
[line p??]
```

— defun commandErrorIfAmbiguous —

```
(defun |commandErrorIfAmbiguous| (x u)
  (declare (special $oldline line))
  (when u
    (setq $oldline line)
    (|commandAmbiguityError| '|command| x u)))
```

—————

```
[stripSpaces p471]
[nplisp p472]
[stripLisp p471]
[sayKeyedMsg p329]
[npboot p472]
[npsystem p472]
[npsynonym p473]
[member p1048]
[concat p1047]
```

— defun handleNoParseCommands —

```
(defun |handleNoParseCommands| (unab string)
```

```

(let (spaceindex funname)
  (setq string (|stripSpaces| string))
  (setq spaceindex (search " " string))
  (cond
    ((eq unab '|lisp|)
     (if spaceindex
      (|nplisp| (|stripLisp| string))
      (|sayKeyedMsg| 's2iv0005 nil)))
    ((eq unab '|boot|)
     (if spaceindex
      (|npboot| (subseq string (1+ spaceindex)))
      (|sayKeyedMsg| 's2iv0005 nil)))
    ((eq unab '|system|)
     (if spaceindex
      (|npsystem| unab string)
      (|sayKeyedMsg| 's2iv0005 nil)))
    ((eq unab '|synonym|)
     (if spaceindex
      (|npsynonym| unab (subseq string (1+ spaceindex)))
      (|npsynonym| unab "")))
    ((null spaceindex)
     (funcall unab))
    ((|member| unab '(|quit| |fin| |pquit| |credits| |copyright| |trademark|))
     (|sayKeyedMsg| 's2iv0005 nil))
    (t
     (setq funname (intern (concat "np" (string unab))))
     (funcall funname (subseq string (1+ spaceindex))))))

```

defun Remove the spaces surrounding a string

TPDHERE: This should probably be a macro or eliminated

— defun stripSpaces 0 —

```

(defun |stripSpaces| (str)
  (string-trim '(#\space) str))

```

defun Remove the lisp command prefix

— defun stripLisp 0 —

```

(defun |stripLisp| (str)

```



```
(if (string= (subseq str 0 4) "lisp")
    (subseq str 4)
    str))
```

defun Handle the)lisp command

[\$ans p??]

— defun nplisp 0 —

```
(defun |nplisp| (str)
  (declare (special |$ans|))
  (setq |$ans| (eval (read-from-string str))))
  (format t "~&Value = ~S~%" |$ans|))
```

defun The)boot command is no longer supported

TPDHERE: Remove all boot references from top level

— defun npboot 0 —

```
(defun |npboot| (str)
  (declare (ignore str))
  (format t "The )boot command is no longer supported~%"))
```

defun Handle the)system command

Note that unAbbreviateKeyword returns the word “system” for unknown words so we have to search for this case. This complication may never arrive in practice. [sayKeyedMsg p329]

— defun npsystem —

```
(defun |npsystem| (unab str)
  (let (spaceIndex sysPart)
    (setq spaceIndex (search " " str))
    (cond
      ((null spaceIndex) (|sayKeyedMsg| 'S2IZ0080 (list str)))
      (t
```

```
(setq sysPart (subseq str 0 spaceIndex))
(if (search sysPart (string unab))
    (obey (subseq str (1+ spaceIndex)))
    (|sayKeyedMsg| 'S2IZ0080 (list sysPart))))))
```

defun Handle the)synonym command

[npProcessSynonym p473]

— defun npsynonym —

```
(defun |npsynonym| (unab str)
  (declare (ignore unab))
  (|npProcessSynonym| str))
```

defun Handle the synonym system command

[printSynonyms p474]
 [processSynonymLine p835]
 [putalist p??]
 [terminateSystemCommand p452]
 [\$CommandSynonymAlist p478]

— defun npProcessSynonym —

```
(defun |npProcessSynonym| (str)
  (let (pair)
    (declare (special |$CommandSynonymAlist|))
    (if (= (length str) 0)
        (|printSynonyms| nil)
        (progn
          (setq pair (|processSynonymLine| str))
          (if |$CommandSynonymAlist|
              (putalist |$CommandSynonymAlist| (car pair) (cdr pair)))
              (setq |$CommandSynonymAlist| (cons pair nil))))
    (|terminateSystemCommand|)))
```

defun printSynonyms

[centerAndHighlight p??]
 [specialChar p980]
 [filterListOfStringsWithFn p943]
 [synonymsForUserLevel p833]
 [printLabelledList p474]
 [\$CommandSynonymAlist p478]
 [\$linelength p774]

— defun printSynonyms —

```
(defun |printSynonyms| (patterns)
  (prog (ls t1)
    (declare (special |$CommandSynonymAlist| $linelength))
    (|centerAndHighlight| ' |System Command Synonyms|
      $linelength (|specialChar| '|hbar|))

    (setq ls
      (|filterListOfStringsWithFn| patterns
        (do ((t2 (|synonymsForUserLevel| |$CommandSynonymAlist|) (cdr t2)))
          ((atom t2) (nreverse0 t1))
          (push (cons (princ-to-string (caar t2)) (cdar t2)) t1))
        (|function| car)))
      (|printLabelledList| ls "user" "synonyms" " " patterns)))
```

defun Print a list of each matching synonym

The prefix goes before each element on each side of the list, eg, ")") [sayMessage p??]

[blankList p??]
 [substring p??]
 [entryWidth p??]
 [sayBrightly p??]
 [concat p1047]
 [fillerSpaces p18]

— defun printLabelledList —

```
(defun |printLabelledList| (ls label1 label2 prefix patterns)
  (let (comm syn wid)
    (if (null ls)
      (if (null patterns)
        (|sayMessage| (list " No " label1 "-defined " label2 " in effect."))
        (|sayMessage|
          ' (" No " ,label1 "-defined " ,label2 " satisfying patterns:"
```

```

    |%l| "      " |%b| ,@(append (|blankList| patterns) (list '|%d|'))))
(progn
  (when patterns
    (|sayMessage|
      '(',label1 "-defined " ,label2 " satisfying patterns:" |%l| "      "
        |%b| ,@(append (|blankList| patterns) (list '|%d|')))))
    (do ((t1 ls (cdr t1)))
      ((atom t1) nil)
      (setq syn (caar t1))
      (setq comm (cdar t1))
      (when (string= (substring syn 0 1) "|")
        (setq syn (substring syn 1 nil)))
      (when (string= syn "%i") (setq syn "%i "))
      (setq wid (max (- 30 (|entryWidth| syn)) 1))
      (|sayBrightly|
        (|concat| '|%b| prefix syn '|%d| (|fillerSpaces| wid ".")
          " " prefix comm)))
      (|sayBrightly| ""))))))

```

defvar \$tokenCommands

This is a list of the commands that expect the interpreter to parse their arguments. Thus the history command expects that Axiom will have tokenized and validated the input before calling the history function.

— **initvars** —

```
(defvar |$tokenCommands| nil)
```

— **postvars** —

```

(eval-when (eval load)
  (setq |$tokenCommands|
    '( |abbreviations|
      |cd|
      |clear|
      |close|
      |compiler|
      |depends|
      |display|
      |describe|
      |edit|

```

```

|frame|
|frame|
|help|
|history|
|input|
|library|
|load|
|ltrace|
|read|
|regress|
|savesystem|
|set|
|spool|
|tangle|
|undo|
|what|
|with|
|workfiles|
|zsystemdevelopment|
)))

```

defvar \$InitialCommandSynonymAlist

Axiom can create “synonyms” for commands. We create an initial table of synonyms which are in common use.

— **initvars** —

```
(defvar |$InitialCommandSynonymAlist| nil)
```

defun Print the current version information

```

[*yearweek* p??]
[*build-version* p??]

```

— **defun axiomVersion 0** —

```

(defun axiomVersion ()
  (declare (special *build-version* *yearweek*))
  (concatenate 'string "Axiom " *build-version* " built on " *yearweek*))

```

— postvars —

```
(eval-when (eval load)
  (setq |$InitialCommandSynonymAlist|
    '(
      (|?|          . "what commands")
      (|ap|         . "what things")
      (|apr|        . "what things")
      (|apropos|    . "what things")
      (|cache|      . "set functions cache")
      (|cl|         . "clear")
      (|cls|        . "zsystemdevelopment )cls")
      (|cms|        . "system")
      (|col|        . "compiler")
      (|d|          . "display")
      (|depl|       . "display dependents")
      (|dependents| . "display dependents")
      (|e|          . "edit")
      (|expose|     . "set expose add constructor")
      (|fc|         . "zsystemdevelopment )c")
      (|fd|         . "zsystemdevelopment )d")
      (|fdt|        . "zsystemdevelopment )dt")
      (|fct|        . "zsystemdevelopment )ct")
      (|fctl|       . "zsystemdevelopment )ctl")
      (|fe|         . "zsystemdevelopment )e")
      (|fec|        . "zsystemdevelopment )ec")
      (|fect|       . "zsystemdevelopment )ect")
      (|fns|        . "exec spadfn")
      (|fortran|    . "set output fortran")
      (|h|          . "help")
      (|hd|         . "system hypertex &")
      (|kclam|      . "boot clearClams ( )")
      (|killcaches| . "boot clearConstructorAndLisplibCaches ( )")
      (|patch|      . "zsystemdevelopment )patch")
      (|pause|      . "zsystemdevelopment )pause")
      (|prompt|     . "set message prompt")
      (|recurrence| . "set functions recurrence")
      (|restore|    . "history )restore")
      (|save|       . "history )save")
      (|startGraphics| . "system $AXIOM/lib/viewman &")
      (|startNAGLink| . "system $AXIOM/lib/nagman &")
      (|stopGraphics| . "lisp (|sockSendSignal| 2 15)")
      (|stopNAGLink| . "lisp (|sockSendSignal| 8 15)")
      (|time|       . "set message time")
      (|type|       . "set message type")
      (|unexpose|   . "set expose drop constructor")
      (|up|         . "zsystemdevelopment )update")
    )
  )
```

```

(|version| . "lisp (axiomVersion)")
(|w| . "what")
(|wc| . "what categories")
(|wd| . "what domains")
(|who| . "lisp (pprint credits)")
(|wp| . "what packages")
(|ws| . "what synonyms")
)))

```

defvar \$CommandSynonymAlist

The actual list of synonyms is initialized to be the same as the above initial list of synonyms. The user synonyms that are added during a session are pushed onto this list for later lookup.

— **initvars** —

```
(defvar |$CommandSynonymAlist| nil)
```

— **postvars** —

```

(eval-when (eval load)
  (setq |$CommandSynonymAlist| (copy-alist |$InitialCommandSynonymAlist|)))

```

defun nclloopCommand

The `$systemCommandFunction` is set in `SpadInterpretStream` to point to the function `InterpExecuteSpadSystemCommand`. The system commands are handled by the function in the “hook” variable `$systemCommandFunction` which has the default function `InterpExecuteSpadSystemCommand`. Thus, when a system command is entered this function is called.

The only exception is the `)include` function which inserts the contents of a file inline in the input stream. This is useful for processing `)read` of input files. [`nclloopPrefix?` p479]

[`nclloopInclude1` p621]

[`$systemCommandFunction` p??]

[`$systemCommandFunction` p??]

— **defun nclloopCommand** —

```
(defun |ncloopCommand| (line n)
  (let (a)
    (declare (special |$systemCommandFunction|))
    (if (setq a (|ncloopPrefix?| ")include" line))
        (|ncloopInclude1| a n)
        (progn
          (funcall |$systemCommandFunction| line)
          n))))
```

defun ncloopPrefix?

If we find the prefix string in the whole string starting at position zero we return the remainder of the string without the leading prefix.

— defun ncloopPrefix? 0 —

```
(defun |ncloopPrefix?| (prefix whole)
  (when (eql (search prefix whole) 0)
    (subseq whole (length prefix))))
```

defun selectOptionLC

```
[selectOption p479]
[downcase p??]
[object2Identifier p??]
```

— defun selectOptionLC —

```
(defun |selectOptionLC| (x l errorFunction)
  (|selectOption| (downcase (|object2Identifier| x)) l errorFunction))
```

defun selectOption

```
[member p1048]
[identp p1046]
[stringPrefix? p??]
[pname p1045]
```



```
[qcdr p??]
[qcar p??]
```

— defun selectOption —

```
(defun |selectOption| (x l errorfunction)
  (let (u y)
    (cond
      ((|member| x l) x)
      ((null (identp x))
       (cond
         (errorfunction (funcall errorfunction x u))
         (t nil)))
      (t
       (setq u
              (let (t0)
                (do ((t1 l (cdr t1)) (y nil))
                    ((or (atom t1) (progn (setq y (car t1)) nil)) (nreverse0 t0))
                  (if (|stringPrefix?| (pname x) (pname y))
                      (setq t0 (cons y t0)))))))
       (cond
         ((and (consp u) (eq (qcdr u) nil) (progn (setq y (qcar u)) t)) y)
         (errorfunction (funcall errorfunction x u))
         (t nil))))))
```

—————

Chapter 19

)abbreviations help page Command

19.1 abbreviations help page man page

— abbreviations.help —

```
=====
A.2. )abbreviation
=====
```

User Level Required: compiler

Command Syntax:

-)abbreviation query [nameOrAbbrev]
-)abbreviation category abbrev fullname [quiet]
-)abbreviation domain abbrev fullname [quiet]
-)abbreviation package abbrev fullname [quiet]
-)abbreviation remove nameOrAbbrev

Command Description:

This command is used to query, set and remove abbreviations for category, domain and package constructors. Every constructor must have a unique abbreviation. This abbreviation is part of the name of the subdirectory under which the components of the compiled constructor are stored. Furthermore, by issuing this command you let the system know what file to load automatically if you use a new constructor. Abbreviations must start with a letter and then be followed by up to seven letters or digits. Any letters appearing in the abbreviation must be in uppercase.

When used with the query argument, this command may be used to list the name associated with a particular abbreviation or the abbreviation for a constructor. If no abbreviation or name is given, the names and corresponding abbreviations for all constructors are listed.

The following shows the abbreviation for the constructor List:

```
)abbreviation query List
```

The following shows the constructor name corresponding to the abbreviation NNI:

```
)abbreviation query NNI
```

The following lists all constructor names and their abbreviations.

```
)abbreviation query
```

To add an abbreviation for a constructor, use this command with category, domain or package. The following add abbreviations to the system for a category, domain and package, respectively:

```
)abbreviation domain SET Set
)abbreviation category COMPCAT ComplexCategory
)abbreviation package LIST2MAP ListToMap
```

If the)quiet option is used, no output is displayed from this command. You would normally only define an abbreviation in a library source file. If this command is issued for a constructor that has already been loaded, the constructor will be reloaded next time it is referenced. In particular, you can use this command to force the automatic reloading of constructors.

To remove an abbreviation, the remove argument is used. This is usually only used to correct a previous command that set an abbreviation for a constructor name. If, in fact, the abbreviation does exist, you are prompted for confirmation of the removal request. Either of the following commands will remove the abbreviation VECTOR2 and the constructor name VectorFunctions2 from the system:

```
)abbreviation remove VECTOR2
)abbreviation remove VectorFunctions2
```

Also See:

- o)compile

19.2 Functions

defun abbreviations

[abbreviationsSpad2Cmd p483]

— defun abbreviations —

```
(defun |abbreviations| (l)
  (|abbreviationsSpad2Cmd| l))
```

—————

defun abbreviationsSpad2Cmd

[listConstructorAbbreviations p484]
 [abbreviation? p??]
 [abbQuery p536]
 [deldatabase p1009]
 [size p1045]
 [sayKeyedMsg p329]
 [mkUserConstructorAbbreviation p??]
 [setdatabase p1009]
 [seq p??]
 [exit p??]
 [opOf p??]
 [helpSpad2Cmd p572]
 [selectOptionLC p479]
 [qcar p??]
 [qcdr p??]
 [\$options p??]

— defun abbreviationsSpad2Cmd —

```
(defun |abbreviationsSpad2Cmd| (arg)
  (let (abopts quiet opt key type constructor t2 a b al)
    (declare (special |$options|))
    (if (null arg)
      (|helpSpad2Cmd| '(|abbreviations|))
      (progn
        (setq abopts '(|query| |domain| |category| |package| |remove|))
        (setq quiet nil)
        (do ((t0 |$options| (cdr t0)) (t1 nil))
          ((or (atom t0)
              (progn (setq t1 (car t0)) nil))
```

```

      (progn (progn (setq opt (car t1)) t1) nil))
    nil)
  (setq opt (|selectOptionLC| opt '(|quiet|) '|optionError|))
  (when (eq opt '|quiet|) (setq quiet t)))
(when
  (and (consp arg)
    (progn
      (setq opt (qcar arg))
      (setq al (qcdr arg))
      t))
  (setq key (|opOf| (car al)))
  (setq type (|selectOptionLC| opt abopts '|optionError|))
  (cond
    ((eq type '|query|)
      (cond
        ((null al) (|listConstructorAbbreviations|))
        ((setq constructor (|abbreviation?| key))
          (|abbQuery| constructor))
        (t (|abbQuery| key))))
    ((eq type '|remove|)
      (deldatabase key 'abbreviation))
    ((oddp (size al))
      (|sayKeyedMsg| 's2iz0002 (list type)))
    (t
      (do () (nil nil)
        (seq
          (exit
            (cond
              ((null al) (return '|fromLoop|))
              (t
                (setq t2 al)
                (setq a (car t2))
                (setq b (cadr t2))
                (setq al (cddr t2))
                (|mkUserConstructorAbbreviation| b a type)
                (setdatabase b 'abbreviation a)
                (setdatabase b 'constructorkind type))))))
      (unless quiet
        (|sayKeyedMsg| 's2iz0001 (list a type (|opOf| b))))))))))

```

defun listConstructorAbbreviations

```

[upcase p??]
[queryUserKeyedMsg p??]
[string2id-n p??]
[whatSpad2Cmd p940]

```

[sayKeyedMsg p[329](#)]

— defun listConstructorAbbreviations —

```
(defun |listConstructorAbbreviations| ()
  (let (x)
    (setq x (upcase (|queryUserKeyedMsg| 's2iz0056 nil)))
    (if (member (string2id-n x 1) '(Y YES))
        (progn
          (|whatSpad2Cmd| '(|categories|))
          (|whatSpad2Cmd| '(|domains|))
          (|whatSpad2Cmd| '(|packages|)))
        (|sayKeyedMsg| 's2iz0057 nil))))
```

Chapter 20

)boot help page Command

20.1 boot help page man page

— boot.help —

```
=====
A.3. )boot
=====
```

User Level Required: development

Command Syntax:

-)boot bootExpression

Command Description:

This command is used by AXIOM system developers to execute expressions written in the BOOT language. For example,

```
)boot times3(x) == 3*x
```

creates and compiles the Lisp function “times3” obtained by translating the BOOT code.

Also See:

- o)fin
- o)lisp
- o)set
- o)system

[1](#)

20.2 Functions

This command is in the list of `$noParseCommands` [18.1](#) which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` [18.2](#)

¹ “fin” ([31.1](#) p [548](#)) “lisp” (?? p ??) “set” ([45.36](#) p [808](#)) “system” (?? p ??)

Chapter 21

)browse help page Command

21.1 browse help page man page

— browse.help —

User Level Required: development

Command Syntax:

```
)browse
```

Command Description:

This command is used by Axiom system users to start the Axiom top level loop listening for browser connections.

—————

21.2 Overview

The Axiom book on the help browser is a complete rewrite of the hyperdoc mechanism. There are several components that were needed to make this function. Most of the web browser components are described in bookvol11.pamphlet. This portion describes some of the design issues needed to support the interface.

The axServer command takes a port (defaulting to 8085) and a program to handle the browser interaction (defaulting to multiServ). The axServer function opens the port, constructs the

stream, and passes the stream to multiServ. The multiServ loop processes one interaction at a time.

So the basic process is that the Axiom “)browse” command opens a socket and listens for http requests. Based on the type of request (either ‘GET’ or ‘POST’) and the content of the request, which is one of:

- command - algebra request/response
- lispcall - a lisp s-expression to be evaluated
- showcall - an Axiom)show command

the multiServ function will call a handler function to evaluate the command line and construct a response. GET requests result in a new browser page. POST requests result in an inline result.

Most responses contain the fields:

- stepnum - this is the Axiom step number
- command - this is the original command from the browser
- algebra - this is the Axiom 2D algebra output
- mathml - this is the MathML version of the Axiom algebra
- type - this is the type of the Axiom result

21.3 Browsers, MathML, and Fonts

This work has the Firefox browser as its target. Firefox has built-in support for MathML, javascript, and XMLHttpRequests. More details are available in bookvol11.pamphlet but the very basic machinery for communication with the browser involves a dance between the browser and the multiServ function (see the axserver.spad.pamphlet).

In particular, a simple request is embedded in a web page as:

```
<ul>
<li>
  <input type="submit" id="p3" class="subbut"
    onclick="makeRequest('p3');"
    value="sin(x)" />
  <div id="ansp3"><div></div></div>
</li>
</ul>
```

which says that this is an html “input” field of type “submit”. The CSS display class is “subbut” which is of a different color than the surrounding text to make it obvious that you can click on this field. Clickable fields that have no response text are of class “noresult”.

The javascript call to “makeRequest” gives the “id” of this input field, which must be unique in the page, as an argument. In this case, the argument is ‘p3’. The “value” field holds the display text which will be passed back to Axiom as a command.

When the result arrives the “showanswer” function will select out the mathml field of the response, construct the “id” of the html div to hold the response by concatenating the string “ans” (answer) to the “id” of the request resulting, in this case, as “ansp3”. The “showanswer” function will find this div and replace it with a div containing the mathml result.

The “makeRequest” function is:

```
function makeRequest(arg) {
  http_request = new XMLHttpRequest();
  var command = cmdline(arg);
  //alert(command);
  http_request.open('POST', '127.0.0.1:8085', true);
  http_request.onreadystatechange = handleResponse;
  http_request.setRequestHeader('Content-Type', 'text/plain');
  http_request.send("command="+command);
  return(false);
}
```

It contains a request to open a local server connection to Axiom, sets “handleResponse” as the function to call on reply, sets up the type of request, fills in the command field, and sends off the http request.

When a response is received, the “handleResponse” function checks for the correct reply state, strips out the important text, and calls “showanswer”.

```
function handleResponse() {
  if (http_request.readyState == 4) {
    if (http_request.status == 200) {
      showanswer(http_request.responseText,'mathAns');
    } else
    {
      alert('There was a problem with the request.'+ http_request.statusText);
    }
  }
}
```

See bookvol11.pamphlet for further details.

21.4 The axServer/multiServ loop

The basic call to start an Axiom browser listener is:

```
)set message autoload off
)set output mathml on
axServer(8085,multiServ)$AXSERV
```

This call sets the port, opens a socket, attaches it to a stream, and then calls “multiServ” with that stream. The “multiServ” function loops serving web responses to that port.

21.5 The)browse command

In order to make the whole process cleaner the function “)browse” handles the details. This code creates the command-line function for)browse

The browse function does the internal equivalent of the following 3 command line statments:

```
)set message autoload off
)set output mathml on
axServer(8085,multiServ)$AXSERV
```

which causes Axiom to start serving web pages on port 8085

For those unfamiliar with calling algebra from lisp there are a few points to mention.

The loadLib needs to be called to load the algebra code into the image. Normally this is automatic but we are not using the interpreter so we need to do this “by hand”.

Each algebra file contains a “constructor function” which builds the domain, which is a vector, and then caches the vector so that every call to the contructor returns an EQ vector, that is, the same vector. In this case, we call the constructor |AxiomServer|

The axServer function was mangled internally to |AXSERV;axServer;IMV;2|. The multiServ function was mangled to |AXSERV;multiServ;SeV;3| Note well that if you change axserver.spad these names might change which will generate the error message along the lines of:

```
System error:
The function $\vert$AXSERV;axServer;IMV;2$\vert$ is undefined.
```

To fix this you need to look at int/algebra/AXSERV.nrllib/code.lsp and find the new mangled function name. A better solution would be to dynamically look up the surface names in the domain vector.

Each Axiom function expects the domain vector as the last argument. This is not obvious from the call as the interpreter supplies it. We must do that “by hand”.

We don’t call the multiServ function. We pass it as a parameter to the axServer function. When it does get called by the SPADCALL macro it needs to be a lisp pair whose car is the function and whose cdr is the domain vector. We construct that pair here as the second argument to axServer. The third, hidden, argument to axServer is the domain vector which we supply “by hand”.

The socket can be supplied on the command line but defaults to 8085. Axiom supplies the arguments as a list.

21.6 Variables Used

21.7 Functions

```
[set p808]
[loadLib p1035]
[AxiomServer p??]
[AXSERV;axServer;IMV;2 p??]
```

— defun browse —

```
(defun |browse| (socket)
  (let (axserv browser)
    (if socket
      (setq socket (car socket))
      (setq socket 8085))
    (|set| '(|mes| |auto| |off|))
    (|set| '(|out| |mathml| |on|))
    (|loadLib| '|AxiomServer|)
    (setq axserv (|AxiomServer|))
    (setq browser
      (|AXSERV;axServer;IMV;2| socket
        (cons #'|AXSERV;multiServ;SeV;3| axserv) axserv))))
```

Now we have to bolt it into Axiom. This involves two lookups.

We create the lisp pair

```
(|browse| . |development|)
```

and cons it into the \$systemCommands command table. This allows the command to be executed in development mode. This lookup decides if this command is allowed. It also has the side-effect of putting the command into the \$SYSCOMMANDS variable which is used to determine if the token is a command.

21.8 The server support code

Chapter 22

)cd help page Command

22.1 cd help page man page

— cd.help —

```
=====
A.4. )cd
=====
```

User Level Required: interpreter

Command Syntax:

-)cd directory

Command Description:

This command sets the AXIOM working current directory. The current directory is used for looking for input files (for)read), AXIOM library source files (for)compile), saved history environment files (for)history)restore), compiled AXIOM library files (for)library), and files to edit (for)edit). It is also used for writing spool files (via)spool), writing history input files (via)history)write) and history environment files (via)history)save), and compiled AXIOM library files (via)compile).

If issued with no argument, this command sets the AXIOM current directory to your home directory. If an argument is used, it must be a valid directory name. Except for the ‘)’ at the beginning of the command, this has the same syntax as the operating system cd command.

Also See:

o)compile

- o)edit
- o)history
- o)library
- o)read
- o)spool

[1](#)

22.2 Variables Used

22.3 Functions

¹ “edit” ([30.2 p 544](#)) “history” ([34.4 p 582](#)) “library” ([66.1 p 1013](#)) “read” ([42.1 p 642](#)) “spool” (?? p ??)

Chapter 23

)clear help page Command

23.1 clear help page man page

— clear.help —

```
=====
A.6. )clear
=====
```

User Level Required: interpreter

Command Syntax:

```
- )clear all
- )clear completely
- )clear properties all
- )clear properties obj1 [obj2 ...]
- )clear value      all
- )clear value      obj1 [obj2 ...]
- )clear mode       all
- )clear mode       obj1 [obj2 ...]
```

Command Description:

This command is used to remove function and variable declarations, definitions and values from the workspace. To empty the entire workspace and reset the step counter to 1, issue

```
)clear all
```

To remove everything in the workspace but not reset the step counter, issue

```
)clear properties all
```

To remove everything about the object `x`, issue

```
)clear properties x
```

To remove everything about the objects `x`, `y` and `f`, issue

```
)clear properties x y f
```

The word `properties` may be abbreviated to the single letter `'p'`.

```
)clear p all
```

```
)clear p x
```

```
)clear p x y f
```

All definitions of functions and values of variables may be removed by either

```
)clear value all
```

```
)clear v all
```

This retains whatever declarations the objects had. To remove definitions and values for the specific objects `x`, `y` and `f`, issue

```
)clear value x y f
```

```
)clear v x y f
```

To remove the declarations of everything while leaving the definitions and values, issue

```
)clear mode all
```

```
)clear m all
```

To remove declarations for the specific objects `x`, `y` and `f`, issue

```
)clear mode x y f
```

```
)clear m x y f
```

The `)display names` and `)display properties` commands may be used to see what is currently in the workspace.

The command

```
)clear completely
```

does everything that `)clear all` does, and also clears the internal system function and constructor caches.

Also See:

- o `)display`

```
o )history
o )undo
```

1

23.2 Variables Used

defvar \$clearOptions

— initvars —

```
(defvar |$clearOptions| '(|modes| |operations| |properties| |types| |values|))
```

23.3 Functions

defun clear

[clearSpad2Cmd p500]

— defun clear —

```
(defun |clear| (1)
  (|clearSpad2Cmd| 1))
```

defvar \$clearExcept

— initvars —

```
(defvar |$clearExcept| nil)
```

¹ “display” (29.2 p 535) “history” (34.4 p 582) “undo” (53.4 p 922)

defun clearSpad2Cmd

TPDHERE: Note that this function also seems to parse out)except)completely and)scaches which don't seem to be documented. [selectOptionLC p479]

[sayKeyedMsg p329]
 [clearCmdAll p503]
 [clearCmdCompletely p502]
 [clearCmdSortedCaches p501]
 [clearCmdExcept p504]
 [clearCmdParts p505]
 [updateCurrentInterpreterFrame p559]
 [\$clearExcept p499]
 [\$options p??]
 [\$clearOptions p499]

— defun clearSpad2Cmd —

```
(defun |clearSpad2Cmd| (l)
  (let (|$clearExcept| opt optlist arg)
    (declare (special |$clearExcept| |$options| |$clearOptions|))
    (cond
      (|$options|
        (setq |$clearExcept|
          (prog (t0)
            (setq t0 t)
            (return
              (do ((t1 nil (null t0))
                  (t2 |$options| (cdr t2))
                  (t3 nil))
                ((or t1
                  (atom t2)
                  (progn (setq t3 (car t2)) nil)
                  (progn (progn (setq opt (car t3)) t3) nil))
                 t0)
              (setq t0
                (and t0
                  (eq
                    (|selectOptionLC| opt '(|except|) '(|optionError|)
                    '|except|))))))))))
      (cond
        ((null l)
          (setq optlist
            (prog (t4)
              (setq t4 nil)
              (return
                (do ((t5 |$clearOptions| (cdr t5)) (x nil))
                  ((or (atom t5) (progn (setq x (car t5)) nil)) t4)
                  (setq t4 (append t4 '(|%1| " " ,x))))))
              (|sayKeyedMsg| 's2iz0010 (list optlist)))
```

```
(t
  (setq arg
    (|selectOptionLC| (car 1) '(|all| |completely| |scaches|) nil))
  (cond
    ((eq arg '|all|)      (|clearCmdAll|))
    ((eq arg '|completely|) (|clearCmdCompletely|))
    ((eq arg '|scaches|)   (|clearCmdSortedCaches|))
    (|$clearExcept|       (|clearCmdExcept| 1))
  )
  (t
    (|clearCmdParts| 1)
    (|updateCurrentInterpreterFrame|))))))
```

defun clearCmdSortedCaches

[compiledLookupCheck p501]
 [spadcall p??]
 [\$lookupDefaults p??]
 [\$Void p??]
 [\$ConstructorCache p??]

— defun clearCmdSortedCaches —

```
(defun |clearCmdSortedCaches| ()
  (let (|$lookupDefaults| domain pair)
    (declare (special |$lookupDefaults| |$Void| |$ConstructorCache|))
    (do ((t0 (hget |$ConstructorCache| '|SortedCache|) (cdr t0))
        (t1 nil))
      ((or (atom t0)
          (progn
            (setq t1 (car t0))
            (setq domain (cddr t1))
            nil))
        nil)
      (setq pair (|compiledLookupCheck| '|clearCache| (list |$Void|) domain))
      (spadcall pair))))
```

defun compiledLookupCheck

[compiledLookup p1076]
 [keyedSystemError p??]
 [formatSignature p??]

— defun compiledLookupCheck —

```
(defun |compiledLookupCheck| (op sig dollar)
  (let (fn)
    (setq fn (|compiledLookup| op sig dollar))
    (cond
      ((and (null fn) (eq op '^))
        (setq fn (|compiledLookup| '** sig dollar)))
      ((and (null fn) (eq op '**))
        (setq fn (|compiledLookup| '^ sig dollar)))
      (t nil))
    (cond
      ((null fn)
        (|keyedSystemError| 'S2NR0001
          (list op (|formatSignature| sig) (elt dollar 0))))
      (t fn))))
```

—————

defvar \$functionTable

— initvars —

```
(defvar |$functionTable| nil)
```

—————

defun clearCmdCompletely

```
[clearCmdAll p503]
[sayKeyedMsg p329]
[clearClams p??]
[clearConstructorCaches p??]
[reclaim p37]
[$localExposureData p697]
[$xdatabase p??]
[$CatOfCatDatabase p??]
[$DomOfCatDatabase p??]
[$JoinOfCatDatabase p??]
[$JoinOfDomDatabase p??]
[$attributeDb p??]
[$functionTable p502]
```

[[existingFiles](#) p??]
 [[localExposureDataDefault](#) p696]

— defun clearCmdCompletely —

```
(defun |clearCmdCompletely| ()
  (declare (special |$localExposureData| |$xdatabase| |$CatOfCatDatabase|
    |$DomOfCatDatabase| |$JoinOfCatDatabase| |$JoinOfDomDatabase|
    |$attributeDb| |$functionTable| |$existingFiles|
    |$localExposureDataDefault|))
  (|clearCmdAll|)
  (setq |$localExposureData| (copy-seq |$localExposureDataDefault|))
  (setq |$xdatabase| nil)
  (setq |$CatOfCatDatabase| nil)
  (setq |$DomOfCatDatabase| nil)
  (setq |$JoinOfCatDatabase| nil)
  (setq |$JoinOfDomDatabase| nil)
  (setq |$attributeDb| nil)
  (setq |$functionTable| nil)
  (|sayKeyedMsg| 's2iz0013 nil)
  (|clearClams|)
  (|clearConstructorCaches|)
  (setq |$existingFiles| (make-hash-table :test #'equal))
  (|sayKeyedMsg| 's2iz0014 nil)
  (reclaim)
  (|sayKeyedMsg| 's2iz0015 nil))
```

defun clearCmdAll

[[clearCmdSortedCaches](#) p501]
 [[untraceMapSubNames](#) p873]
 [[resetInCoreHist](#) p588]
 [[deleteFile](#) p1042]
 [[histFileName](#) p580]
 [[updateCurrentInterpreterFrame](#) p559]
 [[clearMacroTable](#) p504]
 [[sayKeyedMsg](#) p329]
 [[frameRecord](#) p921]
 [[previousBindings](#) p921]
 [[variableNumberAlist](#) p??]
 [[InteractiveFrame](#) p??]
 [[useInternalHistoryTable](#) p579]
 [[internalHistoryTable](#) p??]
 [[frameMessages](#) p741]


```
[$interpreterFrameName p??]
[$currentLine p??]
```

— defun clearCmdAll —

```
(defun |clearCmdAll| ()
  (declare (special |$frameRecord| |$previousBindings| |$variableNumberAlist|
    |$InteractiveFrame| |$useInternalHistoryTable| |$internalHistoryTable|
    |$frameMessages| |$interpreterFrameName| |$currentLine|))
  (|clearCmdSortedCaches|)
  (setq |$frameRecord| nil)
  (setq |$previousBindings| nil)
  (setq |$variableNumberAlist| nil)
  (|untraceMapSubNames| /tracenames)
  (setq |$InteractiveFrame| (list (list nil)))
  (|resetInCoreHist|)
  (when |$useInternalHistoryTable|
    (setq |$internalHistoryTable| nil)
    (|deleteFile| (|histFileName|)))
  (setq |$IOindex| 1)
  (|updateCurrentInterpreterFrame|)
  (setq |$currentLine| ")clear all")
  (|clearMacroTable|)
  (when |$frameMessages|
    (|sayKeyedMsg| 's2iz0011 (list |$interpreterFrameName|))
    (|sayKeyedMsg| 's2iz0012 nil)))
```

—————

defun clearMacroTable

```
[$pfMacros p97]
```

— defun clearMacroTable 0 —

```
(defun |clearMacroTable| ()
  (declare (special |$pfMacros|))
  (setq |$pfMacros| nil))
```

—————

defun clearCmdExcept

Clear all the options except the argument. [stringPrefix? p??]
[object2String p??]

[clearCmdParts p505]

[\$clearOptions p499]

— **defun clearCmdExcept** —

```
(defun |clearCmdExcept| (arg)
  (let ((opt (car arg)) (vl (cdr arg)))
    (declare (special |$clearOptions|))
    (dolist (option |$clearOptions|)
      (unless (|stringPrefix?| (|object2String| opt) (|object2String| option))
        (|clearCmdParts| (cons option vl))))))
```

defun clearCmdParts

[selectOptionLC p479]
 [pname p1045]
 [types p??]
 [modes p??]
 [values p??]
 [boot-equal p??]
 [assocleft p??]
 [remdup p??]
 [assoc p??]
 [isMap p??]
 [get p??]
 [exit p??]
 [untraceMapSubNames p873]
 [seq p??]
 [recordOldValue p592]
 [recordNewValue p591]
 [deleteAssoc p??]
 [sayKeyedMsg p329]
 [getParserMacroNames p453]
 [getInterpMacroNames p??]
 [clearDependencies p??]
 [member p1048]
 [clearParserMacro p453]
 [sayMessage p??]
 [fixObjectForPrinting p456]
 [\$ p??]
 [\$InteractiveFrame p??]
 [\$clearOptions p499]

— defun clearCmdParts —

```
(defun |clearCmdParts| (arg)
  (let (|$e| (opt (car arg)) option pmacs imacs (vl (cdr arg)) p1 lm prop p2)
    (declare (special |$e| |$InteractiveFrame| |$clearOptions|))
    (setq option (|selectOptionLC| opt |$clearOptions| '|optionError|))
    (setq option (intern (pname option)))
    (setq option
      (case option
        (|types| '|mode|)
        (|modes| '|mode|)
        (|values| '|value|)
        (t option)))
    (if (null vl)
      (|sayKeyedMsg| 's2iz0055 nil)
      (progn
        (setq pmacs (|getParserMacroNames|))
        (setq imacs (|getInterpMacroNames|))
        (cond
          ((boot-equal vl '|all|))
          (setf vl (assocleft (caar |$InteractiveFrame|))
            (setf vl (remdup (append vl pmacs))))))
        (setf |$e| |$InteractiveFrame|)
        (do ((t0 vl (cdr t0)) (x nil))
          ((or (atom t0) (progn (setf x (car t0)) nil)) nil)
          (|clearDependencies| x t)
          (when (and (eq option '|properties|) (|member| x pmacs))
            (|clearParserMacro| x))
          (when (and (eq option '|properties|)
            (|member| x imacs)
            (null (|member| x pmacs)))
            (|sayMessage| (cons
              " You cannot clear the definition of the system-defined macro "
              (cons (|fixObjectForPrinting| x)
                (cons (intern "." "BOOT") nil))))))
          (cond
            ((setf p1 (|assoc| x (caar |$InteractiveFrame|)))
              (cond
                ((eq option '|properties|)
                  (cond
                    ((|isMap| x)
                     (seq
                      (cond
                        ((setf lm
                          (|get| x '|localModemap| |$InteractiveFrame|))
                          (cond
                            ((consp lm)
                             (exit (|untraceMapSubNames| (cons (cadar lm) nil))))))
                        (t nil))))))
                    (dolist (p2 (cdr p1))
```

```
(setq prop (car p2))
(|recordOldValue| x prop (cdr p2))
(|recordNewValue| x prop nil))
(setf (caar |$InteractiveFrame|)
      (|deleteAssoc| x (caar |$InteractiveFrame|))))
((setq p2 (|assoc| option (cdr p1)))
(|recordOldValue| x option (cdr p2))
(|recordNewValue| x option nil)
(rplacd p2 nil))))))
nil))))
```

Chapter 24

)close help page Command

24.1 close help page man page

— close.help —

```
=====
A.5. )close
=====
```

User Level Required: interpreter

Command Syntax:

-)close
-)close)quietly

Command Description:

This command is used to close down interpreter client processes. Such processes are started by HyperDoc to run AXIOM examples when you click on their text. When you have finished examining or modifying the example and you do not want the extra window around anymore, issue

)close

to the AXIOM prompt in the window.

If you try to close down the last remaining interpreter client process, AXIOM will offer to close down the entire AXIOM session and return you to the operating system by displaying something like

This is the last AXIOM session. Do you want to kill AXIOM?

Type "y" (followed by the Return key) if this is what you had in mind. Type "n" (followed by the Return key) to cancel the command.

You can use the)quietly option to force AXIOM to close down the interpreter client process without closing down the entire AXIOM session.

Also See:

- o)quit
- o)pquit

1

24.2 Functions

defun queryClients

Returns the number of active scratchpad clients [sockSendInt p??]

[sockGetInt p??]
 [\$SessionManager p??]
 [\$QueryClients p??]

— defun queryClients —

```
(defun |queryClients| ()
  (declare (special |$SessionManager| |$QueryClients|))
  (|sockSendInt| |$SessionManager| |$QueryClients|)
  (|sockGetInt| |$SessionManager|))
```

defun close

[throwKeyedMsg p??]
 [sockSendInt p??]
 [closeInterpreterFrame p562]
 [selectOptionLC p479]
 [upcase p??]
 [queryUserKeyedMsg p??]
 [string2id-n p??]

¹ "quit" (41.2 p 638) "pquit" (40.2 p 634)

```
[queryClients p510]
[$SpadServer p10]
[$SessionManager p??]
[$CloseClient p??]
[$currentFrameNum p41]
[$options p??]
```

— defun close —

```
(defun |close| (args)
  (declare (ignore args))
  (let (numClients opt fullopt quiet x)
    (declare (special |$SpadServer| |$SessionManager| |$CloseClient|
      |$currentFrameNum| |$options|))
    (if (null |$SpadServer|)
      (|throwKeyedMsg| 's2iz0071 nil))
    (progn
      (setq numClients (|queryClients|))
      (cond
        ((> numClients 1)
         (|sockSendInt| |$SessionManager| |$CloseClient|)
         (|sockSendInt| |$SessionManager| |$currentFrameNum|)
         (|closeInterpreterFrame| nil))
        (t
         (do ((t0 |$options| (cdr t0)) (t1 nil))
             ((or (atom t0)
                  (progn (setq t1 (car t0)) nil)
                  (progn (progn (setq opt (car t1)) t1) nil))
              nil)
          (setq fullopt (|selectOptionLC| opt '(|quiet|) '|optionError|))
          (unless quiet (setq quiet (eq fullopt '|quiet|))))
        (cond
          (quiet
           (|sockSendInt| |$SessionManager| |$CloseClient|)
           (|sockSendInt| |$SessionManager| |$currentFrameNum|)
           (|closeInterpreterFrame| nil))
          (t
           (setq x (upcase (|queryUserKeyedMsg| 's2iz0072 nil)))
           (when (member (string2id-n x 1) '(yes y)) (bye))))))))))
```


Chapter 25

)compile help page Command

25.1 compile help page man page

— compile.help —

```
=====
A.7. )compile
=====
```

User Level Required: compiler

Command Syntax:

-)compile
-)compile fileName
-)compile fileName.spad
-)compile directory/fileName.spad
-)compile fileName)quiet
-)compile fileName)noquiet
-)compile fileName)break
-)compile fileName)nobreak
-)compile fileName)library
-)compile fileName)nolibrary
-)compile fileName)vartrace
-)compile fileName)constructor nameOrAbbrev

Command Description:

You use this command to invoke the AXIOM library compiler. This compiles files with file extension .spad with the AXIOM system compiler. The command first looks in the standard system directories for files with extension .spad.

Should you not want the `)library` command automatically invoked, call `)compile` with the `)nolibrary` option. For example,

```
)compile mycode )nolibrary
```

By default, the `)library` system command exposes all domains and categories it processes. This means that the AXIOM interpreter will consider those domains and categories when it is trying to resolve a reference to a function. Sometimes domains and categories should not be exposed. For example, a domain may just be used privately by another domain and may not be meant for top-level use. The `)library` command should still be used, though, so that the code will be loaded on demand. In this case, you should use the `)nolibrary` option on `)compile` and the `)noexpose` option in the `)library` command. For example,

```
)compile mycode.spad )nolibrary
)library mycode )noexpose
```

Once you have established your own collection of compiled code, you may find it handy to use the `)dir` option on the `)library` command. This causes `)library` to process all compiled code in the specified directory. For example,

```
)library )dir /u/jones/as/quantum
```

You must give an explicit directory after `)dir`, even if you want all compiled code in the current working directory processed.

```
)library )dir .
```

You can compile category, domain, and package constructors contained in files with file extension `.spad`. You can compile individual constructors or every constructor in a file.

The full filename is remembered between invocations of this command and `)edit` commands. The sequence of commands

```
)compile matrix.spad
)edit
)compile
```

will call the compiler, edit, and then call the compiler again on the file `matrix.spad`. If you do not specify a directory, the working current directory (see description of command `)cd`) is searched for the file. If the file is not found, the standard system directories are searched.

If you do not give any options, all constructors within a file are compiled. Each constructor should have an `)abbreviation` command in the file in which it is defined. We suggest that you place the `)abbreviation` commands at the top of the file in the order in which the constructors are defined. The list of

`commands` serves as a table of contents for the file.

The `)library` option causes directories containing the compiled code for each constructor to be created in the working current directory. The name of such a directory consists of the constructor abbreviation and the `.NRLIB` file extension. For example, the directory containing the compiled code for the `MATRIX` constructor is called `MATRIX.NRLIB`. The `)nolibrary` option says that such files should not be created.

The `)vartrace` option causes the compiler to generate extra code for the constructor to support conditional tracing of variable assignments. (see description of command `)trace`). Without this option, this code is suppressed and one cannot use the `)vars` option for the `trace` command.

The `)constructor` option is used to specify a particular constructor to compile. All other constructors in the file are ignored. The constructor name or abbreviation follows `)constructor`. Thus either

```
)compile matrix.spad )constructor RectangularMatrix
```

or

```
)compile matrix.spad )constructor RMATRIX
```

compiles the `RectangularMatrix` constructor defined in `matrix.spad`.

The `)break` and `)nobreak` options determine what the compiler does when it encounters an error. `)break` is the default and it indicates that processing should stop at the first error. The value of the `)set break` variable then controls what happens.

Also See:

- o `)abbreviation`
- o `)edit`
- o `)library`

1

25.2 Functions

`defvar $/editfile`

— `initvars` —

¹ “abbreviation” (?? p ??) “edit” (30.2 p 544) “library” (66.1 p 1013)

```
(defvar /editfile nil)
```

Chapter 26

)copyright help page Command

26.1 copyright help page man page

— copyright.help —

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26.2 Functions

defun copyright

```
[obey p??]
[concat p1047]
[getenvirom p29]
```

— defun copyright —

```
(defun |copyright| ()
  (obey (concat "cat " (getenvirom "AXIOM") "/doc/spadhelp/copyright.help")))
```

defun trademark

— defun trademark 0 —

```
(defun |trademark| ()  
  (format t "The term Axiom, in the field of computer algebra software, ~%")  
  (format t "along with AXIOM and associated images are common-law ~%")  
  (format t "trademarks. While the software license allows copies, the ~%")  
  (format t "trademarks may only be used when referring to this project ~%"))
```

This command is in the list of `$noParseCommands` [18.1](#) which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` [18.2](#)

Chapter 27

)credits help page Command

27.1 credits help page man page

27.2 Variables Used

27.3 Functions

defun credits

[credits p[525](#)]

— defun credits 0 —

```
(defun |credits| ()  
  (declare (special credits))  
  (mapcar #'(lambda (x) (princ x) (terpri)) creditlist))
```

—————

This command is in the list of `$noParseCommands` [18.1](#) which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` [18.2](#)

Chapter 28

)describe help page Command

28.1 describe help page man page

— describe.help —

```
=====
)describe
=====
```

User Level Required: interpreter

Command Syntax:

-)describe categoryName
-)describe domainName
-)describe packageName

Command Description:

This command is used to display the comments for the operation, category, domain or package. The comments are part of the algebra source code.

The commands

```
)describe <categoryName> [internal]
)describe <domainName> [internal]
)describe <packageName> [internal]
```

will show a properly formatted version of the "Description:" keyword from the comments in the algebra source for the category, domain, or package requested.

If 'internal' is requested, then the internal format of the domain or package is described. Categories do not have an internal representation.

defvar \$describeOptions

The current value of \$describeOptions is

— **initvars** —

```
(defvar $describeOptions '(|category| |domain| |package|))
```

28.2 Functions

defun Print comment strings from algebra libraries

This trivial function satisfies the standard pattern of making a user command match the name of the function which implements the command. That command immediatly invokes a “Spad2Cmd” version. [describepad2cmd p??]

— **defun describe** —

```
(defun |describe| (l)
  (describeSpad2Cmd l))
```

defun describeSpad2Cmd

The describe command prints cleaned-up comment strings from the algebra libraries. It can print strings associated with a category, domain, package, or by operation.

This implements command line options of the form:

```
)describe categoryName [internal]
)describe domainName   [internal]
)describe packageName   [internal]
```

The describeInternal function will either call the “dc” function to describe the internal representation of the argument or it will print a cleaned up version of the text for the

"Description" keyword in the Category, Domain, or Package source code. [selectOptionLC p479]

[flatten p531]

[cleanline p529]

[getdatabase p1010]

[sayMessage p??]

[\$e p??]

[\$EmptyEnvironment p??]

[\$describeOptions p528]

— defun describeSpad2Cmd —

```
(defun describeSpad2Cmd (l)
  (labels (
    (fullname (arg)
      "Convert abbreviations to the full constructor name"
      (let ((abb (getdatabase arg 'abbreviation)))
        (if abb arg (getdatabase arg 'constructor))))
    (describeInternal (cdp internal?)
      (if internal?
        (progn
          (unless (eq (getdatabase cdp 'constructorkind) '|category|) (|dc| cdp))
          (showdatabase cdp))
        (mapcar #'(lambda (x) (if (stringp x) (cleanline x)))
          (flatten (car (getdatabase (fullname cdp) 'documentation)))))))
    (let ((|$e| |$EmptyEnvironment|) (opt (second l)))
      (declare (special |$e| |$EmptyEnvironment| $describeOptions))
      (if (and (consp l) (not (eq opt '?)))
        (describeInternal (first l) (second l))
        (|sayMessage|
          (append
            '(" )describe keyword arguments are")
            (mapcar #'(lambda (x) (format nil "~%      ~a" x)) $describeOptions)
            (format nil "~% or abbreviations thereof"))))))))
```

—————

defun cleanline

— defun cleanline —

```
(defun cleanline (line)
  (labels (
    (replaceInLine (thing other line)
      (do ((mark (search thing line) (search thing line)))
          ((null mark) line)
```

```

(setq line
  (concatenate 'string (subseq line 0 mark) other
    (subseq line (+ mark (length thing))))))

(removeFromLine (thing line) (replaceInLine thing "" line))

(removeKeyword (str line)
  (do ((mark (search str line) (search str line)))
    ((null mark) line)
    (let (left point mid right)
      (setq left (subseq line 0 mark))
      (setq point (search "]" line :start2 mark))
      (setq mid (subseq line (+ mark (length str)) point))
      (setq right (subseq line (+ point 1)))
      (setq line (concatenate 'string left mid right)))))

(addSpaces (str line)
  (do ((mark (search str line) (search str line)) (cnt))
    ((null mark) line)
    (let (left point mid right)
      (setq left (subseq line 0 mark))
      (setq point (search "]" line :start2 mark))
      (setq mid (subseq line (+ mark (length str)) point))
      (if (setq cnt (parse-integer mid :junk-allowed t))
        (setq mid (make-string cnt :initial-element #\ ))
        (setq mid ""))
      (setq right (subseq line (+ point 1)))
      (setq line (concatenate 'string left mid right)))))

(splitAtNewline (line)
  (do ((mark (search "~%" line) (search "~%" line)) (lines))
    ((null mark)
      (push " " lines)
      (push line lines)
      (nreverse lines))
    (push (subseq line 0 mark) lines)
    (setq line (subseq line (+ mark 2)))))

(wrapOneLine (line margin result)
  (if (null line)
    (nreverse result)
    (if (< (length line) margin)
      (wrapOneLine nil margin (append (list line) result))
      (let (oneline spill aspace)
        (setq aspace (position #\space (subseq line 0 margin) :from-end t))
        (setq oneline (string-trim '(\space) (subseq line 0 aspace)))
        (setq spill (string-trim '(\space) (subseq line aspace)))
        (wrapOneLine spill margin (append (list oneline) result))))))

(reflowParagraph (line))

```

```

(let (lst1)
  (setq lst1 (splitAtNewLine line))
  (dolist (x lst1)
    (mapcar #'(lambda(y) (format t "~a%" y))
      (wrapOneLine x 70 nil))))))

(setq line (removeFromLine "{}" line))
(setq line (replaceInLine "\\blankline" "%%" line))
(setq line (replaceInLine "\\br" "%" line))
(setq line (removeFromLine "\\\" line))
(dolist (str '("spad{" "spadtype{" "spadop{" "spadfun{" "spadatt{"
  "axiom{" "axiomType{" "spadignore{" "axiomFun{"
  "centerline{" "inputbitmap{" "axiomOp{" "spadgloss{"))
  (setq line (removeKeyword str line)))
(setq line (replaceInLine "{e.g.}" "e.g." line))
(dolist (str '("tab{" "indented{" ))
  (setq line (addSpaces str line)))
(reflowParagraph line))

```

defun flatten

— defun flatten 0 —

```

(defun flatten (x)
  (labels (
    (rec (x acc)
      (cond
        ((null x) acc)
        ((atom x) (cons x acc))
        (t (rec (car x) (rec (cdr x) acc))))))
    (rec x nil)))

```

Chapter 29

)display help page Command

29.1 display help page man page

— display.help —

```
=====
A.8. )display
=====
```

User Level Required: interpreter

Command Syntax:

-)display all
-)display properties
-)display properties all
-)display properties [obj1 [obj2 ...]]
-)display value all
-)display value [obj1 [obj2 ...]]
-)display mode all
-)display mode [obj1 [obj2 ...]]
-)display names
-)display operations opName

Command Description:

This command is used to display the contents of the workspace and signatures of functions with a given name. (A signature gives the argument and return types of a function.)

The command

`)display names`

lists the names of all user-defined objects in the workspace. This is useful if you do not wish to see everything about the objects and need only be reminded of their names.

The commands

```
)display all
)display properties
)display properties all
```

all do the same thing: show the values and types and declared modes of all variables in the workspace. If you have defined functions, their signatures and definitions will also be displayed.

To show all information about a particular variable or user functions, for example, something named `d`, issue

```
)display properties d
```

To just show the value (and the type) of `d`, issue

```
)display value d
```

To just show the declared mode of `d`, issue

```
)display mode d
```

All modemaps for a given operation may be displayed by using `)display operations`. A modemap is a collection of information about a particular reference to an operation. This includes the types of the arguments and the return value, the location of the implementation and any conditions on the types. The modemap may contain patterns. The following displays the modemaps for the operation `FromcomplexComplexCategory`:

```
)d op complex
```

Also See:

- o `)clear`
- o `)history`
- o `)set`
- o `)show`
- o `)what`

¹

¹ “clear” (23.3 p 499) “history” (34.4 p 582) “set” (45.36 p 808) “show” (46.1 p 814) “what” (54.1 p 939)

defvar \$displayOptions

The current value of \$displayOptions is

— **initvars** —

```
(defvar |$displayOptions|
  '(|abbreviations| |all| |macros| |modes| |names| |operations|
    |properties| |types| |values|))
```

29.2 Functions**defun display**

This trivial function satisfies the standard pattern of making a user command match the name of the function which implements the command. That command immediatly invokes a “Spad2Cmd” version. [displaySpad2cmd p??]

— **defun display** —

```
(defun |display| (l)
  (displaySpad2Cmd l))
```

displaySpad2Cmd

We process the options to the command and call the appropriate display function. There are really only 4 display functions. All of the other options are just subcases.

There is a slight mismatch between the \$displayOptions list of symbols and the options this command accepts so we have a cond branch to clean up the option variable. This allows for the options to be plural.

If we fall all the way thru we use the \$displayOptions list to construct a list of strings for the sayMessage function and tell the user what options are available. [abbQuery p536]

```
[opOf p??]
[listConstructorAbbreviations p484]
[displayOperations p537]
[displayMacros p538]
[displayWorkspaceNames p454]
[displayProperties p461]
[selectOptionLC p479]
```



```
[sayMessage p??]
[$e p??]
[$EmptyEnvironment p??]
[$displayOptions p535]
```

— defun displaySpad2Cmd —

```
(defun displaySpad2Cmd (l)
  (let ((|$e| |$EmptyEnvironment|) (opt (car l)) (vl (cdr l)) option)
    (declare (special |$e| |$EmptyEnvironment| |$displayOptions|))
    (if (and (consp l) (not (eq opt '???)))
      (progn
        (setq option (|selectOptionLC| opt |$displayOptions| '|optionError|))
        (cond
          ((eq option '|all|)
            (setq l (list '|properties|))
            (setq option '|properties|))
          ((or (eq option '|modes|) (eq option '|types|))
            (setq l (cons '|type| vl))
            (setq option '|type|))
          ((eq option '|values|)
            (setq l (cons '|value| vl))
            (setq option '|value|)))
        (cond
          ((eq option '|abbreviations|)
            (if (null vl)
              (|listConstructorAbbreviations|)
              (dolist (v vl) (|abbQuery| (|opOf| v))))))
          ((eq option '|operations|) (|displayOperations| vl))
          ((eq option '|macros|) (|displayMacros| vl))
          ((eq option '|names|) (|displayWorkspaceNames|))
          (t (|displayProperties| option l))))
      (|sayMessage|
        (append
          '(" )display keyword arguments are")
          (mapcar #'(lambda (x) (format nil "~%      ~a" x)) |$displayOptions|)
          (format nil "~% or abbreviations thereof"))))))))
```

defun abbQuery

```
[getdatabase p1010]
[sayKeyedMsg p329]
```

— defun abbQuery —

```
(defun |abbQuery| (x)
```

```
(let (abb)
  (cond
    ((setq abb (getdatabase x 'abbreviation))
     (|sayKeyedMsg| 's2iz0001 (list abb (getdatabase x 'constructorkind) x)))
    ((setq abb (getdatabase x 'constructor))
     (|sayKeyedMsg| 's2iz0001 (list x (getdatabase abb 'constructorkind) abb)))
    (t
     (|sayKeyedMsg| 's2iz0003 (list x))))))
```

defun displayOperations

This function takes a list of operation names. If the list is null we query the user to see if they want all operations printed. Otherwise we print the information for the requested symbols. [reportOpSymbol p??]

[yesanswer p537]

[sayKeyedMsg p329]

— defun displayOperations —

```
(defun |displayOperations| (l)
  (if l
      (dolist (op l) (|reportOpSymbol| op))
      (if (yesanswer)
          (dolist (op (|allOperations|)) (|reportOpSymbol| op))
          (|sayKeyedMsg| 's2iz0059 nil))))
```

defun yesanswer

This is a trivial function to simplify the logic of displaySpad2Cmd. If the user didn't supply an argument to the)display op command we ask if they wish to have all information about all Axiom operations displayed. If the answer is either Y or YES we return true else nil.

[string2id-n p??]

[upcase p??]

[queryUserKeyedMsg p??]

— defun yesanswer —

```
(defun yesanswer ()
  (member
   (string2id-n (upcase (|queryUserKeyedMsg| 's2iz0058 nil)) 1) '(y yes)))
```

defun displayMacros

```
[getInterpMacroNames p??]
[getParserMacroNames p453]
[remdup p??]
[sayBrightly p??]
[member p1048]
[displayParserMacro p464]
[seq p??]
[exit p??]
[displayMacro p453]
```

— defun displayMacros —

```
(defun |displayMacros| (names)
  (let (imacs pmacs macros first)
    (setq imacs (|getInterpMacroNames|))
    (setq pmacs (|getParserMacroNames|))
    (if names
      (setq macros names)
      (setq macros (append imacs pmacs)))
    (setq macros (remdup macros))
    (cond
      ((null macros) (|sayBrightly| "  There are no Axiom macros."))
      (t
       (setq first t)
       (do ((t0 macros (cdr t0)) (macro nil))
         ((or (atom t0) (progn (setq macro (car t0)) nil)) nil)
         (seq
          (exit
           (cond
            ((|member| macro pmacs)
             (cond
              (first (|sayBrightly|
                      (cons '|%l| (cons "User-defined macros:" nil))) (setq first nil)))
              (|displayParserMacro| macro))
            ((|member| macro imacs) '|iterate|)
            (t (|sayBrightly|
                (cons "  "
                  (cons '|%b|
                    (cons macro
                      (cons '|%d| (cons " is not a known Axiom macro." nil))))))))))
          (setq first t)
          (do ((t1 macros (cdr t1)) (macro nil))
            ((or (atom t1) (progn (setq macro (car t1)) nil)) nil)
            (seq
```

```

(exit
 (cond
  ((|member| macro imacs)
   (cond
    ((|member| macro pmacs) '|iterate|)
    (t
     (cond
      (first
       (|sayBrightly|
        (cons '|%1|
              (cons "System-defined macros:" nil)))) (setq first nil)))
      (|displayMacro| macro))))
   ((|member| macro pmacs) '|iterate|))))
 nil))))

```

defun sayExample

This function expects 2 arguments, the documentation string and the name of the operation. It searches the documentation string for ++X lines. These lines are examples lines for functions. They look like ordinary ++ comments and fit into the ordinary comment blocks. So, for example, in the plot.spad.pamphlet file we find the following function signature:

```

plot: (F -> F,R) -> %
++ plot(f,a..b) plots the function \spad{f(x)}
++ on the interval \spad{[a,b]}.
++
++X fp:=(t:DFLOAT):DFLOAT +-> sin(t)
++X plot(fp,-1.0..1.0)$PLOT

```

This function splits out and prints the lines that begin with ++X.

A minor complication of printing the examples is that the lines have been processed into internal compiler format. Thus the lines that read:

```

++X fp:=(t:DFLOAT):DFLOAT +-> sin(t)
++X plot(fp,-1.0..1.0)$PLOT

```

are actually stored as one long line containing the example lines

```

"\indented{1}{plot(\spad{f},{a}..\spad{b}) plots the function
\spad{f(x)} \indented{1}{on the interval \spad{[a,{b}]}.}
\blankline
\spad{X} fp:=(t:DFLOAT):DFLOAT +-> sin(\spad{t})
\spad{X} plot(\spad{fp},{})\spad{-1}.0..1.0)\$PLOT"

```

So when we have an example line starting with ++X, it gets converted to the compiler to `\spad{X}`. So each example line is delimited by `\spad{X}`.

The compiler also removes the newlines so if there is a subsequent `\spad{X}` in the docstring then it implies multiple example lines and we loop over them, splitting them up at the delimiter.

If there is only one then we clean it up and print it. [cleanupLine p??]
[sayNewLine p??]

— defun sayExample —

```
(defun sayExample (docstring)
  (let (line point)
    (when (setq point (search "spad{X}" docstring))
      (setq line (subseq docstring (+ point 8)))
      (do ((mark (search "spad{X}" line) (search "spad{X}" line)))
          ((null mark))
        (princ (cleanupLine (subseq line 0 mark)))
        (|sayNewLine|)
        (setq line (subseq line (+ mark 8))))
      (princ (cleanupLine line))
      (|sayNewLine|)
      (|sayNewLine|))))
```

—

defun cleanupLine

This function expects example lines in internal format that has been partially processed to remove the prefix. Thus we get lines that look like:

```
fp:=(t:DFLOAT):DFLOAT +-> sin(\spad{t})
plot(\spad{fp},{}\spad{-1}.0..1.0)\$PLOT
```

It removes all instances of `{}`, and `\`, and unwraps the `spad{}` call, leaving only the argument.

We return lines that look like:

```
fp:=(t:DFLOAT):DFLOAT +-> sin(t)
plot(fp,-1.0..1.0)$PLOT
```

which is hopefully exactly what the user wrote.

The compiler inserts `{}` as a space so we remove it. We remove all of the `\` characters. We remove all of the `spad{...}` delimiters which will occur around other `spad` variables. Technically we should search recursively for the matching delimiter rather than the next brace but the problem does not arise in practice.

— defun cleanupLine 0 —

```

(defun cleanupLine (line)
  (do ((mark (search "{}" line) (search "{}" line)))
      ((null mark))
      (setq line
        (concatenate 'string (subseq line 0 mark) (subseq line (+ mark 2))))))
  (do ((mark (search "\\" line) (search "\\" line)))
      ((null mark))
      (setq line
        (concatenate 'string (subseq line 0 mark) (subseq line (+ mark 1))))))
  (do ((mark (search "spad{" line) (search "spad{" line)))
      ((null mark))
      (let (left point mid right)
        (setq left (subseq line 0 mark))
        (setq point (search "}" line :start2 mark))
        (setq mid (subseq line (+ mark 5) point))
        (setq right (subseq line (+ point 1)))
        (setq line (concatenate 'string left mid right))))))
  line)

```

Chapter 30

)edit help page Command

30.1 edit help page man page

— edit.help —

```
=====
A.9. )edit
=====
```

User Level Required: interpreter

Command Syntax:

```
- )edit [filename]
```

Command Description:

This command is used to edit files. It works in conjunction with the `)read` and `)compile` commands to remember the name of the file on which you are working. By specifying the name fully, you can edit any file you wish. Thus

```
)edit /u/julius/matrix.input
```

will place you in an editor looking at the file `/u/julius/matrix.input`. By default, the editor is `vi`, but if you have an `EDITOR` shell environment variable defined, that editor will be used. When AXIOM is running under the X Window System, it will try to open a separate `xterm` running your editor if it thinks one is necessary. For example, under the Korn shell, if you issue

```
export EDITOR=emacs
```

then the `emacs` editor will be used by `)edit`.

If you do not specify a file name, the last file you edited, read or compiled will be used. If there is no ‘‘last file’’ you will be placed in the editor editing an empty unnamed file.

It is possible to use the)system command to edit a file directly. For example,

```
)system emacs /etc/rc.tcpip

calls emacs to edit the file.
```

Also See:

- o)system
- o)compile
- o)read

1

30.2 Functions

defun edit

[editSpad2Cmd p544]

— defun edit —

```
(defun |edit| (1) (|editSpad2Cmd| 1))
```

defun editSpad2Cmd

[pathname p1042]
 [pathnameDirectory p1041]
 [pathnameType p1040]
 [\$FINDFILE p??]
 [pathnameName p1040]
 [editFile p545]
 [updateSourceFiles p546]
 [/editfile p515]

¹ “system” (?? p ??) “read” (42.1 p 642)

— defun editSpad2Cmd —

```
(defun |editSpad2Cmd| (l)
  (let (olddir filetypes ll rc)
    (declare (special /editfile))
    (setq l (cond ((null l) /editfile) (t (car l))))
    (setq l (|pathname| l))
    (setq olddir (|pathnameDirectory| l))
    (setq filetypes
      (cond
        ((|pathnameType| l) (list (|pathnameType| l)))
        ((eq |$UserLevel| '|interpreter|) '("input" "INPUT" "spad" "SPAD"))
        ((eq |$UserLevel| '|compiler|) '("input" "INPUT" "spad" "SPAD"))
        (t '("input" "INPUT" "spad" "SPAD" "boot" "BOOT"
              "lisp" "LISP" "meta" "META"))))
    (setq ll
      (cond
        ((string= olddir "")
         (|pathname| ($findfile (|pathnameName| l) filetypes)))
        (t l)))
    (setq l (|pathname| ll))
    (setq /editfile l)
    (setq rc (|editFile| l))
    (|updateSourceFiles| l)
    rc))
```

—————

defun Implement the)edit command

```
[strconc p??]
[namestring p1040]
[pathname p1042]
[obey p??]
```

— defun editFile —

```
(defun |editFile| (file)
  (cond
    ((member (intern "WIN32" (find-package 'keyword)) *features*)
     (obey (strconc "notepad " (|namestring| (|pathname| file)))))
    (t
     (obey
      (strconc "$AXIOM/lib/SPAEDIT " (|namestring| (|pathname| file)))))))
```

—————

defun updateSourceFiles

```
[pathname p1042]
[pathnameName p1040]
[pathnameType p1040]
[makeInputFilename p983]
[member p1048]
[pathnameTypeId p1041]
[insert p??]
[$sourceFiles p??]
```

— **defun updateSourceFiles** —

```
(defun |updateSourceFiles| (arg)
  (declare (special |$sourceFiles|))
  (setq arg (|pathname| arg))
  (setq arg (|pathname| (list (|pathnameName| arg) (|pathnameType| arg) "*")))
  (when (and (makeInputFilename arg)
             (|member| (|pathnameTypeId| arg) '(boot lisp meta)))
    (setq |$sourceFiles| (|insert| arg |$sourceFiles|)))
  arg)
```

Chapter 31

)fin help page Command

31.1 fin help page man page

— fin.help —

```
=====
A.10. )fin
=====
```

User Level Required: development

Command Syntax:

```
- )fin
```

Command Description:

This command is used by AXIOM developers to leave the AXIOM system and return to the underlying Lisp system. To return to AXIOM, issue the ‘‘(spad)’’ function call to Lisp.

Also See:

- o)pquit
- o)quit

1

¹ “pquit” (40.2 p 634) “quit” (41.2 p 638)

defun Exit from the interpreter to lisp

```
[spad-reader p??]  
[eof p??]
```

— defun fin 0 —

```
(defun |fin| ()  
  (setq *eof* t)  
  (throw 'spad_reader nil))
```

—————

31.2 Functions

This command is in the list of `$noParseCommands` [18.1](#) which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` [18.2](#)

Chapter 32

)frame help page Command

32.1 frame help page man page

— frame.help —

```
=====
A.11. )frame
=====
```

User Level Required: interpreter

Command Syntax:

-)frame new frameName
-)frame drop [frameName]
-)frame next
-)frame last
-)frame names
-)frame import frameName [objectName1 [objectName2 ...]]
-)set message frame on | off
-)set message prompt frame

Command Description:

A frame can be thought of as a logical session within the physical session that you get when you start the system. You can have as many frames as you want, within the limits of your computer's storage, paging space, and so on. Each frame has its own step number, environment and history. You can have a variable named a in one frame and it will have nothing to do with anything that might be called a in any other frame.

Some frames are created by the HyperDoc program and these can have pretty

strange names, since they are generated automatically. To find out the names of all frames, issue

```
)frame names
```

It will indicate the name of the current frame.

You create a new frame ‘‘quark’’ by issuing

```
)frame new quark
```

The history facility can be turned on by issuing either `)set history on` or `)history on`. If the history facility is on and you are saving history information in a file rather than in the AXIOM environment then a history file with filename `quark.ahx` will be created as you enter commands. If you wish to go back to what you were doing in the ‘‘initial’’ frame, use

```
)frame next
```

or

```
)frame last
```

to cycle through the ring of available frames to get back to ‘‘initial’’.

If you want to throw away a frame (say ‘‘quark’’), issue

```
)frame drop quark
```

If you omit the name, the current frame is dropped.

If you do use frames with the history facility on and writing to a file, you may want to delete some of the older history files. These are directories, so you may want to issue a command like `rm -r quark.ahx` to the operating system.

You can bring things from another frame by using `)frame import`. For example, to bring the `f` and `g` from the frame ‘‘quark’’ to the current frame, issue

```
)frame import quark f g
```

If you want everything from the frame ‘‘quark’’, issue

```
)frame import quark
```

You will be asked to verify that you really want everything.

There are two `)set` flags to make it easier to tell where you are.

```
)set message frame on | off
```

will print more messages about frames when it is set on. By default, it is off.

```
)set message prompt frame
```

will give a prompt that looks like

```
initial (1) ->
```

when you start up. In this case, the frame name and step make up the prompt.

Also See:

- o `)history`
- o `)set`

1

32.2 Variables Used

The frame mechanism uses several dollar variables.

Primary variables

Primary variables are those which exist solely to make the frame mechanism work.

The `$interpreterFrameName` contains a symbol which is the name of the current frame in use.

The `$interpreterFrameRing` contains a list of all of the existing frames. The first frame on the list is the “current” frame. When AXIOMsys is started directly there is only one frame named “initial”.

If the system is started under `sman` (using the axiom shell script, for example), there are two frames, “initial” and “frame0”. In this case, “frame0” is the current frame. This can cause subtle problems because functions defined in the axiom initialization file (`.axiom.input`) will be defined in frame “initial” but the current frame will be “frame0”. They will appear to be undefined. However, if the user does “`)frame next`” they can switch to the “initial” frame and see the functions correctly defined.

The `$frameMessages` variable controls when frame messages will be displayed. The variable is initially `NIL`. It can be set on (T) or off (NIL) using the system command:

```
)set message frame on | off
```

¹ “history” ([34.4 p 582](#)) “set” ([45.36 p 808](#))

Setting frame messages on will output a line detailing the current frame after every output is complete.

Used variables

The frame collects and uses a few top level variables. These are: \$InteractiveFrame, \$IOindex, \$HiFiAccess, \$HistList, \$HistListLen, \$HistListAct, \$HistRecord, \$internalHistoryTable, and \$localExposureData.

These variables can also be changed by the frame mechanism when the user requests changing to a different frame.

32.3 Data Structures

Frames and the Interpreter Frame Ring

Axiom has the notion of “frames”. A frame is a data structure which holds all the vital data from an Axiom session. There can be multiple frames and these live in a top-level variable called \$interpreterFrameRing. This variable holds a circular list of frames. The parts of a frame and their initial, default values are:

\$interpreterFrameName	a string, named on creation
\$InteractiveFrame	(list (list nil))
\$IOindex	an integer, 1
\$HiFiAccess	\$HiFiAccess, see the variable description
\$HistList	\$HistList, see the variable description
\$HistListLen	\$HistListLen, see the variable description
\$HistListAct	\$HistListAct, see the variable description
\$HistRecord	\$HistRecord, see the variable description
\$internalHistoryTable	nil
\$localExposureData	a copy of \$localExposureData

32.4 Accessor Functions

These could be macros but we wish to export them to the API code in the algebra so we keep them as functions.

0th Frame Component – frameName

defun frameName

— defun frameName 0 —

```
(defun frameName (frame)
  (car frame))
```

1st Frame Component – frameInteractive

— defun frameInteractive 0 —

```
(defun frameInteractive (frame)
  (nth 1 frame))
```

2nd Frame Component – frameIOIndex

— defun frameIOIndex 0 —

```
(defun frameIOIndex (frame)
  (nth 2 frame))
```

3rd Frame Component – frameHiFiAccess

— defun frameHiFiAccess 0 —

```
(defun frameHiFiAccess (frame)
  (nth 3 frame))
```

4th Frame Component – frameHistList

— defun frameHistList 0 —

```
(defun frameHistList (frame)
  (nth 4 frame))
```

5th Frame Component – frameHistListLen

— defun frameHistListLen 0 —

```
(defun frameHistListLen (frame)
  (nth 5 frame))
```

6th Frame Component – frameHistListAct

— defun frameHistListAct 0 —

```
(defun frameHistListAct (frame)
  (nth 6 frame))
```

7th Frame Component – frameHistRecord

— defun frameHistRecord 0 —

```
(defun frameHistRecord (frame)
  (nth 7 frame))
```

8th Frame Component – frameHistoryTable

— defun frameHistoryTable 0 —

```
(defun frameHistoryTable (frame)
  (nth 8 frame))
```

9th Frame Component – frameExposureData

— defun frameExposureData 0 —

```
(defun frameExposureData (frame)
  (nth 9 frame))
```

32.5 Functions

Initializing the Interpreter Frame Ring

Now that we know what a frame looks like we need a function to initialize the list of frames. This function sets the initial frame name to “initial” and creates a list of frames containing an empty frame. This list is the interpreter frame ring and is not actually circular but is managed as a circular list.

As a final step we update the world from this frame. This has the side-effect of resetting all the important global variables to their initial values.

```
[emptyInterpreterFrame p556]
[updateFromCurrentInterpreterFrame p558]
[$interpreterFrameName p??]
[$interpreterFrameRing p??]
```

— defun initializeInterpreterFrameRing —

```
(defun |initializeInterpreterFrameRing| ()
  "Initializing the Interpreter Frame Ring"
  (declare (special |$interpreterFrameName| |$interpreterFrameRing|))
  (setq |$interpreterFrameName| ' |initial|)
  (setq |$interpreterFrameRing|
    (list (|emptyInterpreterFrame| |$interpreterFrameName|)))
  (|updateFromCurrentInterpreterFrame|)
  nil)
```

Creating a List of all of the Frame Names

This function simply walks across the frame in the frame ring and returns a list of the name of each frame. [`$interpreterFrameRing p??`]

— **defun frameNames 0** —

```
(defun |frameNames| ()
  "Creating a List of all of the Frame Names"
  (declare (special |$interpreterFrameRing|))
  (mapcar #'frameName |$interpreterFrameRing|))
```

Get Named Frame Environment (aka Interactive)

If the frame is found we return the environment portion of the frame otherwise we construct an empty environment and return it. The initial values of an empty frame are created here. This function returns a single frame that will be placed in the frame ring. [`frameInteractive p??`]

— **defun frameEnvironment** —

```
(defun |frameEnvironment| (fname)
  "Get Named Frame Environment (aka Interactive)"
  (let ((frame (|findFrameInRing| fname)))
    (if frame
      (frameInteractive frame)
      (list (list nil)))))
```

Create a new, empty Interpreter Frame

```
[$HiFiAccess p733]
[$HistList p??]
[$HistListLen p??]
[$HistListAct p??]
[$HistRecord p??]
[$localExposureDataDefault p696]
```

— **defun emptyInterpreterFrame 0** —

```
(defun |emptyInterpreterFrame| (name)
```

```
"Create a new, empty Interpreter Frame"
(declare (special |$HiFiAccess| |$HistList| |$HistListLen| |$HistListAct|
  |$HistRecord| |$localExposureDataDefault|))
(list name                               ; frame name
  (list (list nil))                     ; environment
  1                                     ; $IOindex
  |$HiFiAccess|
  |$HistList|
  |$HistListLen|
  |$HistListAct|
  |$HistRecord|
  nil                                  ; $internalHistoryTable
  (copy-seq |$localExposureDataDefault|))) ; $localExposureData
```

Collecting up the Environment into a Frame

We can collect up all the current environment information into one frame element with this call. It creates a list of the current values of the global variables and returns this as a frame element.

```
[$interpreterFrameName p??]
[$InteractiveFrame p??]
[$IOindex p10]
[$HiFiAccess p733]
[$HistList p??]
[$HistListLen p??]
[$HistListAct p??]
[$HistRecord p??]
[$internalHistoryTable p??]
[$localExposureData p697]
```

— defun createCurrentInterpreterFrame 0 —

```
(defun |createCurrentInterpreterFrame| ()
  "Collecting up the Environment into a Frame"
  (declare (special |$interpreterFrameName| |$InteractiveFrame| |$IOindex|
    |$HiFiAccess| |$HistList| |$HistListLen| |$HistListAct| |$HistRecord|
    |$internalHistoryTable| |$localExposureData|))
  (list
    |$interpreterFrameName|
    |$InteractiveFrame|
    |$IOindex|
    |$HiFiAccess|
    |$HistList|
    |$HistListLen|
```

```

|$HistListAct|
|$HistRecord|
|$internalHistoryTable|
|$localExposureData|))

```

Update from the Current Frame

The frames are kept on a circular list. The first element on that list is known as “the current frame”. This will initialize all of the interesting interpreter data structures from that frame.

```

[sayMessage p??]
[$interpreterFrameRing p??]
[$interpreterFrameName p??]
[$InteractiveFrame p??]
[$IOindex p10]
[$HiFiAccess p733]
[$HistList p??]
[$HistListLen p??]
[$HistListAct p??]
[$HistRecord p??]
[$internalHistoryTable p??]
[$localExposureData p697]
[$frameMessages p741]

```

— defun updateFromCurrentInterpreterFrame —

```

(defun |updateFromCurrentInterpreterFrame| ()
  "Update from the Current Frame"
  (let (tmp1)
    (declare (special |$interpreterFrameRing| |$interpreterFrameName|
      |$InteractiveFrame| |$IOindex| |$HiFiAccess| |$HistList| |$HistListLen|
      |$HistListAct| |$HistRecord| |$internalHistoryTable| |$localExposureData|
      |$frameMessages|))
    (setq tmp1 (first |$interpreterFrameRing|))
    (setq |$interpreterFrameName| (nth 0 tmp1))
    (setq |$InteractiveFrame|      (nth 1 tmp1))
    (setq |$IOindex|               (nth 2 tmp1))
    (setq |$HiFiAccess|            (nth 3 tmp1))
    (setq |$HistList|              (nth 4 tmp1))
    (setq |$HistListLen|           (nth 5 tmp1))
    (setq |$HistListAct|           (nth 6 tmp1))
    (setq |$HistRecord|            (nth 7 tmp1))
    (setq |$internalHistoryTable|  (nth 8 tmp1))
    (setq |$localExposureData|     (nth 9 tmp1))
    (when |$frameMessages|

```

```
(|sayMessage|
  '( "    Current interpreter frame is called"
    ,#(|bright| |$interpreterFrameName|))))
```

Find a Frame in the Frame Ring by Name

Each frame contains its name as the 0th element. We simply walk all the frames and if we find one we return it. [boot-equal p??]

```
[frameName p552]
[$interpreterFrameRing p??]
```

— defun findFrameInRing 0 —

```
(defun |findFrameInRing| (name)
  "Find a Frame in the Frame Ring by Name"
  (let (result)
    (declare (special |$interpreterFrameRing|))
    (dolist (frame |$interpreterFrameRing|)
      (when (boot-equal (frameName frame) name)
        (setq result frame)))
    result))
```

Update the Current Interpreter Frame

This function collects the normal contents of the world into a frame object, places it first on the frame list, and then sets the current values of the world from the frame object.

```
[createCurrentInterpreterFrame p557]
[updateFromCurrentInterpreterFrame p558]
[$interpreterFrameRing p??]
```

— defun updateCurrentInterpreterFrame —

```
(defun |updateCurrentInterpreterFrame| ()
  "Update the Current Interpreter Frame"
  (declare (special |$interpreterFrameRing|))
  (rplaca |$interpreterFrameRing| (|createCurrentInterpreterFrame|))
  (|updateFromCurrentInterpreterFrame|))
```

Move to the next Interpreter Frame in Ring

This function updates the current frame to make sure all of the current information is recorded. If there are more frame elements in the list then this will destructively move the current frame to the end of the list, that is, assume the frame list reads (1 2 3) this function will destructively change it to (2 3 1). [updateFromCurrentInterpreterFrame p558]

[`$interpreterFrameRing p??`]

— **defun nextInterpreterFrame** —

```
(defun |nextInterpreterFrame| ()
  "Move to the next Interpreter Frame in Ring"
  (declare (special |$interpreterFrameRing|))
  (when (cdr |$interpreterFrameRing|)
    (setq |$interpreterFrameRing|
      (nconc (cdr |$interpreterFrameRing|) (list (car |$interpreterFrameRing|))))
    (|updateFromCurrentInterpreterFrame|)))
```

Change to the Named Interpreter Frame

[updateCurrentInterpreterFrame p559]
 [findFrameInRing p559]
 [nremove p??]
 [updateFromCurrentInterpreterFrame p558]
 [`$interpreterFrameRing p??`]

— **defun changeToNamedInterpreterFrame** —

```
(defun |changeToNamedInterpreterFrame| (name)
  "Change to the Named Interpreter Frame"
  (let (frame)
    (declare (special |$interpreterFrameRing|))
    (|updateCurrentInterpreterFrame|)
    (setq frame (|findFrameInRing| name))
    (when frame
      (setq |$interpreterFrameRing|
        (cons frame (nremove |$interpreterFrameRing| frame)))
      (|updateFromCurrentInterpreterFrame|))))
```

Move to the previous Interpreter Frame in Ring

```
[updateCurrentInterpreterFrame p559]
[updateFromCurrentInterpreterFrame p558]
[$interpreterFrameRing p??]
```

— **defun previousInterpreterFrame** —

```
(defun |previousInterpreterFrame| ()
  "Move to the previous Interpreter Frame in Ring"
  (let (tmp1 l b)
    (declare (special |$interpreterFrameRing|))
    (|updateCurrentInterpreterFrame|)
    (when (cdr |$interpreterFrameRing|)
      (setq tmp1 (reverse |$interpreterFrameRing|))
      (setq l (car tmp1))
      (setq b (nreverse (cdr tmp1)))
      (setq |$interpreterFrameRing| (nconc (cons l nil) b))
      (|updateFromCurrentInterpreterFrame|))))
```

Add a New Interpreter Frame

```
[boot-equal p??]
[framename p??]
[throwKeyedMsg p??]
[updateCurrentInterpreterFrame p559]
[initHistList p581]
[emptyInterpreterFrame p556]
[updateFromCurrentInterpreterFrame p558]
[$erase p??]
[histFileName p580]
[$interpreterFrameRing p??]
```

— **defun addNewInterpreterFrame** —

```
(defun |addNewInterpreterFrame| (name)
  "Add a New Interpreter Frame"
  (declare (special |$interpreterFrameRing|))
  (if (null name)
    (|throwKeyedMsg| 's2iz0018 nil) ; you must provide a name for new frame
    (progn
      (|updateCurrentInterpreterFrame|)
      (dolist (f |$interpreterFrameRing|)
        (when (boot-equal name (frameName f)) ; existing frame with same name
```

```

      (|throwKeyedMsg| 's2iz0019 (list name)))
    (|initHistList|)
    (setq |$interpreterFrameRing|
      (cons (|emptyInterpreterFrame| name) |$interpreterFrameRing|))
    (|updateFromCurrentInterpreterFrame|)
    ($erase (|histFileName|))))

```

Close an Interpreter Frame

```

[framename p??]
[throwKeyedMsg p??]
[$erase p??]
[makeHistFileName p579]
[updateFromCurrentInterpreterFrame p558]
[$interpreterFrameRing p??]
[$interpreterFrameName p??]

```

— defun closeInterpreterFrame —

```

(defun |closeInterpreterFrame| (name)
  "Close an Interpreter Frame"
  (declare (special |$interpreterFrameRing| |$interpreterFrameName|))
  (let (ifr found)
    (if (null (cdr |$interpreterFrameRing|))
      (if (and name (not (equal name |$interpreterFrameName|)))
        (|throwKeyedMsg| 's2iz0020 ; 1 frame left. not the correct name.
          (cons |$interpreterFrameName| nil))
        (|throwKeyedMsg| 's2iz0021 nil)) ; only 1 frame left, not closed
      (progn
        (if (null name)
          (setq |$interpreterFrameRing| (cdr |$interpreterFrameRing|))
          (progn
            (setq found nil)
            (setq ifr nil)
            (dolist (f |$interpreterFrameRing|)
              (if (or found (not (equal name (frameName f))))
                (setq ifr (cons f ifr)))
              (setq found t)))
            (if (null found)
              (|throwKeyedMsg| 's2iz0022 (cons name nil))
              (progn
                ($erase (|makeHistFileName| name))
                (setq |$interpreterFrameRing| (nreverse ifr))))))
        (|updateFromCurrentInterpreterFrame|))))

```

Display the Frame Names

```
[bright p??]
[frameName p??]
[sayKeyedMsg p329]
[$interpreterFrameRing p??]
```

— defun displayFrameNames —

```
(defun |displayFrameNames| ()
  "Display the Frame Names"
  (declare (special |$interpreterFrameRing|))
  (let (t1)
    (setq t1
      (mapcar #'(lambda (f) '(|%1| "      " ,@(|bright| (frameName f))))
        |$interpreterFrameRing|))
    (|sayKeyedMsg| 's2iz0024 (list (apply #'append t1)))))
```

Import items from another frame

```
[member p1048]
[frameNames p556]
[throwKeyedMsg p??]
[boot-equal p??]
[frameName p??]
[frameEnvironment p556]
[upcase p??]
[queryUserKeyedMsg p??]
[string2id-n p??]
[importFromFrame p563]
[sayKeyedMsg p329]
[clearCmdParts p505]
[seq p??]
[exit p??]
[putHist p590]
[get p??]
[getalist p??]
[$interpreterFrameRing p??]
```

— defun importFromFrame —

```

(defun |importFromFrame| (args)
  "Import items from another frame"
  (prog (temp1 fname fenv x v props vars plist prop val m)
    (declare (special |$interpreterFrameRing|))
    (when (and args (atom args)) (setq args (cons args nil)))
    (if (null args)
      (|throwKeyedMsg| 'S2IZ0073 nil) ; missing frame name
      (progn
        (setq temp1 args)
        (setq fname (car temp1))
        (setq args (cdr temp1))
        (cond
          ((null (|member| fname (|frameNames|)))
            (|throwKeyedMsg| 'S2IZ0074 (cons fname nil))) ; not frame name
          ((boot-equal fname (frameName (car |$interpreterFrameRing|)))
            (|throwKeyedMsg| 'S2IZ0075 NIL)) ; cannot import from curr frame
          (t
            (setq fenv (|frameEnvironment| fname))
            (cond
              ((null args)
                (setq x
                  (upcase (|queryUserKeyedMsg| 'S2IZ0076 (cons fname nil))))
                  ; import everything?
                (cond
                  ((member (string2id-n x 1) '(y yes))
                    (setq vars nil)
                    (do ((tmp0 (caar fenv) (cdr tmp0)) (tmp1 nil))
                      ((or (atom tmp0)
                        (progn (setq tmp1 (car tmp0)) nil)
                        (progn
                          (progn
                            (setq v (car tmp1))
                            (setq props (cdr tmp1))
                            tmp1
                            nil)))
                      nil)
                    (cond
                      ((eq v '|--macros|)
                        (do ((tmp2 props (cdr tmp2))
                          (tmp3 nil))
                          ((or (atom tmp2)
                            (progn (setq tmp3 (car tmp2)) nil)
                            (progn
                              (progn (setq m (car tmp3)) tmp3)
                              nil))
                        nil)
                      (setq vars (cons m vars))))
                    (t (setq vars (cons v vars))))
                  (|importFromFrame| (cons fname vars)))
              (t

```

```

(|sayKeyedMsg| 'S2IZ0077 (cons fname nil))))))
(t
 (do ((tmp4 args (cdr tmp4)) (v nil))
      ((or (atom tmp4) (progn (setq v (car tmp4)) nil)) nil)
      (seq
       (exit
        (progn
         (setq plist (getalist (caar fenv) v))
         (cond
          (plist
           (|clearCmdParts| (cons '|propert| (cons v nil)))
           (do ((tmp5 plist (cdr tmp5)) (tmp6 nil))
                ((or (atom tmp5)
                     (progn (setq tmp6 (car tmp5)) nil)
                     (progn
                      (progn
                       (setq prop (car tmp6))
                       (setq val (cdr tmp6))
                       tmp6)
                      nil))
                nil))
          nil)
         (seq
          (exit (|putHist| v prop val |$InteractiveFrame|))))))
      ((setq m (|get| '|--macros--| v fenv))
       (|putHist| '|--macros--| v m |$InteractiveFrame|))
      (t
       (|sayKeyedMsg| 'S2IZ0079 ; frame not found
        (cons v (cons fname nil)))))))))
(|sayKeyedMsg| 'S2IZ0078 ; import complete
 (cons fname nil)))))))))

```

The top level frame command

[frameSpad2Cmd p566]

— defun frame —

```

(defun |frame| (l)
  "The top level frame command"
  (|frameSpad2Cmd| l))

```

The top level frame command handler

```
[throwKeyedMsg p??]
[helpSpad2Cmd p572]
[selectOptionLC p479]
[qcdr p??]
[qcar p??]
[object2Identifier p??]
[frameSpad2Cmd drop (vol9)]
[closeInterpreterFrame p562]
[import p??]
[importFromFrame p563]
[last p??]
[previousInterpreterFrame p561]
[names p??]
[displayFrameNames p563]
[new p??]
[addNewInterpreterFrame p561]
[next p36]
[nextInterpreterFrame p560]
[$options p??]
```

— defun frameSpad2Cmd —

```
(defun |frameSpad2Cmd| (args)
  "The top level frame command handler"
  (let (frameArgs arg a)
    (declare (special |$options|))
    (setq frameArgs '(|drop| |import| |last| |names| |new| |next|))
    (cond
      (|$options|
        (|throwKeyedMsg| 'S2IZ0016 ; frame command does not take options
          (cons ")frame" nil)))
      ((null args) (|helpSpad2Cmd| (cons '|frame| nil)))
      (t
        (setq arg (|selectOptionLC| (car args) frameArgs '|optionError|))
        (setq args (cdr args))
        (when (and (consp args)
          (eq (qcdr args) nil)
          (progn (setq a (qcar args)) t))
          (setq args a))
        (when (atom args) (setq args (|object2Identifier| args)))
        (case arg
          (|drop|
            (if (and args (consp args))
              (|throwKeyedMsg| 'S2IZ0017 ; not a valid frame name
                (cons args nil))
              (|closeInterpreterFrame| args))))
```

```
(|import| (|importFromFrame| args))
(|last| (|previousInterpreterFrame|))
(|names| (|displayFrameNames|))
(|new|
  (if (and args (consp args))
      (|throwKeyedMsg| 'S2IZ0017 ; not a valid frame name
        (cons args nil))
      (|addNewInterpreterFrame| args)))
(|next| (|nextInterpreterFrame|))
(t nil))))))
```

32.6 Frame File Messages

— Frame File Messages —

S2IZ0016

The %1b system command takes arguments but no options.

S2IZ0017

%1b is not a valid frame name

S2IZ0018

You must provide a name for the new frame.

S2IZ0019

You cannot use the name %1b for a new frame because an existing frame already has that name.

S2IZ0020

There is only one frame active and therefore that cannot be closed.
Furthermore, the frame name you gave is not the name of the current frame.
The current frame is called %1b .

S2IZ0021

The current frame is the only active one. Issue %b)clear all %d to clear its contents.

S2IZ0022

There is no frame called %1b and so your command cannot be processed.

S2IZ0024

The names of the existing frames are: %1 %1
The current frame is the first one listed.

S2IZ0073

%b)frame import %d must be followed by the frame name. The names of objects in that frame can then optionally follow the frame name.
For example,
%ceon %b)frame import calculus %d %ceoff
imports all objects in the %b calculus %d frame, and
%ceon %b)frame import calculus epsilon delta %d %ceoff

imports the objects named %b epsilon %d and %b delta %d from the frame %b calculus %d .

Please note that if the current frame contained any information about objects with these names, then that information would be cleared before the import took place.

S2IZ0074

You cannot import anything from the frame %1b because that is not the name of an existing frame.

S2IZ0075

You cannot import from the current frame (nor is there a need!).

S2IZ0076

User verification required:

do you really want to import everything from the frame %1b ?

If so, please enter %b y %d or %b yes %d :

S2IZ0077

On your request, AXIOM will not import everything from frame %1b.

S2IZ0078

Import from frame %1b is complete. Please issue %b)display all %d if you wish to see the contents of the current frame.

S2IZ0079

AXIOM cannot import %1b from frame %2b because it cannot be found.

Chapter 33

)help help page Command

33.1 help help page man page

— help.help —

```
=====
A.12. )help
=====
```

User Level Required: interpreter

Command Syntax:

-)help
-)help commandName
-)help syntax

Command Description:

This command displays help information about system commands. If you issue

```
)help
```

then this very text will be shown. You can also give the name or abbreviation of a system command to display information about it. For example,

```
)help clear
```

will display the description of the)clear system command.

The command

)help syntax

will give further information about the Axiom language syntax.

All this material is available in the AXIOM User Guide and in HyperDoc. In HyperDoc, choose the Commands item from the Reference menu.

```
=====
A.1.  Introduction
=====
```

System commands are used to perform AXIOM environment management. Among the commands are those that display what has been defined or computed, set up multiple logical AXIOM environments (frames), clear definitions, read files of expressions and commands, show what functions are available, and terminate AXIOM.

Some commands are restricted: the commands

```
)set userlevel interpreter
)set userlevel compiler
)set userlevel development
```

set the user-access level to the three possible choices. All commands are available at development level and the fewest are available at interpreter level. The default user-level is interpreter. In addition to the)set command (discussed in description of command)set) you can use the HyperDoc settings facility to change the user-level. Click on [Settings] here to immediately go to the settings facility.

Each command listing begins with one or more syntax pattern descriptions plus examples of related commands. The syntax descriptions are intended to be easy to read and do not necessarily represent the most compact way of specifying all possible arguments and options; the descriptions may occasionally be redundant.

All system commands begin with a right parenthesis which should be in the first available column of the input line (that is, immediately after the input prompt, if any). System commands may be issued directly to AXIOM or be included in .input files.

A system command argument is a word that directly follows the command name and is not followed or preceded by a right parenthesis. A system command option follows the system command and is directly preceded by a right parenthesis. Options may have arguments: they directly follow the option. This example may make it easier to remember what is an option and what is an argument:

```
)syscmd arg1 arg2 )opt1 opt1arg1 opt1arg2 )opt2 opt2arg1 ...
```

In the system command descriptions, optional arguments and options are enclosed in brackets ('[' and ']'). If an argument or option name is in italics, it is meant to be a variable and must have some actual value substituted for it when the system command call is made. For example, the syntax pattern description

```
)read fileName [quietly]
```

would imply that you must provide an actual file name for *fileName* but need not use the *)quietly* option. Thus

```
)read matrix.input
```

is a valid instance of the above pattern.

System command names and options may be abbreviated and may be in upper or lower case. The case of actual arguments may be significant, depending on the particular situation (such as in file names). System command names and options may be abbreviated to the minimum number of starting letters so that the name or option is unique. Thus

```
)s Integer
```

is not a valid abbreviation for the *)set* command, because both *)set* and *)show* begin with the letter 's'. Typically, two or three letters are sufficient for disambiguating names. In our descriptions of the commands, we have used no abbreviations for either command names or options.

In some syntax descriptions we use a vertical line '|' to indicate that you must specify one of the listed choices. For example, in

```
)set output fortran on | off
```

only on and off are acceptable words for following boot. We also sometimes use '...' to indicate that additional arguments or options of the listed form are allowed. Finally, in the syntax descriptions we may also list the syntax of related commands.

```
=====
Other help topics
=====
```

Available help topics are:

abbreviations	assignment	blocks	browse	boot	cd
clear	clef	close	collection	compile	describe
display	edit	fin	for	frame	help
history	if	iterate	leave	library	lisp
load	ltrace	parallel	pquit	quit	read
repeat	savesystem	set	show	spool	suchthat

```

synonym      system      syntax      trace      undo      what
while

```

Available algebra help topics are:

33.2 Functions

The top level help command

[helpSpad2Cmd p572]

— defun help —

```

(defun |help| (1)
  "The top level help command"
  (|helpSpad2Cmd| 1))

```

The top level help command handler

[newHelpSpad2Cmd p572]
[sayKeyedMsg p329]

— defun helpSpad2Cmd —

```

(defun |helpSpad2Cmd| (args)
  "The top level help command handler"
  (unless (|newHelpSpad2Cmd| args)
    (|sayKeyedMsg| 's2iz0025 (cons args nil))))

```

defun newHelpSpad2Cmd

```

[makeInputFilename p983]
[obey p??]
[concat p1047]
[namestring p1040]

```

```

[make-instream p981]
[say p??]
[poundsign p??]
[sayKeyedMsg p329]
[pname p1045]
[selectOptionLC p479]
[$syscommands p444]
[$useFullScreenHelp p732]

```

— defun newHelpSpad2Cmd —

```

(defun |newHelpSpad2Cmd| (args)
  (let (sarg arg narg helpfile filestream line)
    (declare (special $syscommands |$useFullScreenHelp|))
    (when (null args) (setq args (list '?)))
    (if (> (|#| args) 1)
      (|sayKeyedMsg| 's2iz0026 nil)
      (progn
        (setq sarg (pname (car args)))
        (cond
          ((string= sarg "?") (setq args (list '|help|)))
          ((string= sarg "%") (setq args (list '|history|)))
          ((string= sarg "%%") (setq args (list '|history|)))
          (t nil))
        (setq arg (|selectOptionLC| (car args) $syscommands nil))
        (cond ((null arg) (setq arg (car args))))
        (setq narg (pname arg))
        (cond
          ((null (setq helpfile (makeInputFilename (list narg "help"))))
           nil)
          (|$useFullScreenHelp|
           (obey (concat "$AXIOM/lib/SPAEDIT " (|namestring| helpfile))) t)
          (t
           (setq filestream (make-instream helpfile))
           (do ((line (|read-line| filestream nil) (|read-line| filestream nil)))
               ((null line) (shut filestream))
              (say line)))))))

```

Chapter 34

)history help page Command

34.1 history help page man page

— history.help —

```
=====
A.13. )history
=====
```

User Level Required: interpreter

Command Syntax:

-)history)on
-)history)off
-)history)write historyInputFileName
-)history)show [n] [both]
-)history)save savedHistoryName
-)history)restore [savedHistoryName]
-)history)reset
-)history)change n
-)history)memory
-)history)file
- %
- %% (n)
-)set history on | off

Command Description:

The history facility within AXIOM allows you to restore your environment to that of another session and recall previous computational results. Additional commands allow you to review previous input lines and to create an .input

file of the lines typed to AXIOM.

AXIOM saves your input and output if the history facility is turned on (which is the default). This information is saved if either of

```
)set history on
)history )on
```

has been issued. Issuing either

```
)set history off
)history )off
```

will discontinue the recording of information.

Whether the facility is disabled or not, the value of % in AXIOM always refers to the result of the last computation. If you have not yet entered anything, % evaluates to an object of type Variable('%'). The function %% may be used to refer to other previous results if the history facility is enabled. In that case, %(n) is the output from step n if n > 0. If n < 0, the step is computed relative to the current step. Thus %(-1) is also the previous step, %(-2), is the step before that, and so on. If an invalid step number is given, AXIOM will signal an error.

The environment information can either be saved in a file or entirely in memory (the default). Each frame (description of command)frame) has its own history database. When it is kept in a file, some of it may also be kept in memory for efficiency. When the information is saved in a file, the name of the file is of the form FRAME.ahx where "FRAME" is the name of the current frame. The history file is placed in the current working directory (see description of command)cd). Note that these history database files are not text files (in fact, they are directories themselves), and so are not in human-readable format.

The options to the)history command are as follows:

```
)change n
    will set the number of steps that are saved in memory to n. This option
    only has effect when the history data is maintained in a file. If you
    have issued )history )memory (or not changed the default) there is no
    need to use )history )change.

)on
    will start the recording of information. If the workspace is not empty,
    you will be asked to confirm this request. If you do so, the workspace
    will be cleared and history data will begin being saved. You can also
    turn the facility on by issuing )set history on.

)off
    will stop the recording of information. The )history )show command will
```

not work after issuing this command. Note that this command may be issued to save time, as there is some performance penalty paid for saving the environment data. You can also turn the facility off by issuing `)set history off`.

`)file`
indicates that history data should be saved in an external file on disk.

`)memory`
indicates that all history data should be kept in memory rather than saved in a file. Note that if you are computing with very large objects it may not be practical to keep this data in memory.

`)reset`
will flush the internal list of the most recent workspace calculations so that the data structures may be garbage collected by the underlying Lisp system. Like `)history)change`, this option only has real effect when history data is being saved in a file.

`)restore [savedHistoryName]`
completely clears the environment and restores it to a saved session, if possible. The `)save` option below allows you to save a session to a file with a given name. If you had issued `)history)save jacobi` the command `)history)restore jacobi` would clear the current workspace and load the contents of the named saved session. If no saved session name is specified, the system looks for a file called `last.axh`.

`)save savedHistoryName`
is used to save a snapshot of the environment in a file. This file is placed in the current working directory (see description of command `)cd`). Use `)history)restore` to restore the environment to the state preserved in the file. This option also creates an input file containing all the lines of input since you created the workspace frame (for example, by starting your AXIOM session) or last did a `)clear all` or `)clear completely`.

`)show [n] [both]`
can show previous input lines and output results. `)show` will display up to twenty of the last input lines (fewer if you haven't typed in twenty lines). `)show n` will display up to `n` of the last input lines. `)show both` will display up to five of the last input lines and output results. `)show n both` will display up to `n` of the last input lines and output results.

`)write historyInputFile`
creates an `.input` file with the input lines typed since the start of the session/frame or the last `)clear all` or `)clear completely`. If `historyInputFileName` does not contain a period (`'.'`) in the filename, `.input` is appended to it. For example, `)history)write chaos` and `)history)write chaos.input` both write the input lines to a file called `chaos.input` in your current working directory. If you issued one or more

)undo commands,)history)write eliminates all input lines backtracked over as a result of)undo. You can edit this file and then use)read to have AXIOM process the contents.

Also See:

- o)frame
- o)read
- o)set
- o)undo

1

History recording is done in two different ways:

- all changes in variable bindings (i.e. previous values) are written to `$HistList`, which is a circular list
- all new bindings (including the binding to `%`) are written to a file called `histFileName()` one older session is accessible via the file `$oldHistFileName()`

34.2 Initialized history variables

The following global variables are used:

`$HistList`, `$HistListLen` and `$HistListAct` which is the actual number of “undoable” steps)

`$HistRecord` collects the input line, all variable bindings and the output of a step, before it is written to the file `histFileName()`.

`$HiFiAccess` is a flag, which is reset by `)history)off`

The result of step `n` can be accessed by `%n`, which is translated into a call of `fetchOutput(n)`. The `updateHist` is called after every interpreter step. The `putHist` function records all changes in the environment to `$HistList` and `$HistRecord`.

defvar \$oldHistoryFileName

— initvars —

```
(defvar |$oldHistoryFileName| ' |last| "vm/370 filename name component")
```

¹ “frame” (32.5 p 565) “read” (42.1 p 642) “set” (45.36 p 808) “undo” (53.4 p 922)

defvar \$historyFileType

— initvars —

```
(defvar |$historyFileType| '|axh| "vm/370 filename type component")
```

defvar \$historyDirectory

— initvars —

```
(defvar |$historyDirectory| 'A "vm/370 filename disk component")
```

defvar \$useInternalHistoryTable

— initvars —

```
(defvar |$useInternalHistoryTable| t "t means keep history in core")
```

34.3 Data Structures

34.4 Functions

defun makeHistFileName

[makePathname p¹⁰⁴²]

— defun makeHistFileName —

```
(defun |makeHistFileName| (fname)
  (|makePathname| fname |$historyFileType| |$historyDirectory|))
```

defun oldHistFileName

```
[makeHistFileName p579]
[$oldHistoryFileName p578]
```

— defun oldHistFileName —

```
(defun |oldHistFileName| ()
  (declare (special |$oldHistoryFileName|))
  (|makeHistFileName| |$oldHistoryFileName|))
```

—————

defun histFileName

```
[makeHistFileName p579]
[$interpreterFrameName p??]
```

— defun histFileName —

```
(defun |histFileName| ()
  (declare (special |$interpreterFrameName|))
  (|makeHistFileName| |$interpreterFrameName|))
```

—————

defun histInputFileName

```
[makePathname p1042]
[$interpreterFrameName p??]
[$historyDirectory p579]
```

— defun histInputFileName —

```
(defun |histInputFileName| (fn)
  (declare (special |$interpreterFrameName| |$historyDirectory|))
  (if (null fn)
    (|makePathname| |$interpreterFrameName| 'input |$historyDirectory|)
    (|makePathname| fn 'input |$historyDirectory|)))
```

—————

defun initHist

[initHistList p581]
 [oldHistFileName p580]
 [histFileName p580]
 [histFileErase p617]
 [makeInputFilename p983]
 [\$replace p??]
 [\$useInternalHistoryTable p579]
 [\$HiFiAccess p733]

— defun initHist —

```
(defun |initHist| ()
  (let (oldFile newFile)
    (declare (special |$useInternalHistoryTable| |$HiFiAccess|))
    (if |$useInternalHistoryTable|
      (|initHistList|)
      (progn
        (setq oldFile (|oldHistFileName|))
        (setq newFile (|histFileName|))
        (|histFileErase| oldFile)
        (when (makeInputFilename newFile) (replaceFile oldFile newFile))
        (setq |$HiFiAccess| t)
        (|initHistList|))))))
```

—————

defun initHistList

[\$HistListLen p??]
 [\$HistList p??]
 [\$HistListAct p??]
 [\$HistRecord p??]

— defun initHistList —

```
(defun |initHistList| ()
  (let (li)
    (declare (special |$HistListLen| |$HistList| |$HistListAct| |$HistRecord|))
    (setq |$HistListLen| 20)
    (setq |$HistList| (list nil))
    (setq li |$HistList|)
    (do ((i 1 (1+ i)))
      ((> i |$HistListLen|) nil)
      (setq li (cons nil li))))
```

```
(rplacd |$HistList| li)
(setq |$HistListAct| 0)
(setq |$HistRecord| nil)))
```

The top level history command

```
[sayKeyedMsg p329]
[historySpad2Cmd p582]
[$options p??]
```

— defun history —

```
(defun |history| (l)
  "The top level history command"
  (declare (special |$options|))
  (if (or l (null |$options|))
      (|sayKeyedMsg| 's2ih0006 nil) ; syntax error
      (|historySpad2Cmd|)))
```

The top level history command handler

```
[selectOptionLC p479]
[member p1048]
[sayKeyedMsg p329]
[initHistList p581]
[upcase p??]
[queryUserKeyedMsg p??]
[string2id-n p??]
[histFileErase p617]
[histFileName p580]
[clearSpad2Cmd p500]
[disableHist p603]
[setHistoryCore p584]
[resetInCoreHist p588]
[saveHistory p595]
[showHistory p??]
[changeHistListLen p589]
[restoreHistory p597]
[writeInputLines p587]
[seq p??]
```

```
[exit p??]
[$options p??]
[$HiFiAccess p733]
[$IOindex p10]
```

— defun historySpad2Cmd —

```
(defun |historySpad2Cmd| ()
  "The top level history command handler"
  (let (histOptions opts opt optargs x)
    (declare (special |$options| |$HiFiAccess| |$IOindex|))
    (setq histOptions
      '(|on| |off| |yes| |no| |change| |reset| |restore| |write|
        |save| |show| |file| |memory|))
    (setq opts
      (prog (tmp1)
        (setq tmp1 nil)
        (return
          (do ((tmp2 |$options| (cdr tmp2)) (tmp3 nil))
              ((or (atom tmp2)
                    (progn
                      (setq tmp3 (car tmp2))
                      nil)
                    (progn
                      (progn
                        (setq opt (car tmp3))
                        (setq optargs (cdr tmp3))
                        tmp3)
                      nil)))
              (nreverse0 tmp1)))
          (setq tmp1
            (cons
              (cons
                (|selectOptionLC| opt histOptions '|optionError|)
                optargs)
              tmp1))))))
    (do ((tmp4 opts (cdr tmp4)) (tmp5 nil))
        ((or (atom tmp4)
              (progn
                (setq tmp5 (car tmp4))
                nil)
              (progn
                (progn
                  (setq opt (car tmp5))
                  (setq optargs (cdr tmp5))
                  tmp5)
                nil)))
        nil)
    (seq
```



```

(exit
(cond
  ((|member| opt '(|on| |yes|))
    (cond
      (|$HiFiAccess|
        (|sayKeyedMsg| 'S2IH0007 nil)) ; history already on
      ((eq1 |$I0index| 1)
        (setq |$HiFiAccess| t)
        (|initHistList|)
        (|sayKeyedMsg| 'S2IH0008 nil)) ; history now on
      (t
        (setq x ; really want to turn history on?
          (upcase (|queryUserKeyedMsg| 'S2IH0009 nil)))
        (cond
          ((member (string2id-n x 1) '(Y YES))
            (|histFileErase| (|histFileName|))
            (setq |$HiFiAccess| t)
            (setq |$options| nil)
            (|clearSpad2Cmd| '(|all|))
            (|sayKeyedMsg| 'S2IH0008 nil) ; history now on
            (|initHistList|))
          (t
            (|sayKeyedMsg| 'S2IH0010 nil)))))) ; history still off
    (|member| opt '(|off| |no|))
    (cond
      ((null |$HiFiAccess|)
        (|sayKeyedMsg| 'S2IH0011 nil)) ; history already off
      (t
        (setq |$HiFiAccess| nil)
        (|disableHist|)
        (|sayKeyedMsg| 'S2IH0012 nil)))) ; history now off
    ((eq opt '|file|) (|setHistoryCore| nil))
    ((eq opt '|memory|) (|setHistoryCore| t))
    ((eq opt '|reset|) (|resetInCoreHist|))
    ((eq opt '|save|) (|saveHistory| optargs))
    ((eq opt '|show|) (|showHistory| optargs))
    ((eq opt '|change|) (|changeHistListLen| (car optargs)))
    ((eq opt '|restore|) (|restoreHistory| optargs))
    ((eq opt '|write|) (|writeInputLines| optargs 1))))))
'|done|))

```

defun setHistoryCore

We case on the inCore argument value

If history is already on and is kept in the same location as requested (file or memory)

then complain.

If history is not in use then start using the file or memory as requested. This is done by simply setting the `$useInternalHistoryTable` to the requested value, where T means use memory and NIL means use a file. We tell the user.

If history should be in memory, that is `inCore` is not NIL, and the history file already contains information we read the information from the file, store it in memory, and erase the history file. We modify `$useInternalHistoryTable` to T to indicate that we're maintaining the history in memory and tell the user.

Otherwise history must be on and in memory. We erase any old history file and then write the in-memory history to a new file

```
[boot-equal p??]
[sayKeyedMsg p329]
[rkeyids p??]
[histFileName p580]
[readHiFi p601]
[disableHist p603]
[histFileErase p617]
[rdefiostream p??]
[spadrwrite p605]
[object2Identifier p??]
[rshut p??]
[$useInternalHistoryTable p579]
[$internalHistoryTable p??]
[$HiFiAccess p733]
[$IOindex p10]
```

— **defun setHistoryCore** —

```
(defun |setHistoryCore| (inCore)
  (let (l vec str n rec)
    (declare (special |$useInternalHistoryTable| |$internalHistoryTable|
      |$HiFiAccess| |$IOindex|))
    (cond
      ((boot-equal inCore |$useInternalHistoryTable|)
        (if inCore
          (|sayKeyedMsg| 's2ih0030 nil) ; memory history already in use
          (|sayKeyedMsg| 's2ih0029 nil))) ; file history already in use
      ((null |$HiFiAccess|)
        (setq |$useInternalHistoryTable| inCore)
        (if inCore
          (|sayKeyedMsg| 's2ih0032 nil) ; use memory history
          (|sayKeyedMsg| 's2ih0031 nil))) ; use file history
      (inCore
        (setq |$internalHistoryTable| nil)
        (cond
```

```

(not (eql |$I0index| 0))
  (setq l (length (rkeyids (|histFileName|))))
  (do ((i 1 (1+ i)))
      ((> i l) nil)
      (setq vec (unwind-protect (|readHiFi| i) (|disableHist|)))
      (setq |$internalHistoryTable|
        (cons (cons i vec) |$internalHistoryTable|)))
    (|histFileErase| (|histFileName|)))
  (setq |$useInternalHistoryTable| t)
  (|sayKeyedMsg| 'S2IH0032 nil)) ; use memory history
(t
  (setq |$HiFiAccess| nil)
  (|histFileErase| (|histFileName|))
  (setq str
    (rdefiostream
      (cons
        '(mode . output)
        (cons
          (cons 'file (|histFileName|))
          nil))))
    (do ((tmp0 (reverse |$internalHistoryTable|) (cdr tmp0))
        (tmp1 nil))
        ((or (atom tmp0)
              (progn
                (setq tmp1 (car tmp0))
                nil)
              (progn
                (progn
                  (setq n (car tmp1))
                  (setq rec (cdr tmp1))
                  tmp1)
                nil))
              nil)
          (spadrwrite (|object2Identifier| n) rec str))
    (rshut str)
    (setq |$HiFiAccess| t)
    (setq |$internalHistoryTable| nil)
    (setq |$useInternalHistoryTable| nil)
    (|sayKeyedMsg| 's2ih0031 nil)))) ; use file history

```

defvar \$underbar

Also used in the output routines.

— **initvars** —

```
(defvar underbar "_")
```

defun writeInputLines

```

[sayKeyedMsg p329]
[throwKeyedMsg p??]
[size p1045]
[spaddifference p??]
[concat p1047]
[substring p??]
[readHiFi p601]
[histInputFileName p580]
[histFileErase p617]
[defiostream p982]
[namestring p1040]
[shut p982]
[underbar p586]
[$HiFiAccess p733]
[$IOindex p10]

```

— defun writeInputLines —

```

(defun |writeInputLines| (fn initial)
  (let (maxn breakChars vec1 k svec done n lineList file inp)
    (declare (special underbar |$HiFiAccess| |$IOindex|))
    (cond
      ((null |$HiFiAccess|) (|sayKeyedMsg| 's2ih0013 nil)) ; history is not on
      ((null fn) (|throwKeyedMsg| 's2ih0038 nil)) ; missing file name
      (t
       (setq maxn 72)
       (setq breakChars (cons ' | (cons '+ nil)))
       (do ((tmp0 (spaddifference |$IOindex| 1))
            (i initial (+ i 1)))
           ((> i tmp0) nil)
           (setq vec1 (car (|readHiFi| i)))
           (when (stringp vec1) (setq vec1 (cons vec1 nil)))
           (dolist (vec vec1)
             (setq n (size vec))
             (do ()
                 ((null (> n maxn)) nil)
                 (setq done nil)
                 (do ((j 1 (1+ j)))
                     ((or (> j maxn) (null (null done)))) nil)
                 (setq k (spaddifference (1+ maxn) j))
                 (when (member (elt vec k) breakChars)

```

```

      (setq svec (concat (substring vec 0 (1+ k)) underbar))
      (setq lineList (cons svec lineList))
      (setq done t)
      (setq vec (substring vec (1+ k) nil))
      (setq n (size vec))))
    (when done (setq n 0)))
  (setq lineList (cons vec lineList)))
(setq file (|histInputFileName| fn))
(|histFileErase| file)
(setq inp
  (defiostream
    (cons
      '(mode . output)
      (cons (cons 'file file) nil)) 255 0))
(dolist (x (|removeUndoLines| (nreverse lineList)))
  (write-line x inp))
(cond
  ((not (eq fn '|redo|))
    (|sayKeyedMsg| 's2ih0014 ; edit this file to see input lines
      (list (|namestring| file)))))
(shut inp)
nil))))

```

defun resetInCoreHist

```

[$HistListAct p??]
[$HistListLen p??]
[$HistList p??]

```

— defun resetInCoreHist —

```

(defun |resetInCoreHist| ()
  (declare (special |$HistListAct| |$HistListLen| |$HistList|))
  (setq |$HistListAct| 0)
  (do ((i 1 (1+ i)))
    ((> i |$HistListLen|) nil)
    (setq |$HistList| (cdr |$HistList|))
    (rplaca |$HistList| nil)))

```

defun changeHistListLen

[sayKeyedMsg p329]
 [spaddifference p??]
 [\$HistListLen p??]
 [\$HistList p??]
 [\$HistListAct p??]

— defun changeHistListLen —

```
(defun |changeHistListLen| (n)
  (let (dif 1)
    (declare (special |$HistListLen| |$HistList| |$HistListAct|))
    (if (null (integerp n))
      (|sayKeyedMsg| 's2ih0015 (list n)) ; only positive integers
      (progn
        (setq dif (spaddifference n |$HistListLen|))
        (setq |$HistListLen| n)
        (setq l (cdr |$HistList|))
        (cond
          ((> dif 0)
            (do ((i 1 (1+ i)))
              ((> i dif) nil)
              (setq l (cons nil l))))
          ((minusp dif)
            (do ((tmp0 (spaddifference dif))
                (i 1 (1+ i)))
              ((> i tmp0) nil)
              (setq l (cdr l)))
            (cond
              ((> |$HistListAct| n) (setq |$HistListAct| n))
              (t nil))))
        (rplacd |$HistList| l)
        '|done|))))
```

—————

defun updateHist

[startTimingProcess p??]
 [updateInCoreHist p590]
 [writeHiFi p602]
 [disableHist p603]
 [updateCurrentInterpreterFrame p559]
 [stopTimingProcess p??]
 [\$IOindex p10]
 [\$HiFiAccess p733]

```
[$HistRecord p??]
[$mkTestInputStack p??]
[$currentLine p??]
```

— defun updateHist —

```
(defun |updateHist| ()
  (declare (special |$IOindex| |$HiFiAccess| |$HistRecord| |$mkTestInputStack|
    |$currentLine|))
  (when |$IOindex|
    (|startTimingProcess| ' |history|)
    (|updateInCoreHist|)
    (when |$HiFiAccess|
      (unwind-protect (|writeHiFi|) (|disableHist|))
      (setq |$HistRecord| nil))
    (incf |$IOindex|)
    (|updateCurrentInterpreterFrame|)
    (setq |$mkTestInputStack| nil)
    (setq |$currentLine| nil)
    (|stopTimingProcess| ' |history|)))
```

—————

defun updateInCoreHist

```
[$HistList p??]
[$HistListLen p??]
[$HistListAct p??]
```

— defun updateInCoreHist —

```
(defun |updateInCoreHist| ()
  (declare (special |$HistList| |$HistListLen| |$HistListAct|))
  (setq |$HistList| (cdr |$HistList|))
  (rplaca |$HistList| nil)
  (when (> |$HistListLen| |$HistListAct|)
    (setq |$HistListAct| (1+ |$HistListAct|))))
```

—————

defun putHist

```
[recordOldValue p592]
[get p??]
[recordNewValue p591]
```

```
[putIntSymTab p??]
[$HiFiAccess p733]
```

— defun putHist —

```
(defun |putHist| (x prop val e)
  (declare (special |$HiFiAccess|))
  (when (null (eq x '%)) (|recordOldValue| x prop (|get| x prop e)))
  (when |$HiFiAccess| (|recordNewValue| x prop val))
  (|putIntSymTab| x prop val e))
```

—————

defun recordNewValue

```
[startTimingProcess p??]
[recordNewValue0 p591]
[stopTimingProcess p??]
```

— defun recordNewValue —

```
(defun |recordNewValue| (x prop val)
  (|startTimingProcess| '|history|)
  (|recordNewValue0| x prop val)
  (|stopTimingProcess| '|history|))
```

—————

defun recordNewValue0

```
[assq p1050]
[$HistRecord p??]
```

— defun recordNewValue0 —

```
(defun |recordNewValue0| (x prop val)
  (let (p1 p2 p)
    (declare (special |$HistRecord|))
    (if (setq p1 (assq x |$HistRecord|))
      (if (setq p2 (assq prop (cdr p1)))
        (rplacd p2 val)
        (rplacd p1 (cons (cons prop val) (cdr p1))))
      (progn
        (setq p (cons x (list (cons prop val))))
```



```
(setq |$HistRecord| (cons p |$HistRecord|))))))
```

defun recordOldValue

```
[startTimingProcess p??]
[recordOldValue0 p592]
[stopTimingProcess p??]
[assq p1050]
```

— defun recordOldValue —

```
(defun |recordOldValue| (x prop val)
  (|startTimingProcess| ' |history|)
  (|recordOldValue0| x prop val)
  (|stopTimingProcess| ' |history|))
```

defun recordOldValue0

```
[$HistList p??]
```

— defun recordOldValue0 —

```
(defun |recordOldValue0| (x prop val)
  (let (p1 p)
    (declare (special |$HistList|))
    (when (setq p1 (assq x (car |$HistList|)))
      (when (null (assq prop (cdr p1)))
        (rplacd p1 (cons (cons prop val) (cdr p1)))))
    (setq p (cons x (list (cons prop val))))
    (rplaca |$HistList| (cons p (car |$HistList|)))))
```

defun undoInCore

```
[undoChanges p593]
[spaddifference p??]
[readHiFi p601]
```

```
[disableHist p603]
[assq p1050]
[sayKeyedMsg p329]
[putHist p590]
[updateHist p589]
[$HistList p??]
[$HistListLen p??]
[$IOindex p10]
[$HiFiAccess p733]
[$InteractiveFrame p??]
```

— defun undoInCore —

```
(defun |undoInCore| (n)
  (let (li vec p p1 val)
    (declare (special |$HistList| |$HistListLen| |$IOindex| |$HiFiAccess|
      |$InteractiveFrame|))
    (setq li |$HistList|)
    (do ((i n (+ i 1)))
      ((> i |$HistListLen|) nil)
      (setq li (cdr li)))
    (|undoChanges| li)
    (setq n (spaddifference (spaddifference |$IOindex| n) 1))
    (and
      (> n 0)
      (if |$HiFiAccess|
        (progn
          (setq vec (cdr (unwind-protect (|readHiFi| n) (|disableHist|))))
          (setq val
            (and
              (setq p (assq '% vec))
              (setq p1 (assq '|value| (cdr p)))
              (cdr p1))))
          (|sayKeyedMsg| 's2ih0019 (cons n nil)))) ; no history file
      (setq |$InteractiveFrame| (|putHist| '% '|value| val |$InteractiveFrame|))
      (|updateHist|)))
```

defun undoChanges

```
[boot-equal p??]
[undoChanges p593]
[putHist p590]
[$HistList p??]
[$InteractiveFrame p??]
```

— defun undoChanges —

```
(defun |undoChanges| (li)
  (let (x)
    (declare (special |$HistList| |$InteractiveFrame|))
    (when (null (boot-equal (cdr li) |$HistList|)) (|undoChanges| (cdr li)))
    (dolist (p1 (car li))
      (setq x (car p1))
      (dolist (p2 (cdr p1))
        (|putHist| x (car p2) (cdr p2) |$InteractiveFrame|))))))
```

—————

defun undoFromFile

```
[seq p??]
[exit p??]
[recordOldValue p592]
[recordNewValue p591]
[readHiFi p601]
[disableHist p603]
[putHist p590]
[assq p1050]
[updateHist p589]
[$InteractiveFrame p??]
[$HiFiAccess p733]
```

— defun undoFromFile —

```
(defun |undoFromFile| (n)
  (let (var1 prop vec x p p1 val)
    (declare (special |$InteractiveFrame| |$HiFiAccess|))
    (do ((tmp0 (caar |$InteractiveFrame|) (cdr tmp0)) (tmp1 nil))
      ((or (atom tmp0)
            (progn (setq tmp1 (car tmp0)) nil)
            (progn
              (progn
                (setq x (car tmp1))
                (setq var1 (cdr tmp1))
                tmp1)
              nil))
           nil)
      (seq
        (exit
          (do ((tmp2 var1 (cdr tmp2)) (p nil))
```

```

      ((or (atom tmp2) (progn (setq p (car tmp2)) nil)) nil)
    (seq
      (exit
        (progn
          (setq prop (car p))
          (setq val (cdr p))
          (when val
            (progn
              (when (null (eq x '%))
                (|recordOldValue| x prop val))
              (when (|$HiFiAccess|
                (|recordNewValue| x prop val))
              (rplacd p nil))))))))))
  (do ((i 1 (1+ i)))
    ((> i n) nil)
    (setq vec
      (unwind-protect (cdr (|readHiFi| i)) (|disableHist|)))
    (do ((tmp3 vec (cdr tmp3)) (p1 nil))
      ((or (atom tmp3) (progn (setq p1 (car tmp3)) nil)) nil)
      (setq x (car p1))
      (do ((tmp4 (cdr p1) (cdr tmp4)) (p2 nil))
        ((or (atom tmp4) (progn (setq p2 (car tmp4)) nil)) nil)
        (setq |$InteractiveFrame|
          (|putHist| x (car p2) (CDR p2) |$InteractiveFrame|))))
    (setq val
      (and
        (setq p (assq '% vec))
        (setq p1 (assq '|value| (cdr p)))
        (cdr p1)))
    (setq |$InteractiveFrame| (|putHist| '% '|value| val |$InteractiveFrame|))
    (|updateHist|)))

```

defun saveHistory

```

[sayKeyedMsg p329]
[makeInputFilename p983]
[histFileName p580]
[throwKeyedMsg p??]
[makeHistFileName p579]
[histInputFileName p580]
[writeInputLines p587]
[histFileErase p617]
[rdefiostream p??]
[spadrwrite0 p604]
[object2Identifier p??]

```

```
[rshut p??]
[namestring p1040]
[$seen p??]
[$HiFiAccess p733]
[$useInternalHistoryTable p579]
[$internalHistoryTable p??]
```

— defun saveHistory —

```
(defun |saveHistory| (fn)
  (let (|$seen| savefile inputfile saveStr n rec val)
    (declare (special |$seen| |$HiFiAccess| |$useInternalHistoryTable|
      |$internalHistoryTable|))
    (setq |$seen| (make-hash-table :test #'eq))
    (cond
      ((null |$HiFiAccess|)
        (|sayKeyedMsg| 's2ih0016 nil)) ; the history file is not on
      ((and (null |$useInternalHistoryTable|)
        (null (makeInputFilename (|histFileName|))))
        (|sayKeyedMsg| 's2ih0022 nil)) ; no history saved yet
      (null fn)
        (|throwKeyedMsg| 's2ih0037 nil)) ; need to specify a history filename
    (t
      (setq savefile (|makeHistFileName| fn))
      (setq inputfile (|histInputFileName| fn))
      (|writeInputLines| fn 1)
      (|histFileErase| savefile)
      (when |$useInternalHistoryTable|
        (setq saveStr
          (rdefiostream
            (cons '(mode . output)
              (cons (cons 'file savefile) nil))))
        (do ((tmp0 (reverse |$internalHistoryTable|) (cdr tmp0))
          (tmp1 nil))
          ((or (atom tmp0)
            (progn (setq tmp1 (car tmp0)) nil)
            (progn
              (progn
                (setq n (car tmp1))
                (setq rec (cdr tmp1))
                tmp1)
              nil))
            nil)
          (setq val (spadrwrite0 (|object2Identifier| n) rec saveStr))
          (when (eq val '|writifyFailed|)
            (|sayKeyedMsg| 's2ih0035 ; can't save the value of step
              (list n inputfile))))
        (rshut saveStr))
      (|sayKeyedMsg| 's2ih0018 ; saved history file is
```

```
(cons (|namestring| savefile) nil))
nil)))))
```

defun restoreHistory

```
[qcdr p??]
[qcar p??]
[identp p1046]
[throwKeyedMsg p??]
[makeHistFileName p579]
[putHist p590]
[makeInputFilename p983]
[sayKeyedMsg p329]
[namestring p1040]
[clearSpad2Cmd p500]
[histFileName p580]
[histFileErase p617]
[$fcopy p??]
[rkeyids p??]
[readHiFi p601]
[disableHist p603]
[updateInCoreHist p590]
[get p??]
[rempropI p??]
[clearCmdSortedCaches p501]
[$options p??]
[$internalHistoryTable p??]
[$HiFiAccess p733]
[$e p??]
[$useInternalHistoryTable p579]
[$InteractiveFrame p??]
[$oldHistoryFileName p578]
```

— defun restoreHistory —

```
(defun |restoreHistory| (fn)
  (let (|$options| fnq restfile curfile l oldInternal vec line x a)
    (declare (special |$options| |$internalHistoryTable| |$HiFiAccess| |$e|
                      |$useInternalHistoryTable| |$InteractiveFrame| |$oldHistoryFileName|))
    (cond
      ((null fn) (setq fnq |$oldHistoryFileName|))
      ((and (consp fn)
            (eq (qcdr fn) nil)
```

```

(progn
  (setq fnq (qcar fn))
  t)
(identp fnq))
(setq fnq fnq))
(t (|throwKeyedMsg| 's2ih0023 (cons fnq nil)))) ; invalid filename
(setq restfile (|makeHistFileName| fnq))
(if (null (makeInputFilename restfile))
  (|sayKeyedMsg| 's2ih0024 ; file does not exist
    (cons (|namestring| restfile) nil))
  (progn
    (setq |$options| nil)
    (|clearSpad2Cmd| '(|all|))
    (setq curfile (|histFileName|))
    (|histFileErase| curfile)
    ($fcopy restfile curfile)
    (setq l (length (rkeyids curfile)))
    (setq |$HiFiAccess| t)
    (setq oldInternal |$useInternalHistoryTable|)
    (setq |$useInternalHistoryTable| nil)
    (when oldInternal (setq |$internalHistoryTable| nil))
    (do ((i 1 (1+ i)))
      ((> i l) nil)
      (setq vec (unwind-protect (|readHiFi| i) (|disableHist|)))
      (when oldInternal
        (setq |$internalHistoryTable|
          (cons (cons i vec) |$internalHistoryTable|)))
      (setq line (car vec))
      (dolist (p1 (cdr vec))
        (setq x (car p1))
        (do ((tmp1 (cdr p1) (cdr tmp1)) (p2 nil))
          ((or (atom tmp1) (progn (setq p2 (car tmp1)) nil)) nil)
          (setq |$InteractiveFrame|
            (|putHist| x
              (car p2) (cdr p2) |$InteractiveFrame|))))
        (|updateInCoreHist|))
      (setq |$e| |$InteractiveFrame|)
      (do ((tmp2 (caar |$InteractiveFrame|) (cdr tmp2)) (tmp3 nil))
        ((or (atom tmp2)
          (progn
            (setq tmp3 (car tmp2))
            nil)
          (progn
            (progn
              (setq a (car tmp3))
              tmp3)
            nil))
          nil)
        (when (|get| a '|localModemap| |$InteractiveFrame|)
          (|rempropI| a '|localModemap|)

```

```

      (|rempropI| a ' |localVars|)
      (|rempropI| a ' |mapBody|)))
  (setq |$IOindex| (1+ 1))
  (setq |$useInternalHistoryTable| oldInternal)
  (|sayKeyedMsg| 'S2IH0025 ; workspace restored
    (cons (|namestring| restfile) nil))
  (|clearCmdSortedCaches|)
  nil))))

```

defun setIOindex

[[\\$IOindex](#) [p10](#)]

— defun setIOindex —

```

(defun |setIOindex| (n)
  (declare (special |$IOindex|))
  (setq |$IOindex| n))

```

defun showInput

[[tab](#) [p??](#)]
 [[readHiFi](#) [p601](#)]
 [[disableHist](#) [p603](#)]
 [[sayMSG](#) [p331](#)]

— defun showInput —

```

(defun |showInput| (mini maxi)
  (let (vec l)
    (do ((|ind| mini (+ |ind| 1)))
      ((> |ind| maxi) nil)
      (setq vec (unwind-protect (|readHiFi| |ind|) (|disableHist|))))
    (cond
      ((> 10 |ind|) (tab 2))
      ((> 100 |ind|) (tab 1))
      (t nil))
    (setq l (car vec))
    (if (stringp l)
      (|sayMSG| (list " [" |ind| "]" " (car vec)))
      (progn

```



```
(|sayMSG| (list " [" |ind| "]" "))
(do ((tmp0 1 (cdr tmp0)) (ln nil))
  ((or (atom tmp0) (progn (setq ln (car tmp0)) nil)) nil)
(|sayMSG| (list " " ln))))))
```

defun showInOut

```
[assq p1050]
[spadPrint p??]
[objValUnwrap p??]
[objMode p??]
[readHiFi p601]
[disableHist p603]
[sayMSG p331]
```

— defun showInOut —

```
(defun |showInOut| (mini maxi)
  (let (vec Alist triple)
    (do ((ind mini (+ ind 1))
        (> ind maxi) nil)
      (setq vec (unwind-protect (|readHiFi| ind) (|disableHist|)))
      (|sayMSG| (cons (car vec) nil))
      (cond
        ((setq Alist (assq '% (cdr vec)))
         (setq triple (cdr (assq '|value| (cdr Alist))))
         (setq |$I0index| ind)
         (|spadPrint| (|objValUnwrap| triple) (|objMode| triple)))))))
```

defun fetchOutput

```
[boot-equal p??]
[spaddifference p??]
[getI p??]
[throwKeyedMsg p??]
[readHiFi p601]
[disableHist p603]
[assq p1050]
```

— defun fetchOutput —

```

(defun |fetchOutput| (n)
  (let (vec Alist val)
    (cond
      ((and (boot-equal n (spaddifference 1)) (setq val (|getI| '% '|value|)))
        val)
      (|$HiFiAccess|
        (setq n
          (cond
            ((minusp n) (+ |$IOindex| n))
            (t n)))
          (cond
            ((>= n |$IOindex|)
              (|throwKeyedMsg| 'S2IH0001 (cons n nil))) ; no step n yet
            (> 1 n)
              (|throwKeyedMsg| 's2ih0002 (cons n nil))) ; only nonzero steps
            (t
              (setq vec (unwind-protect (|readHiFi| n) (|disableHist|)))
              (cond
                ((setq Alist (assq '% (cdr vec)))
                  (cond
                    ((setq val (cdr (assq '|value| (cdr Alist))))
                      val)
                    (t
                      (|throwKeyedMsg| 's2ih0003 (cons n nil)))) ; no step value
                  (t (|throwKeyedMsg| 's2ih0003 (cons n nil)))) ; no step value
                (t (|throwKeyedMsg| 's2ih0004 nil)))) ; history not on

```

Read the history file using index n

```

[assoc p??]
[keyedSystemError p??]
[qcdr p??]
[rdefiostream p??]
[histFileName p580]
[spadrread p605]
[object2Identifier p??]
[rshut p??]
[$useInternalHistoryTable p579]
[$internalHistoryTable p??]

```

— defun readHiFi —

```

(defun |readHiFi| (n)
  "Read the history file using index n"
  (let (pair HiFi vec)

```

```

(declare (special |$useInternalHistoryTable| |$internalHistoryTable|))
(if |$useInternalHistoryTable|
  (progn
    (setq pair (|assoc| n |$internalHistoryTable|))
    (if (atom pair)
      (|keyedSystemError| 's2ih0034 nil) ; missing element
      (setq vec (qcdr pair))))
  (progn
    (setq HiFi
      (rdefiostream
        (cons
          '(mode . input)
          (cons
            (cons 'file (|histFileName|)) nil))))
    (setq vec (spadrread (|object2Identifier| n) HiFi))
    (rshut HiFi)))
vec))

```

Write information of the current step to history file

```

[rdefiostream p??]
[histFileName p580]
[spadrwrite p605]
[object2Identifier p??]
[rshut p??]
[$useInternalHistoryTable p579]
[$internalHistoryTable p??]
[$IOindex p10]
[$HistRecord p??]
[$currentLine p??]

```

— defun writeHiFi —

```

(defun |writeHiFi| ()
  "Writes information of the current step to history file"
  (let (HiFi)
    (declare (special |$useInternalHistoryTable| |$internalHistoryTable|
      |$IOindex| |$HistRecord| |$currentLine|))
    (if |$useInternalHistoryTable|
      (setq |$internalHistoryTable|
        (cons
          (cons |$IOindex|
            (cons |$currentLine| |$HistRecord|))
          |$internalHistoryTable|))
      (progn

```

```

(setq HiFi
  (rdefiostream
    (cons
      '(mode . output)
      (cons (cons 'file (|histFileName|)) nil))))
(spadrwrite (|object2Identifier| |$IOindex|)
  (cons |$currentLine| |$HistRecord|) HiFi)
(rshut HiFi))))

```

Disable history if an error occurred

[histFileErase p617]
 [histFileName p580]
 [\$HiFiAccess p733]

— defun disableHist —

```

(defun |disableHist| ()
  "Disable history if an error occurred"
  (declare (special |$HiFiAccess|))
  (cond
    ((null |$HiFiAccess|)
     (|histFileErase| (|histFileName|)))
    (t nil)))

```

defun writeHistModesAndValues

[get p??]
 [putHist p590]
 [\$InteractiveFrame p??]

— defun writeHistModesAndValues —

```

(defun |writeHistModesAndValues| ()
  (let (a x)
    (declare (special |$InteractiveFrame|))
    (do ((tmp0 (caar |$InteractiveFrame|) (cdr tmp0)) (tmp1 nil))
      ((or (atom tmp0)
           (progn
            (setq tmp1 (car tmp0))
            nil))

```

```

      (progn
        (progn
          (setq a (car tmp1))
          tmp1)
        nil))
    nil)
  (cond
    ((setq x (|get| a '|value| |$InteractiveFrame|))
     (|putHist| a '|value| x |$InteractiveFrame|))
    ((setq x (|get| a '|mode| |$InteractiveFrame|))
     (|putHist| a '|mode| x |$InteractiveFrame|))))))

```

34.5 Lisplib output transformations

Lisplib output transformations

Some types of objects cannot be saved by LISP/VM in lislibs. These functions transform an object to a writable form and back.

defun spadrwrite0

[safeWritify [p606](#)]
[rwrite [p604](#)]

— defun spadrwrite0 —

```

(defun spadrwrite0 (vec item stream)
  (let (val)
    (setq val (|safeWritify| item))
    (if (eq val '|writifyFailed|)
        val
        (progn
          (|rwrite| vec val stream)
          item))))

```

defun Random write to a stream

[rwrite [p604](#)]
[pname [p1045](#)]
[identp [p1046](#)]

— defun rwrite —

```
(defun |rwrite| (key val stream)
  (when (identp key) (setq key (pname key)))
  (rwrite key val stream))
```

—————

defun spadrwrite

[spadrwrite0 p604]
[throwKeyedMsg p??]

— defun spadrwrite —

```
(defun spadrwrite (vec item stream)
  (let (val)
    (setq val (spadrwrite0 vec item stream))
    (if (eq val '|writifyFailed|)
        (|throwKeyedMsg| 's2ih0036 nil) ; cannot save value to file
        item)))
```

—————

defun spadrread

[dewritify p615]
[rread p605]

— defun spadrread —

```
(defun spadrread (vec stream)
  (|dewritify| (|rread| vec stream nil)))
```

—————

defun Random read a key from a stream

RREAD takes erroval to return if key is missing [rread p605]
[identp p1046]
[pname p1045]

— defun rread —

```
(defun |rread| (key rstream errorval)
  (when (identp key) (setq key (pname key)))
  (rread key rstream errorval))
```

defun unwritable?

```
[vecp p??]
[placep p??]
```

— defun unwritable? —

```
(defun |unwritable?| (ob)
  (cond
    ((or (consp ob) (vecp ob)) nil)
    ((or (compiled-function-p ob) (hash-table-p ob)) t)
    ((or (placep ob) (readtablep ob)) t)
    ((floatp ob) t)
    (t nil)))
```

defun writifyComplain

Create a full isomorphic object to be saved in a lisplib. Note that `dewritify(writify(x))` preserves `UEQUALity` of hashtables. `HASHTABLEs` go both ways. `READTABLEs` cannot presently be transformed back. [`sayKeyedMsg` p329] [`$writifyComplained` p??]

— defun writifyComplain —

```
(defun |writifyComplain| (s)
  (declare (special |$writifyComplained|))
  (unless |$writifyComplained|
    (setq |$writifyComplained| t)
    (|sayKeyedMsg| 's2ih0027 (list s)))) ; cannot save value
```

defun safeWritify

```
[writifyTag p??]
[writify p610]
```

— defun safeWritify —

```
(defun |safeWritify| (ob)
  (catch '|writifyTag| (|writify| ob)))
```

—————

defun writify,writifyInner

```
[writifyTag p??]
[seq p??]
[exit p??]
[hget p1044]
[qcar p??]
[qcdr p??]
[spadClosure? p611]
[writify,writifyInner p607]
[hput p1044]
[qrplaca p??]
[qrplacd p??]
[vecp p??]
[isDomainOrPackage p875]
[mkEvalable p913]
[devaluate p??]
[qvmaxindex p??]
[qsetvelt p??]
[qvelt p??]
[constructor? p??]
[hkeys p1044]
[hash-table-class p??]
[placep p??]
[boot-equal p??]
[$seen p??]
[$NonNullStream p611]
[$NullStream p611]
```

— defun writify,writifyInner —

```
(defun |writify,writifyInner| (ob)
  (prog (e name tmp1 tmp2 tmp3 x qcar qcdr d n keys nob)
    (declare (special |$seen| |$NonNullStream| |$NullStream|))
    (return
      (seq
        (when (null ob) (exit nil))
```



```

(when (setq e (hget |$seen| ob)) (exit e))
(when (consp ob)
  (exit
    (seq
      (setq qcar (qcar ob))
      (setq qcdr (qcdr ob))
      (when (setq name (|spadClosure?| ob))
        (exit
          (seq
            (setq d (|writify,writifyInner| (qcdr ob)))
            (setq nob
              (cons 'writified!!
                (cons 'spadclosure
                  (cons d (cons name nil))))))
            (hput |$seen| ob nob)
            (hput |$seen| nob nob)
            (exit nob))))
        (when
          (and
            (and (consp ob)
              (eq (qcar ob) 'lambda-closure)
              (progn
                (setq tmp1 (qcdr ob))
                (and (consp tmp1)
                  (progn
                    (setq tmp2 (qcdr tmp1))
                    (and
                      (consp tmp2)
                      (progn
                        (setq tmp3 (qcdr tmp2))
                        (and (consp tmp3)
                          (progn
                            (setq x (qcar tmp3))
                            t)))))))) x)
              (exit
                (throw '|writifyTag| '|writifyFailed|)))
              (setq nob (cons qcar qcdr))
              (hput |$seen| ob nob)
              (hput |$seen| nob nob)
              (setq qcar (|writify,writifyInner| qcar))
              (setq qcdr (|writify,writifyInner| qcdr))
              (qrplaca nob qcar)
              (qrplacd nob qcdr)
              (exit nob))))
            (when (vecp ob)
              (exit
                (seq
                  (when (|isDomainOrPackage| ob)
                    (setq d (|mkEvalable| (|devaluate| ob)))
                    (setq nob (list 'writified!! 'devaluated (|writify,writifyInner| d)))

```

```

      (hput |$seen| ob nob)
      (hput |$seen| nob nob)
      (exit nob))
    (setq n (qvmaxindex ob))
    (setq nob (make-array (1+ n)))
    (hput |$seen| ob nob)
    (hput |$seen| nob nob)
    (do ((i 0 (≠ i)))
        ((> i n) nil)
      (qsetvelt nob i (|writify,writifyInner| (qvelt ob i))))
    (exit nob)))
(when (eq ob 'writified!!)
  (exit
    (cons 'writified!! (cons 'self nil))))
(when (|constructor?| ob)
  (exit ob))
(when (compiled-function-p ob)
  (exit
    (throw '|writifyTag| '|writifyFailed|)))
(when (hash-table-p ob)
  (setq nob (cons 'writified!! nil))
  (hput |$seen| ob nob)
  (hput |$seen| nob nob)
  (setq keys (hkeys ob))
  (qrplacd nob
    (cons
      'hashtable
      (cons
        (hashtable-class ob)
        (cons
          (|writify,writifyInner| keys)
          (cons
            (prog (tmp0)
              (setq tmp0 nil)
              (return
                (do ((tmp1 keys (cdr tmp1)) (k nil))
                    ((or (atom tmp1)
                        (progn
                          (setq k (car tmp1))
                          nil))
                  (nreverse0 tmp0))
              (setq tmp0
                (cons (|writify,writifyInner| (hget ob k)) tmp0))))
            nil))))))
    (exit nob))
(when (placep ob)
  (setq nob (cons 'writified!! (cons 'place nil)))
  (hput |$seen| ob nob)
  (hput |$seen| nob nob)
  (exit nob))

```

```

(when (readtablep ob)
  (exit
    (throw '|writifyTag| '|writifyFailed|)))
(when (stringp ob)
  (exit
    (seq
      (when (eq ob |$NullStream|)
        (exit
          (cons 'writified!! (cons 'nullstream nil))))
      (when (eq ob |$NonNullStream|)
        (exit
          (cons 'writified!! (cons 'nonnullstream nil))))
      (exit ob))))
(when (floatp ob)
  (exit
    (seq
      (when (boot-equal ob (read-from-string (princ-to-string ob)))
        (exit ob))
      (exit
        (cons 'writified!!
          (cons 'float
            (cons ob
              (multiple-value-list (integer-decode-float ob))))))))
  (exit ob))))

```

defun writify

```

[ScanOrPairVec p616]
[function p??]
[writify,writifyInner p607]
[$seen p??]
[$writifyComplained p??]

```

— defun writify —

```

(defun |writify| (ob)
  (let (|$seen| |$writifyComplained|)
    (declare (special |$seen| |$writifyComplained|))
    (if (null (|ScanOrPairVec| (|function| |unwritable?|) ob))
      ob
      (progn
        (setq |$seen| (make-hash-table :test #'eq))
        (setq |$writifyComplained| nil)
        (|writify,writifyInner| ob))))

```

defun spadClosure?

```
[qcar p??]
[bpname p??]
[qcdr p??]
[vecp p??]
```

— defun spadClosure? —

```
(defun |spadClosure?| (ob)
  (let (fun name vec)
    (setq fun (qcar ob))
    (if (null (setq name (bpname fun)))
        nil
        (progn
          (setq vec (qcdr ob))
          (if (null (vecp vec))
              nil
              name))))))
```

defvar \$NonNullStream

— initvars —

```
(defvar |$NonNullStream| "NonNullStream")
```

defvar \$NullStream

— initvars —

```
(defvar |$NullStream| "NullStream")
```

defun dewritify,dewritifyInner

```

[seq p??]
[exit p??]
[hget p1044]
[intp p??]
[gensymmer p??]
[error p??]
[poundsign p??]
[hput p1044]
[dewritify,dewritifyInner p612]
[concat p1047]
[vmread p??]
[make-instream p981]
[spaddifference p??]
[qcar p??]
[qcdr p??]
[qrplaca p??]
[qrplacd p??]
[vecp p??]
[qvmaxindex p??]
[qsetvelt p??]
[qvelt p??]
[$seen p??]
[$NullStream p611]
[$NonNullStream p611]

```

— defun dewritify,dewritifyInner —

```

(defun |dewritify,dewritifyInner| (ob)
  (prog (e type oname f vec name tmp1 signif expon sign fval qcar qcdr n nob)
    (declare (special |$seen| |$NullStream| |$NonNullStream|))
    (return
      (seq
        (when (null ob)
          (exit nil))
        (when (setq e (hget |$seen| ob))
          (exit e))
        (when (and (consp ob) (eq (car ob) 'writified!))
          (exit
            (seq
              (setq type (elt ob 1))
              (when (eq type 'self)
                (exit 'writified!))
              (when (eq type 'bpi)
                (exit
                  (seq

```

```

(setq oname (elt ob 2))
(setq f
  (seq
    (when (integerp oname) (exit (eval (gensymmer oname))))
    (exit (symbol-function oname))))
(when (null (compiled-function-p f))
  (exit (|error| "A required BPI does not exist.")))
(when (and (> (|#| ob) 3) (not (equal (sxhash f) (elt ob 3))))
  (exit (|error| "A required BPI has been redefined.")))
(hput |$seen| ob f)
(exit f)))
(when (eq type 'hashtable)
  (exit
    (seq
      (setq nob (make-hash-table :test #'equal))
      (hput |$seen| ob nob)
      (hput |$seen| nob nob)
      (do ((tmp0 (elt ob 3) (cdr tmp0))
          (k nil)
          (tmp1 (elt ob 4) (cdr tmp1))
          (e nil))
          ((or (atom tmp0)
              (progn
                (setq k (car tmp0))
                nil)
              (atom tmp1)
              (progn
                (setq e (car tmp1))
                nil)))
          nil)
      (seq
        (exit
          (hput nob (|dewritify,dewritifyInner| k)
            (|dewritify,dewritifyInner| e))))
        (exit nob))))
  (when (eq type 'devaluated)
    (exit
      (seq
        (setq nob (eval (|dewritify,dewritifyInner| (elt ob 2))))
        (hput |$seen| ob nob)
        (hput |$seen| nob nob)
        (exit nob))))
    (when (eq type 'spadclosure)
      (exit
        (seq
          (setq vec (|dewritify,dewritifyInner| (elt ob 2)))
          (setq name (ELT ob 3))
          (when (null (fboundp name))
            (exit
              (|error|

```

```

        (concat "undefined function: " (symbol-name name))))))
      (setq nob (cons (symbol-function name) vec))
      (hput |$seen| ob nob)
      (hput |$seen| nob nob)
      (exit nob))))
    (when (eq type 'place)
      (exit
        (seq
          (setq nob (vmread (make-instream nil)))
          (hput |$seen| ob nob)
          (hput |$seen| nob nob)
          (exit nob))))))
    (when (eq type 'readtable)
      (exit (|error| "Cannot de-writify a read table.")))
    (when (eq type 'nullstream)
      (exit |$NullStream|))
    (when (eq type 'nonnullstream)
      (exit |$NonnullStream|))
    (when (eq type 'float)
      (exit
        (seq
          (progn
            (setq tmp1 (cddr ob))
            (setq fval (car tmp1))
            (setq signif (cadr tmp1))
            (setq expon (caddr tmp1))
            (setq sign (caddrr tmp1))
            tmp1)
          (setq fval (scale-float (float signif fval) expon))
          (when (minusp sign)
            (exit (spaddifference fval)))
          (exit fval))))))
      (exit (|error| "Unknown type to de-writify."))))))
    (when (consp ob)
      (exit
        (seq
          (setq qcar (qcar ob))
          (setq qcdr (qcdr ob))
          (setq nob (cons qcar qcdr))
          (hput |$seen| ob nob)
          (hput |$seen| nob nob)
          (qrplaca nob (|dewritify,dewritifyInner| qcar))
          (qrplacd nob (|dewritify,dewritifyInner| qcdr))
          (exit nob))))))
    (when (vecp ob)
      (exit
        (seq
          (setq n (qvmaxindex ob))
          (setq nob (make-array (1+ n)))
          (hput |$seen| ob nob)

```

```

(hput |$seen| nob nob)
(do ((i 0 (1+ i)))
    (> i n) nil)
(seq
 (exit
  (qsetvelt nob i
   (|dewritify,dewritifyInner| (qveld ob i))))))
(exit nob)))
(exit ob))))

```

defun dewritify

```

[ScanOrPairVec p616]
[function p??]
[dewritify,dewritifyInner p612]
[$seen p??]

```

— defun dewritify —

```

(defun |dewritify| (ob)
  (let (|$seen|)
    (declare (special |$seen|))
    (if (null (|ScanOrPairVec| #'(lambda (a) (eq a 'writified!!)) ob))
        ob
        (progn
         (setq |$seen| (make-hash-table :test #'eq))
         (|dewritify,dewritifyInner| ob))))))

```

defun ScanOrPairVec,ScanOrInner

```

[ScanOrPairVecAnswer p??]
[hget p1044]
[hput p1044]
[ScanOrPairVec,ScanOrInner p615]
[qcar p??]
[qcdr p??]
[vecp p??]
[$seen p??]

```

— defun ScanOrPairVec,ScanOrInner —


```
(defun |ScanOrPairVec,ScanOrInner| (f ob)
  (declare (special |$seen|))
  (when (hget |$seen| ob) nil)
  (when (consp ob)
    (hput |$seen| ob t)
    (|ScanOrPairVec,ScanOrInner| f (qcar ob))
    (|ScanOrPairVec,ScanOrInner| f (qcdr ob)))
  (when (vecp ob)
    (hput |$seen| ob t)
    (do ((tmp0 (spaddifference (|#| ob) 1)) (i 0 (1+ i)))
        ((> i tmp0) nil)
        (|ScanOrPairVec,ScanOrInner| f (elt ob i))))
  (when (funcall f ob) (throw '|ScanOrPairVecAnswer| t))
  nil)
```

defun ScanOrPairVec

```
[ScanOrPairVecAnswer p??]
[ScanOrPairVec,ScanOrInner p615]
[$seen p??]
```

— defun ScanOrPairVec —

```
(defun |ScanOrPairVec| (f ob)
  (let (|$seen|)
    (declare (special |$seen|))
    (setq |$seen| (make-hash-table :test #'eq))
    (catch '|ScanOrPairVecAnswer| (|ScanOrPairVec,ScanOrInner| f ob))))
```

defun gensymInt

```
[gensymp p??]
[error p??]
[pname p1045]
[charDigitVal p617]
```

— defun gensymInt —

```
(defun |gensymInt| (g)
  (let (p n)
    (if (null (gensymp g))
```

```
(|error| "Need a GENSYM")
(progn
  (setq p (pname g))
  (setq n 0)
  (do ((tmp0 (spaddifference (|#| p) 1)) (i 2 (1+ i)))
      ((> i tmp0) nil)
      (setq n (+ (* 10 n) (|charDigitVal| (elt p i)))))
  n)))
```

defun charDigitVal

```
[spaddifference p??]
[error p??]
```

— defun charDigitVal —

```
(defun |charDigitVal| (c)
  (let (digits n)
    (setq digits "0123456789")
    (setq n (spaddifference 1))
    (do ((tmp0 (spaddifference (|#| digits) 1)) (i 0 (1+ i)))
        ((or (> i tmp0) (null (minusp n))) nil)
        (if (char= c (elt digits i))
            (setq n i)
            nil))
    (if (minusp n)
        (|error| "Character is not a digit")
        n)))
```

defun histFileErase

— defun histFileErase —

```
(defun |histFileErase| (file)
  (when (probe-file file) (delete-file file)))
```

34.6 History File Messages

— History File Messages —

S2IH0001

You have not reached step %1b yet, and so its value cannot be supplied.

S2IH0002

Cannot supply value for step %1b because 1 is the first step.

S2IH0003

Step %1b has no value.

S2IH0004

The history facility is not on, so you cannot use %b %% %d .

S2IH0006

You have not used the correct syntax for the %b history %d command.

Issue %b)help history %d for more information.

S2IH0007

The history facility is already on.

S2IH0008

The history facility is now on.

S2IH0009

Turning on the history facility will clear the contents of the workspace.

Please enter %b y %d or %b yes %d if you really want to do this:

S2IH0010

The history facility is still off.

S2IH0011

The history facility is already off.

S2IH0012

The history facility is now off.

S2IH0013

The history facility is not on, so the .input file containing your user input cannot be created.

S2IH0014

Edit %b %1 %d to see the saved input lines.

S2IH0015

The argument %b n %d for %b)history)change n must be a nonnegative integer and your argument, %1b , is not one.

S2IH0016

The history facility is not on, so no information can be saved.

S2IH0018

The saved history file is %1b .

S2IH0019

There is no history file, so value of step %1b is undefined.

S2IH0022

No history information had been saved yet.

S2IH0023

%1b is not a valid filename for the history file.
S2IH0024
History information cannot be restored from %1b because the file does not exist.
S2IH0025
The workspace has been successfully restored from the history file %1b .
S2IH0026
The history facility command %1b cannot be performed because the history facility is not on.
S2IH0027
A value containing a %1b is being saved in a history file or a compiled input file INLIB. This type is not yet usable in other history operations. You might want to issue %b)history)off %d
S2IH0029
History information is already being maintained in an external file (and not in memory).
S2IH0030
History information is already being maintained in memory (and not in an external file).
S2IH0031
When the history facility is active, history information will be maintained in a file (and not in an internal table).
S2IH0032
When the history facility is active, history information will be maintained in memory (and not in an external file).
S2IH0034
Missing element in internal history table.
S2IH0035
Can't save the value of step number %1b. You can re-generate this value by running the input file %2b.
S2IH0036
The value specified cannot be saved to a file.
S2IH0037
You must specify a file name to the history save command
S2IH0038
You must specify a file name to the history write command

Chapter 35

)include help page Command

35.1 include help page man page

— include.help —

User Level Required: interpreter

Command Syntax:

```
)include filename
```

Command Description:

The `)include` command can be used in `.input` files to place the contents of another file inline with the current file. The path can be an absolute or relative pathname.

35.2 Functions

defun ncloopInclude1

[[ncloopIncFileName p622](#)]

[[ncloopInclude p622](#)]

— defun ncloopInclude1 —

```
(defun |ncloopInclude1| (name n)
  (let (a)
    (if (setq a (|ncloopIncFileName| name))
        (|ncloopInclude| a n)
        n)))
```

Returns the first non-blank substring of the given string

[incFileName p622]
 [concat p1047]

— defun ncloopIncFileName —

```
(defun |ncloopIncFileName| (string)
  "Returns the first non-blank substring of the given string"
  (let (fn)
    (unless (setq fn (|incFileName| string))
      (write-line (concat string " not found"))))
  fn))
```

Open the include file and read it in

The ncloopInclude0 function is part of the parser and lives in int-top.boot. [ncloopInclude0 p71]

— defun ncloopInclude —

```
(defun |ncloopInclude| (name n)
  "Open the include file and read it in"
  (with-open-file (st name) (|ncloopInclude0| st name n)))
```

Return the include filename

Given a string we return the first token from the string which is the first non-blank substring. [incBiteOff p623]

— defun incFileName —

```
(defun |incFileName| (x)
  "Return the include filename"
  (car (|incBiteOff| x)))
```

Return the next token

Takes a sequence and returns the a list of the first token and the remaining string characters. If there are no remaining string characters the second string is of length 0. Effectively it "bites off" the first token in the string. If the string only 0 or more blanks it returns nil.

— **defun incBiteOff** —

```
(defun |incBiteOff| (x)
  "Return the next token"
  (let (blank nonblank)
    (setq x (string x))
    (when (setq nonblank (position #\space x :test-not #'char=))
      (setq blank (position #\space x :start nonblank))
      (if blank
        (list (subseq x nonblank blank) (subseq x blank))
        (list (subseq x nonblank) ""))))))
```

Chapter 36

)library help page Command

36.1 library help page man page

— library.help —

```
=====
A.14. )library
=====
```

User Level Required: interpreter

Command Syntax:

-)library libName1 [libName2 ...]
-)library)dir dirName
-)library)only objName1 [objlib2 ...]
-)library)noexpose

Command Description:

This command replaces the)load system command that was available in AXIOM releases before version 2.0. The)library command makes available to AXIOM the compiled objects in the libraries listed.

For example, if you)compile dopler.spad in your home directory, issue)library dopler to have AXIOM look at the library, determine the category and domain constructors present, update the internal database with various properties of the constructors, and arrange for the constructors to be automatically loaded when needed. If the)noexpose option has not been given, the constructors will be exposed (that is, available) in the current frame.

If you compiled a file you will have an NRLIB present, for example,

DOPLER.NRLIB, where DOPLER is a constructor abbreviation. The command `)library DOPLER` will then do the analysis and database updates as above.

To tell the system about all libraries in a directory, use `)library)dir dirName` where `dirName` is an explicit directory. You may specify `'.'` as the directory, which means the current directory from which you started the system or the one you set via the `)cd` command. The directory name is required.

You may only want to tell the system about particular constructors within a library. In this case, use the `)only` option. The command `)library dopler)only Test1` will only cause the `Test1` constructor to be analyzed, autoloaded, etc..

Finally, each constructor in a library are usually automatically exposed when the `)library` command is used. Use the `)noexpose` option if you not want them exposed. At a later time you can use `)set expose add constructor` to expose any hidden constructors.

Note for AXIOM beta testers: At various times this command was called `)local` and `)with` before the name `)library` became the official name.

Also See:

- o `)cd`
- o `)compile`
- o `)frame`
- o `)set`

¹ “cd” (?? p ??) “frame” (32.5 p 565) “set” (45.36 p 808)

Chapter 37

)lisp help page Command

37.1 lisp help page man page

— lisp.help —

```
=====
A.15. )lisp
=====
```

User Level Required: development

Command Syntax:

-)lisp [lispExpression]

Command Description:

This command is used by AXIOM system developers to have single expressions evaluated by the Lisp system on which AXIOM is built. The `lispExpression` is read by the Lisp reader and evaluated. If this expression is not complete (unbalanced parentheses, say), the reader will wait until a complete expression is entered.

Since this command is only useful for evaluating single expressions, the `)fin` command may be used to drop out of AXIOM into Lisp.

Also See:

- o)system
- o)boot
- o)fin

[1](#)

37.2 Functions

This command is in the list of `$noParseCommands` [18.1](#) which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` [18.2](#)

¹ “system” (?? p ??) “boot” ([4.1](#) p 23) “fin” ([31.1](#) p 548)

Chapter 38

)load help page Command

38.1 load help page man page

— load.help —

```
=====
A.16. )load
=====
```

User Level Required: interpreter

Command Description:

This command is obsolete. Use)library instead.

—————

defun The)load command (obsolete)

We keep this command around in case anyone has the original Axiom book. [sayKeyedMsg p329]

— defun load —

```
(defun |load| (ignore)
  (declare (ignore ignore))
  (|sayKeyedMsg| 'S2IU0003 nil))
```

—————

Chapter 39

)ltrace help page Command

39.1 ltrace help page man page

— ltrace.help —

```
=====
A.17. )ltrace
=====
```

User Level Required: development

Command Syntax:

This command has the same arguments as options as the)trace command.

Command Description:

This command is used by AXIOM system developers to trace Lisp or BOOT functions. It is not supported for general use.

Also See:

- o)boot
- o)lisp
- o)trace

1

¹ “boot” ([4.1 p 23](#)) “lisp” (?? p ??) “trace” ([52.1 p 847](#))

defun The top level)ltrace function

[trace p[847](#)]

— defun ltrace —

(defun |ltrace| (arg) (|ltrace| arg))

—————

39.2 Variables Used

39.3 Functions

Chapter 40

)pquit help page Command

40.1 pquit help page man page

— pquit.help —

```
=====
A.18. )pquit
=====
```

User Level Required: interpreter

Command Syntax:

-)pquit

Command Description:

This command is used to terminate AXIOM and return to the operating system. Other than by redoing all your computations or by using the)history)restore command to try to restore your working environment, you cannot return to AXIOM in the same state.

)pquit differs from the)quit in that it always asks for confirmation that you want to terminate AXIOM (the ‘p’ is for ‘protected’). When you enter the)pquit command, AXIOM responds

Please enter y or yes if you really want to leave the interactive
environment and return to the operating system:

If you respond with y or yes, you will see the message

You are now leaving the AXIOM interactive environment.

Issue the command `axiom` to the operating system to start a new session.

and AXIOM will terminate and return you to the operating system (or the environment from which you invoked the system). If you responded with something other than `y` or `yes`, then the message

You have chosen to remain in the AXIOM interactive environment.

will be displayed and, indeed, AXIOM would still be running.

Also See:

- o `)fin`
- o `)history`
- o `)close`
- o `)quit`
- o `)system`

1

40.2 Functions

The top level `pquit` command

[`pquitSpad2Cmd` p634]

— `defun pquit` —

```
(defun |pquit| ()
  "The top level pquit command"
  (|pquitSpad2Cmd|))
```

The top level `pquit` command handler

[`quitSpad2Cmd` p638]

[`$quitCommandType` p800]

— `defun pquitSpad2Cmd` —

```
(defun |pquitSpad2Cmd| ()
```

¹ “`fin`” (31.1 p 548) “`history`” (34.4 p 582) “`close`” (24.2 p 510) “`quit`” (41.2 p 638) “`system`” (?? p ??)

```
"The top level pquit command handler"  
(let ((|quitCommandType| '|protected|))  
  (declare (special |quitCommandType|))  
  (|quitSpad2Cmd|)))
```

This command is in the list of `$noParseCommands` [18.1](#) which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` [18.2](#)

Chapter 41

)quit help page Command

41.1 quit help page man page

— quit.help —

```
=====
A.19. )quit
=====
```

User Level Required: interpreter

Command Syntax:

-)quit
-)set quit protected | unprotected

Command Description:

This command is used to terminate AXIOM and return to the operating system. Other than by redoing all your computations or by using the)history)restore command to try to restore your working environment, you cannot return to AXIOM in the same state.

)quit differs from the)pquit in that it asks for confirmation only if the command

)set quit protected

has been issued. Otherwise,)quit will make AXIOM terminate and return you to the operating system (or the environment from which you invoked the system).

The default setting is)set quit protected so that)quit and)pquit behave in

the same way. If you do issue

```
)set quit unprotected
```

we suggest that you do not (somehow) assign)quit to be executed when you press, say, a function key.

Also See:

- o)fin
- o)history
- o)close
- o)pquit
- o)system

1

41.2 Functions

The top level quit command

[quitSpad2Cmd p638]

— defun quit —

```
(defun |quit| ()
  "The top level quit command"
  (|quitSpad2Cmd|))
```

The top level quit command handler

```
[upcase p??]
[queryUserKeyedMsg p??]
[string2id-n p??]
[leaveScratchpad p639]
[sayKeyedMsg p329]
[tersyscommand p452]
[$quitCommandType p800]
```

— defun quitSpad2Cmd —

¹ “fin” (31.1 p 548) “history” (34.4 p 582) “close” (24.2 p 510) “pquit” (40.2 p 634) “system” (?? p ??)

```
(defun |quitSpad2Cmd| ()
  "The top level quit command handler"
  (declare (special |$quitCommandType|))
  (if (eq |$quitCommandType| '|protected|)
      (let (x)
        (setq x (upcase (|queryUserKeyedMsg| 's2iz0031 nil)))
        (when (member (string2id-n x 1) '(y yes)) (|leaveScratchpad|))
        (|sayKeyedMsg| 's2iz0032 nil)
        (tersyscommand))
      (|leaveScratchpad|)))
```

Leave the Axiom interpreter

— defun leaveScratchpad —

```
(defun |leaveScratchpad| ()
  "Leave the Axiom interpreter"
  (bye))
```

This command is in the list of `$noParseCommands` [18.1](#) which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` [18.2](#)

Chapter 42

)read help page Command

42.1 read help page man page

— read.help —

```
=====
A.20. )read
=====
```

User Level Required: interpreter

Command Syntax:

-)read [fileName]
-)read [fileName] []quiet] []ifthere]

Command Description:

This command is used to read .input files into AXIOM. The command

)read matrix.input

will read the contents of the file matrix.input into AXIOM. The ‘.input’ file extension is optional. See the AXIOM User Guide index for more information about .input files.

This command remembers the previous file you edited, read or compiled. If you do not specify a file name, the previous file will be read.

The)ifthere option checks to see whether the .input file exists. If it does not, the)read command does nothing. If you do not use this option and the file does not exist, you are asked to give the name of an existing .input

file.

The `)quiet` option suppresses output while the file is being read.

Also See:

- o `)compile`
- o `)edit`
- o `)history`

1

defun The `)read` command

[readSpad2Cmd p642]

— defun read —

```
(defun |read| (arg) (|readSpad2Cmd| arg))
```

defun Implement the `)read` command

```
[selectOptionLC p479]
[optionError p449]
[pathname p1042]
[pathnameTypeId p1041]
[makePathname p1042]
[pathnameName p1040]
[mergePathnames p1041]
[findfile p??]
[throwKeyedMsg p??]
[namestring p1040]
[upcase p??]
[member p1048]
[/read p644]
[$InteractiveMode p22]
[$findfile p??]
[$UserLevel p807]
[$options p??]
[/editfile p515]
```

¹ “edit” (30.2 p 544) “history” (34.4 p 582)

— defun readSpad2Cmd —

```
(defun |readSpad2Cmd| (arg)
  (prog (|$InteractiveMode| fullopt ifthere quiet ef devFTs fileTypes
        ll ft upft fs)
    (declare (special |$InteractiveMode| $findfile |$UserLevel| |$Options|
                      /editfile))
    (setq |$InteractiveMode| t)
    (dolist (opt |$Options|)
      (setq fullopt
        (|selectOptionLC| (caar opt) '(|quiet| |test| |ifthere|) '|optionError|))
      (cond
        ((eq fullopt '|ifthere|) (setq ifthere t))
        ((eq fullopt '|quiet|) (setq quiet t))))
    (setq ef (|pathname| /editfile))
    (when (eq (|pathnameTypeId| ef) 'spad)
      (setq ef (|makePathname| (|pathnameName| ef) "*" "*")))
    (if arg
      (setq arg (|mergePathnames| (|pathname| arg) ef))
      (setq arg ef))
    (setq devFTs '("input" "INPUT" "boot" "BOOT" "lisp" "LISP"))
    (setq fileTypes
      (cond
        ((eq |$UserLevel| '|interpreter|) '("input" "INPUT"))
        ((eq |$UserLevel| '|compiler|) '("input" "INPUT"))
        (t devFTs)))
    (setq ll ($findfile arg fileTypes))
    (unless ll
      (if ifthere
        (return nil)
        (|throwKeyedMsg| 'S2IL0003 (list (|namestring| arg)))))
    (setq ll (|pathname| ll))
    (setq ft (|pathnameType| ll))
    (setq upft (upcase ft))
    (cond
      ((null (|member| upft fileTypes))
        (setq fs (|namestring| arg))
        (if (|member| upft devFTs)
          (|throwKeyedMsg| 'S2IZ0033 (list fs))
          (|throwKeyedMsg| 'S2IZ0034 (list fs))))
      (t
        (setq /editfile ll)
        (when (string= upft "BOOT") (setq |$InteractiveMode| nil))
        (/read ll quiet))))
```

—————

defun /read

```
[/read /rf (vol9)]
[/read /rq (vol9)]
[/editfile p515]
```

— defun /read —

```
(defun /read (l q)
  (declare (special /editfile))
  (setq /editfile l)
  (cond
    (q (/rq))
    (t (/rf)) )
  (flag |boot-NewKEY| 'key)
  (|terminateSystemCommand|)
  (|spadPrompt|))
```

Chapter 43

)regress help page Command

43.1 regress help page man page

— regress.help —

```
=====
A.18. )regress
=====
```

User Level Required: interpreter

Command Syntax:

-)regress fileName

Command Description:

The regress command will run the regress function that was compiled as part of the lisp image build process. This function expects an input filename, possibly containing a path prefix.

If the filename contains a period then we consider it a fully formed filename, otherwise we append ‘.output’, which is the default file extension.

```
)regress matrix
)regress matrix.output
)regress /path/to/file/matrix
)regress /path/to/file/matrix.output
```

will test the contents of the file matrix.output.

The idea behind regression testing is to check that the results we currently get match the results we used to get. In order to do that we create input files with a special comment format that contains the prior results. These are easy to create as all you need to do is run the Axiom function, capture the results, and turn them input specially formed comments using the `-- comment`.

A regression file caches the result of an Axiom function so we can automate the testing process. It is a file of many tests, each with their own output.

The regression file format uses the Axiom `-- comment` syntax to keep a copy of the expected output from an Axiom command. This expected output is compared character by character against the actual output.

The regression file is broken into numbered blocks, delimited by a `--S` for the beginning and a `--E` for the end. The total number of blocks is also given so missing or failed tests also raise an error.

There are 4 special kinds of `-- comments` in regression files:

<code>--S n of M</code>	this is test n of M tests in this file
<code>--E n</code>	this marks the end of test n
<code>--R any output</code>	this marks the actual expected output line
<code>--I any output</code>	this line is compared but ignored

A regression test file looks like:

```
)set break resume
)spool foo.output
)set message type off
)clear all

--S 1 of 3
2+3
--R
--R      this is the exact Axiom output
--R (1) 5
--E 1

--S 2 of 3
2+3
--R
--R      this should fail to match
--R (2) 7
--E 2

--S 3 of 3
2+3
--R
--R      this fails to match but we
--I (3) 7      use --I to ignore this line
--E 3
```

We can now run this file with

```
)read foo.input
```

Note that when this file is run it will create a spool file called "foo.output" because of the lines:

```
)spool foo.output
)spool
```

The "foo.output" file contains the console image of the result. It will look like:

```
Starts dribbling to foo.output (2012/2/28, 12:25:7).
)set message type off
)clear all

--S 1 of 3
2+3

      (1)  5
--R
--R      (1)  5
--E 1

--S 2 of 3
2+3

      (2)  5
--R
--R      (2)  7
--E 2

--S 3 of 3
2+3

      (3)  5
--R
--R      (3)  7
--E 3

)spool
```

This "foo.output" file can now be checked using the)regress command.

When we run the)regress foo.output we see;

```
testing foo
passed foo 1 of 3
```



```

MISMATCH
expected:"  (2)  7"
      got:"  (2)  5"
FAILED foo  2 of 2
passed foo  3 of 3
regression result FAILED 1 of 3 stanzas file foo

```

Tests either pass or fail. A passing test generates the message:

```
passed foo  1 of 3
```

A failing test will give a reversed printout of the expected vs actual output as well as a FAILED message, as in:

```

MISMATCH
expected:"  (2)  7"
      got:"  (2)  5"
FAILED foo  2 of 3

```

The last line of output is a summary:

```
regression result FAILED 1 of 3 stanzas file foo
```

— defun regress —

```

(defun |regress| (arg)
  (let (|$InteractiveMode| namestring dot1 outfile (extension "output"))
    (declare (special |$InteractiveMode|))
    (setq |$InteractiveMode| t)
    (setq namestring (symbol-name (car arg)))
    (setq dot1 (position #\. namestring))
    (unless dot1
      (setq outfile (concatenate 'string (subseq namestring 0) "." extension)))
    (if (probe-file outfile)
        (regress outfile)
        (format t (concatenate 'string outfile "% file not found")))))

```

Chapter 44

)savesystem help page Command

44.1 savesystem help page man page

— savesystem.help —

```
=====
A.8. )savesystem
=====
```

User Level Required: interpreter

Command Syntax:

```
- )savesystem filename
```

Command Description:

This command is used to save an AXIOM image to disk. This creates an executable file which, when started, has everything loaded into it that was there when the image was saved. Thus, after executing commands which cause the loading of some packages, the command:

```
)savesystem /tmp/savesys
```

will create an image that can be restarted with the UNIX command:

```
axiom -ws /tmp/savesys
```

This new system will not need to reload the packages and domains that were already loaded when the system was saved.

There is currently a restriction that only systems started with the command "AXIOMsys" may be saved.

defun The `)savesystem` command

[helpSpad2Cmd p572]

[spad-save p989]

— defun `savesystem` —

```
(defun |savesystem| (arg)
  (if (or (not (eql (|#| arg) 1)) (null (symbolp (car arg))))
      (|helpSpad2Cmd| '(|savesystem|))
      (spad-save (symbol-name (car arg)))))
```

Chapter 45

)set help page Command

45.1 set help page man page

— set.help —

```
=====
A.21. )set
=====
```

User Level Required: interpreter

Command Syntax:

-)set
-)set label1 [... labelN]
-)set label1 [... labelN] newValue

Command Description:

The)set command is used to view or set system variables that control what messages are displayed, the type of output desired, the status of the history facility, the way AXIOM user functions are cached, and so on. Since this collection is very large, we will not discuss them here. Rather, we will show how the facility is used. We urge you to explore the)set options to familiarize yourself with how you can modify your AXIOM working environment. There is a HyperDoc version of this same facility available from the main HyperDoc menu. Click [\[here\]](#) to go to it.

The)set command is command-driven with a menu display. It is tree-structured. To see all top-level nodes, issue)set by itself.

)set

Variables with values have them displayed near the right margin. Subtrees of selections have ‘‘...’’ displayed in the value field. For example, there are many kinds of messages, so issue `)set message` to see the choices.

```
)set message
```

The current setting for the variable that displays whether computation times are displayed is visible in the menu displayed by the last command. To see more information, issue

```
)set message time
```

This shows that time printing is on now. To turn it off, issue

```
)set message time off
```

As noted above, not all settings have so many qualifiers. For example, to change the `)quit` command to being unprotected (that is, you will not be prompted for verification), you need only issue

```
)set quit unprotected
```

Also See:

- o `)quit`

1

45.2 Overview

This section contains tree of information used to initialize the `)set` command in the interpreter. The current list is:

Variable	Description	Current Value

<code>compile</code>	Library compiler options	...
<code>breakmode</code>	execute break processing on error	break
<code>expose</code>	control interpreter constructor exposure	...
<code>functions</code>	some interpreter function options	...
<code>fortran</code>	view and set options for FORTRAN output	...
<code>kernel</code>	library functions built into the kernel for efficiency	...
<code>hyperdoc</code>	options in using HyperDoc	...

¹ “quit” (41.2 p 638)

help	view and set some help options	...
history	save workspace values in a history file	on
messages	show messages for various system features	...
naglink	options for NAGLink	...
output	view and set some output options	...
quit	protected or unprotected quit	unprotected
streams	set some options for working with streams	...
system	set some system development variables	...
userlevel	operation access level of system user	development

Variables with current values of ... have further sub-options.
 For example, issue `)set system` to see what the options are
 for system. For more information, issue `)help set .`

45.3 Variables Used

45.4 Functions

Initialize the set variables

The argument `settree` is initially the `$setOption` variable. The fourth element is a union-style switch symbol. The fifth element is usually a variable to set. The sixth element is a subtree to recurse for the `TREE` switch. The seventh element is usually the default value. For more detailed explanations see the list structure section [45.5](#). [[sayMSG p331](#)]

[[literals p??](#)]

[[translateYesNo2TrueFalse p658](#)]

[[tree p??](#)]

[[initializeSetVariables p653](#)]

— `defun initializeSetVariables` —

```
(defun |initializeSetVariables| (settree)
  "Initialize the set variables"
  (dolist (setdata settree)
    (case (fourth setdata)
      (function
        (if (canFuncall? (fifth setdata))
            (funcall (fifth setdata) '|%initialize%|)
            (|sayMSG| (concatenate 'string "    Function not implemented. "
                                   (package-name *package*) ":" (string (fifth setdata))))))
        (integer (set (fifth setdata) (seventh setdata)))
        (string (set (fifth setdata) (seventh setdata)))
        (literals
         (set (fifth setdata) (|translateYesNo2TrueFalse| (seventh setdata))))
        (tree (|initializeSetVariables| (sixth setdata))))))
```

Reset the workspace variables

```
[copy p??]
[initializeSetVariables p653]
[/countlist p??]
[/editfile p515]
[/sourcefiles p??]
[/pretty p??]
[/spacelist p??]
[/timerlist p??]
[$sourceFiles p??]
[$existingFiles p??]
[$functionTable p502]
[$boot p23]
[$compileMapFlag p??]
[$echoLineStack p??]
[$operationNameList p??]
[$slamFlag p??]
[$CommandSynonymAlist p478]
[$InitialCommandSynonymAlist p476]
[$UserAbbreviationsAlist p??]
[$msgAlist p326]
[$msgDatabase p??]
[$msgDatabaseName p7]
[$dependeeClosureAlist p??]
[$IOindex p10]
[$coerceIntByMapCounter p??]
[$e p??]
[$env p??]
[$setOptions p??]
```

— defun resetWorkspaceVariables —

```
(defun |resetWorkspaceVariables| ()
  "Reset the workspace variables"
  (declare (special /countlist /editfile /sourcefiles |$sourceFiles| /pretty
    /spacelist /timerlist |$existingFiles| |$functionTable| $boot
    |$compileMapFlag| |$echoLineStack| |$operationNameList| |$slamFlag| | |
    |$CommandSynonymAlist| |$InitialCommandSynonymAlist|
    |$UserAbbreviationsAlist| |$msgAlist| |$msgDatabase| |$msgDatabaseName|
    |$dependeeClosureAlist| |$IOindex| |$coerceIntByMapCounter| |$e| |$env|
    |$setOptions|))
```

```

(setq /countlist nil)
(setq /editfile nil)
(setq /sourcefiles nil)
(setq |$sourceFiles| nil)
(setq /pretty nil)
(setq /spacelist nil)
(setq /timerlist nil)
(setq |$existingFiles| (make-hash-table :test #'equal))
(setq |$functionTable| nil)
(setq $boot nil)
(setq |$compileMapFlag| nil)
(setq |$echoLineStack| nil)
(setq |$operationNameList| nil)
(setq |$slamFlag| nil)
(setq |$CommandSynonymAlist| (copy |$InitialCommandSynonymAlist|))
(setq |$UserAbbreviationsAlist| nil)
(setq |$msgAlist| nil)
(setq |$msgDatabase| nil)
(setq |$msgDatabaseName| nil)
(setq |$dependeeClosureAlist| nil)
(setq |$I0index| 1)
(setq |$coerceIntByMapCounter| 0)
(setq |$e| (cons (cons nil nil) nil))
(setq |$env| (cons (cons nil nil) nil))
(|initializeSetVariables| |$setOptions|))

```

Display the set option information

```

[displaySetVariableSettings p657]
[centerAndHighlight p??]
[concat p1047]
[object2String p??]
[specialChar p980]
[sayBrightly p??]
[bright p??]
[sayMSG p331]
[boot-equal p??]
[sayMessage p??]
[eval p??]
[literals p??]
[translateTrueFalse2YesNo p659]
[$linelength p774]

```

— defun displaySetOptionInformation —


```

(defun |displaySetOptionInformation| (arg setdata)
  "Display the set option information"
  (let (current)
    (declare (special $linelength))
    (cond
      ((eq (fourth setdata) 'tree)
        (|displaySetVariableSettings| (sixth setdata) (first setdata)))
      (t
        (|centerAndHighlight|
          (concat "The " (|object2String| arg) " Option")
          $linelength (|specialChar| '|hbar|))
        (|sayBrightly|
          '(|%l| ,@( |bright| "Description:") ,(second setdata)))
        (case (fourth setdata)
          (function
            (terpri)
            (if (canFuncall? (fifth setdata))
              (funcall (fifth setdata) '|%describe%|)
              (|sayMSG| " Function not implemented.")))
          (integer
            (|sayMessage|
              '(" The" ,@( |bright| arg) "option"
                " may be followed by an integer in the range"
                ,@( |bright| (elt (sixth setdata) 0)) "to"
                '|%l| ,@( |bright| (elt (sixth setdata) 1)) "inclusive."
                " The current setting is" ,@( |bright| (|eval| (fifth setdata))))))
          (string
            (|sayMessage|
              '(" The" ,@( |bright| arg) "option"
                " is followed by a string enclosed in double quote marks."
                '|%l| " The current setting is"
                ,@( |bright| (list '|'| (|eval| (fifth setdata)) '|'|))))))
          (literals
            (|sayMessage|
              '(" The" ,@( |bright| arg) "option"
                " may be followed by any one of the following:"))
            (setq current
              (|translateTrueFalse2YesNo| (|eval| (fifth setdata))))
            (dolist (name (sixth setdata))
              (if (boot-equal name current)
                (|sayBrightly| '(" ->" ,@( |bright| (|object2String| name))))
                (|sayBrightly| (list " " (|object2String| name))))
              (|sayMessage| " The current setting is indicated."))))))

```

Display the set variable settings

```
[concat p1047]
[object2String p??]
[centerAndHighlight p??]
[sayBrightly p??]
[say p??]
[fillerSpaces p18]
[specialChar p980]
[concat p1047]
[satisfiesUserLevel p451]
[spaddifference p??]
[poundsign p??]
[eval p??]
[bright p??]
[literals p??]
[translateTrueFalse2YesNo p659]
[tree p??]
[$linelength p774]
```

— **defun displaySetVariableSettings** —

```
(defun |displaySetVariableSettings| (settree label)
  "Display the set variable settings"
  (let (setoption opt subtree subname)
    (declare (special $linelength))
    (if (eq label '|')
        (setq label ")set")
        (setq label (concat " " (|object2String| label) " ")))
    (|centerAndHighlight|
     (concat "Current Values of" label " Variables") $linelength '| |)
    (terpri)
    (|sayBrightly|
     (list "Variable" "Description"
           "Current Value" ))
    (say (|fillerSpaces| $linelength (|specialChar| '|hbar|)))
    (setq subtree nil)
    (dolist (setdata settree)
      (when (|satisfiesUserLevel| (third setdata))
        (setq setoption (|object2String| (first setdata)))
        (setq setoption
         (concat setoption
          (|fillerSpaces| (spaddifference 13 (|#| setoption)) " ")
          (second setdata)))
        (setq setoption
         (concat setoption
          (|fillerSpaces| (spaddifference 55 (|#| setoption)) " ")))
        (case (fourth setdata)
```

```

(function
  (setq opt
    (if (canFuncall? (fifth setdata))
      (funcall (fifth setdata) '%display%)
      "unimplemented"))
  (cond
    ((consp opt)
     (setq opt
       (do ((t2 opt (cdr t2)) t1 (o nil))
           ((or (atom t2) (progn (setq o (car t2)) nil)) t1)
         (setq t1 (append t1 (cons o (cons " " nil)))))))
    (|sayBrightly| (|concat| setoption '%b| opt '%d|)))
  (string
   (setq opt (|object2String| (|eval| (fifth setdata))))
   (|sayBrightly| '(',setoption ,@(|bright| opt))))
  (integer
   (setq opt (|object2String| (|eval| (fifth setdata))))
   (|sayBrightly| '(',setoption ,@(|bright| opt))))
  (literals
   (setq opt (|object2String|
              (|translateTrueFalse2YesNo| (|eval| (fifth setdata)))))
   (|sayBrightly| '(',setoption ,@(|bright| opt))))
  (TREE
   (|sayBrightly| '(',setoption ,@(|bright| "..."))
   (setq subtree t)
   (setq subname (|object2String| (first setdata)))))
(terpri)
(when subtree
  (|sayBrightly|
   ("Variables with current values of" ,@(|bright| "...")
    "have further sub-options. For example,")
  (|sayBrightly|
   ("issue" ,@(|bright| ")set ") ,subname
    " to see what the options are for" ,@(|bright| subname) "."
    |%l| "For more information, issue" ,@(|bright| ")help set") "."))))

```

Translate options values to t or nil

[member p1048]

— defun translateYesNo2TrueFalse —

```

(defun |translateYesNo2TrueFalse| (x)
  "Translate options values to t or nil"
  (cond
    ((|member| x '(|yes| |on|)) t)

```

```
((|member| x '(|no| |off|)) nil)
(t x))
```

Translate t or nil to option values

— defun translateTrueFalse2YesNo —

```
(defun |translateTrueFalse2YesNo| (x)
  "Translate t or nil to option values"
  (cond
    ((eq x t) '|on|)
    ((null x) '|off|)
    (t x)))
```

45.5 The list structure

The structure of each list item consists of 7 items. Consider this example:

```
(userlevel
  "operation access level of system user"
  interpreter
  LITERALS
  $UserLevel
  (interpreter compiler development)
  development)
```

The list contains (the names in bold are accessor names that can be found in **property.lisp.pamphlet**[\[1\]](#). Look for "setName".):

- 1** *Name* the keyword the user will see. In this example the user would say ")set output userlevel".
- 2** *Label* the message the user will see. In this example the user would see "operation access level of system user".
- 3** *Level* the level where the command will be accepted. There are three levels: interpreter, compiler, development. These commands are restricted to keep the user from causing damage.

4 Type a symbol, one of **FUNCTION**, **INTEGER**, **STRING**, **LITERALS**, **FILENAME** or **TREE**.

5 *Var*

FUNCTION is the function to call

INTEGER is the variable holding the current user setting.

STRING is the variable holding the current user setting.

LITERALS variable which holds the current user setting.

FILENAME is the variable that holds the current user setting.

TREE

6 *Leaf*

FUNCTION is the list of all possible values

INTEGER is the range of possible values

STRING is a list of all possible values

LITERALS is a list of all of the possible values

FILENAME is the function to check the filename

TREE

7 *Def* is the default value

FUNCTION is the default setting

INTEGER is the default setting

STRING is the default setting

LITERALS is the default setting

FILENAME is the default value

TREE

45.6 breakmode

----- The breakmode Option -----

Description: execute break processing on error

The breakmode option may be followed by any one of the following:

```
nobreak
-> break
query
resume
```

```
fastlinks
quit
```

The current setting is indicated.

defvar \$BreakMode

— initvars —

```
(defvar |$BreakMode| ' |nobreak| "execute break processing on error")
```

—————

— breakmode —

```
(|breakmode|
 "execute break processing on error"
 |interpreter|
 LITERALS
 |$BreakMode|
 (|nobreak| |break| |query| |resume| |fastlinks| |quit|)
 |nobreak|) ; needed to avoid possible startup looping
```

—————

45.7 debug

Current Values of debug Variables

Variable	Description	Current Value

lambdatype	Show type information for #1 syntax	off
dalymode	Interpret leading open paren as lisp	off

— debug —

```
(|debug|
 "debug options"
 |interpreter|
 TREE
 |novar|
```

```
(
\getchunk{debuglambdtype}
\getchunk{debugdalymode}
))
```

45.8 debug lambda type

----- The lambdtype Option -----

Description: Show type information for #1 syntax

defvar \$lambdtype

— initvars —

```
(defvar $lambdtype nil "show type information for #1 syntax")
```

— debuglambdtype —

```
(|lambdtype|
 "show type information for #1 syntax"
 |interpreter|
 LITERALS
 $lambdtype
 (|on| |off|)
 |off|)
```

45.9 debug dalymode

The `$dalymode` variable is used in a case statement in `intloopReadConsole`. This variable can be set to any non-nil value. When not nil the interpreter will send any line that begins with an “(” to be sent to the underlying lisp. This is useful for debugging Axiom. The normal value of this variable is NIL.

This variable was created as an alternative to prefixing every lisp command with `)lisp`. When doing a lot of debugging this is tedious and error prone. This variable was created to shortcut

that process. Clearly it breaks some semantics of the language accepted by the interpreter as parens are used for grouping expressions.

----- The dalymode Option -----

Description: Interpret leading open paren as lisp

defvar \$dalymode

— initvars —

```
(defvar $dalymode nil "Interpret leading open paren as lisp")
```

— debugdalymode —

```
(|dalymode|
  "Interpret leading open paren as lisp"
  |interpreter|
  LITERALS
  $dalymode
  (|on| |off|)
  |off|)
```

45.10 compile

Current Values of compiler Variables

Variable	Description	Current Value
output	library in which to place compiled code	
input	controls libraries from which to load compiled code	

— compile —

```
(|compiler|
  "Library compiler options")
```



```

|interpreter|
TREE
|novar|
(
\getchunk{compileoutput}
\getchunk{compileinput}
))

```

45.11 compile output

----- The output Option -----

Description: library in which to place compiled code

— compileoutput —

```

(|output|
"library in which to place compiled code"
|interpreter|
FUNCTION
|setOutputLibrary|
NIL
|htSetOutputLibrary|
)

```

45.12 Variables Used

45.13 Functions

The set output command handler

```

[poundsign p??]
[describeOutputLibraryArgs p665]
[filep p??]
[openOutputLibrary p666]
[$outputLibraryName p??]

```

— defun setOutputLibrary —

```
(defun |setOutputLibrary| (arg)
  "The set output command handler"
  (let (fn)
    (declare (special |$outputLibraryName|))
    (cond
      ((eq arg '|%initialize%|) (setq |$outputLibraryName| nil))
      ((eq arg '|%display%|) (or |$outputLibraryName| "user.lib"))
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?)) (/= (|#| arg) 1))
      (|describeOutputLibraryArgs|))
    (t
     (when (probe-file (setq fn (princ-to-string (car arg))))
       (setq fn (truename fn)))
     (|openOutputLibrary| (setq |$outputLibraryName| fn))))))
```

Describe the set output library arguments

[sayBrightly p??]

— defun describeOutputLibraryArgs —

```
(defun |describeOutputLibraryArgs| ()
  "Describe the set output library arguments"
  (|sayBrightly| (list
    '|%b| "set compile output library"
    '|%d| "is used to tell the compiler where to place"
    '|%l| "compiled code generated by the library compiler. By default it goes"
    '|%l| "in a file called"
    '|%b| "user.lib"
    '|%d| "in the current directory.")))
```

defvar \$output-library

— initvars —

```
(defvar output-library nil)
```

Open the output library

The input-libraries and output-library are now truename based. [dropInputLibrary p669]

[output-library p665]

[input-libraries p668]

— defun openOutputLibrary —

```
(defun |openOutputLibrary| (lib)
  "Open the output library"
  (declare (special output-library input-libraries))
  (|dropInputLibrary| lib)
  (setq output-library (truename lib))
  (push output-library input-libraries))
```

—————

45.14 compile input

----- The input Option -----

Description: controls libraries from which to load compiled code

)set compile input add library is used to tell AXIOM to add library to the front of the path which determines where compiled code is loaded from.

)set compile input drop library is used to tell AXIOM to remove library from this path.

— compileinput —

```
(|input|
  "controls libraries from which to load compiled code"
  |interpreter|
  FUNCTION
  |setInputLibrary|
  NIL
  |htSetInputLibrary|)
```

—————

45.15 Variables Used

45.16 Functions

The set input library command handler

The input-libraries is now maintained as a list of truenames. [describeInputLibraryArgs p668]

```
[qcar p??]
[qcdr p??]
[selectOptionLC p479]
[addInputLibrary p668]
[dropInputLibrary p669]
[setInputLibrary p667]
[input-libraries p668]
```

— defun setInputLibrary —

```
(defun |setInputLibrary| (arg)
  "The set input library command handler"
  (declare (special input-libraries))
  (let (tmp1 filename act)
    (cond
      ((eq arg '|%initialize%|) t)
      ((eq arg '|%display%|) (mapcar #'namestring input-libraries))
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
       (|describeInputLibraryArgs|))
      ((and (consp arg)
            (progn
              (setq act (qcar arg))
              (setq tmp1 (qcdr arg))
              (and (consp tmp1)
                    (eq (qcdr tmp1) nil)
                    (progn (setq filename (qcar tmp1)) t))))
       (setq act (|selectOptionLC| act '(|add| |drop|) nil)))
      (cond
        ((eq act '|add|)
         (|addInputLibrary| (truename (princ-to-string filename))))
        ((eq act '|drop|)
         (|dropInputLibrary| (truename (princ-to-string filename))))
        (t (|setInputLibrary| nil)))))
```

—————

Describe the set input library arguments

[sayBrightly p??]

— defun describeInputLibraryArgs —

```
(defun |describeInputLibraryArgs| ()
  "Describe the set input library arguments"
  (|sayBrightly| (list
    '|%b| "set compile input add library"
    '|%d| "is used to tell AXIOM to add"
    '|%b| "library"
    '|%d| "to"
    '|%l| "the front of the path used to find compile code."'
    '|%l|
    '|%b| "set compile input drop library"
    '|%d| "is used to tell AXIOM to remove"
    '|%b| "library"
    '|%d|
    '|%l| "from this path.")))
```

—————

Add the input library to the list

The input-libraries variable is now maintained as a list of truenames. [dropInputLibrary p669]

[input-libraries p668]

— defun addInputLibrary —

```
(defun |addInputLibrary| (lib)
  "Add the input library to the list"
  (declare (special input-libraries))
  (|dropInputLibrary| lib)
  (push (true-name lib) input-libraries))
```

—————

defvar \$input-libraries

— initvars —

```
(defvar input-libraries nil)
```

Drop an input library from the list

[input-libraries p668]

— defun dropInputLibrary —

```
(defun |dropInputLibrary| (lib)
  "Drop an input library from the list"
  (declare (special input-libraries))
  (setq input-libraries (delete (truename lib) input-libraries :test #'equal)))
```

45.17 expose

----- The expose Option -----

Description: control interpreter constructor exposure

The following groups are explicitly exposed in the current frame (called initial):

```
        basic
categories
        naglink
        anna
```

The following constructors are explicitly exposed in the current frame:

there are no explicitly exposed constructors

The following constructors are explicitly hidden in the current frame:

there are no explicitly hidden constructors

When)set expose is followed by no arguments, the information you now see is displayed. When followed by the initialize argument, the exposure group data in the file interp.exposed is read and is then available. The arguments add and drop are used to add or drop exposure groups or explicit constructors from the local frame exposure data. Issue

)set expose add or)set expose drop
for more information.

— expose —

```
(|expose|
  "control interpreter constructor exposure"
  |interpreter|
  FUNCTION
  |setExpose|
  NIL
  |htSetExpose|)
```

45.18 Variables Used

NOTE: If you add new algebra you must also update this list otherwise the new algebra won't be loaded by the interpreter when needed.

defvar \$globalExposureGroupAlist

— initvars —

```
(defvar |$globalExposureGroupAlist|
  '(
    ;;define the groups |basic| |naglink| |anna| |categories| |Hidden| |defaults|
    (|basic|
      (|AffineAlgebraicSetComputeWithGroebnerBasis| . AFALGGRO)
      (|AffineAlgebraicSetComputeWithResultant| . AFALGRES)
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(|RepeatedSquaring| . REPSQ)
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  (|AbelianGroup&| . ABELGRP-)
  (|AbelianMonoid&| . ABELMON-)
  (|AbelianMonoidRing&| . AMR-)
  (|AbelianSemiGroup&| . ABELSG-)
  (|Aggregate&| . AGG-)
  (|Algebra&| . ALGEBRA-)
  (|AlgebraicallyClosedField&| . ACF-)
  (|AlgebraicallyClosedFunctionSpace&| . ACFS-)
  (|ArcTrigonometricFunctionCategory&| . ATRIG-)
  (|BagAggregate&| . BGAGG-)
  (|BasicType&| . BASTYPE-)
  (|BinaryRecursiveAggregate&| . BRAGG-)
  (|BinaryTreeCategory&| . BTCAT-)
  (|BitAggregate&| . BTAGG-)
  (|Collection&| . CLAGG-)
  (|ComplexCategory&| . COMPCAT-)
  (|Dictionary&| . DIAGG-)
  (|DictionaryOperations&| . DIOPS-)
  (|DifferentialExtension&| . DIFEXT-)
  (|DifferentialPolynomialCategory&| . DPOLCAT-)
  (|DifferentialRing&| . DIFRING-)
  (|DifferentialVariableCategory&| . DVARCAT-)
  (|DirectProductCategory&| . DIRPCAT-)
  (|DivisionRing&| . DIVRING-)
  (|ElementaryFunctionCategory&| . ELEMFUN-)
  (|EltableAggregate&| . ELTAGG-)
  (|EuclideanDomain&| . EUCDOM-)
  (|Evalable&| . EVALAB-)
  (|ExpressionSpace&| . ES-)

```

```

(|ExtensibleLinearAggregate&| . ELAGG-)
(|ExtensionField&| . XF-)
(|Field&| . FIELD-)
(|FieldOfPrimeCharacteristic&| . FPC-)
(|FiniteAbelianMonoidRing&| . FAMR-)
(|FiniteAlgebraicExtensionField&| . FAXF-)
(|FiniteDivisorCategory&| . FDIVCAT-)
(|FiniteFieldCategory&| . FFIELDC-)
(|FiniteLinearAggregate&| . FLAGG-)
(|FiniteSetAggregate&| . FSAGG-)
(|FiniteRankAlgebra&| . FINRALG-)
(|FiniteRankNonAssociativeAlgebra&| . FINAALG-)
(|FloatingPointSystem&| . FPS-)
(|FramedAlgebra&| . FRAMALG-)
(|FramedNonAssociativeAlgebra&| . FRNAALG-)
(|FullyEvaluableOver&| . FEVALAB-)
(|FullyLinearlyExplicitRingOver&| . FLINEXP-)
(|FullyRetractableTo&| . FRETRACT-)
(|FunctionFieldCategory&| . FFCAT-)
(|FunctionSpace&| . FS-)
(|GcdDomain&| . GCDDOM-)
(|GradedAlgebra&| . GRALG-)
(|GradedModule&| . GRMOD-)
(|Group&| . GROUP-)
(|HomogeneousAggregate&| . HOAGG-)
(|HyperbolicFunctionCategory&| . HYPCAT-)
(|IndexedAggregate&| . IXAGG-)
(|InnerEvaluable&| . IEVALAB-)
(|IntegerNumberSystem&| . INS-)
(|IntegralDomain&| . INTDOM-)
(|KeyedDictionary&| . KDAGG-)
(|LazyStreamAggregate&| . LZSTAGG-)
(|LeftAlgebra&| . LALG-)
(|LieAlgebra&| . LIECAT-)
(|LinearAggregate&| . LNAGG-)
(|ListAggregate&| . LSAGG-)
(|Logic&| . LOGIC-)
(|LinearOrdinaryDifferentialOperatorCategory&| . LODOCAT-)
(|MatrixCategory&| . MATCAT-)
(|Module&| . MODULE-)
(|Monad&| . MONAD-)
(|MonadWithUnit&| . MONADWU-)
(|Monoid&| . MONOID-)
(|MonogenicAlgebra&| . MONOGEN-)
(|NonAssociativeAlgebra&| . NAALG-)
(|NonAssociativeRing&| . NASRING-)
(|NonAssociativeRng&| . NARNG-)
(|OctonionCategory&| . OC-)
(|OneDimensionalArrayAggregate&| . A1AGG-)
(|OrderedRing&| . ORDRING-)

```



```
(|OrderedSet&| . ORDSET-)
(|PartialDifferentialRing&| . PDRING-)
(|PolynomialCategory&| . POLYCAT-)
(|PolynomialFactorizationExplicit&| . PFECAT-)
(|PolynomialSetCategory&| . PSETCAT-)
(|PowerSeriesCategory&| . PSCAT-)
(|QuaternionCategory&| . QUATCAT-)
(|QuotientFieldCategory&| . QFCAT-)
(|RadicalCategory&| . RADCAT-)
(|RealClosedField&| . RCFIELD-)
(|RealNumberSystem&| . RNS-)
(|RealRootCharacterizationCategory&| . RRCC-)
(|RectangularMatrixCategory&| . RMATCAT-)
(|RecursiveAggregate&| . RCAGG-)
(|RecursivePolynomialCategory&| . RPOLCAT-)
(|RegularTriangularSetCategory&| . RSETCAT-)
(|RetractableTo&| . RETRACT-)
(|Ring&| . RING-)
(|SemiGroup&| . SGROUP-)
(|SetAggregate&| . SETAGG-)
(|SetCategory&| . SETCAT-)
(|SquareMatrixCategory&| . SMATCAT-)
(|StreamAggregate&| . STAGG-)
(|StringAggregate&| . SRAGG-)
(|TableAggregate&| . TBAGG-)
(|TranscendentalFunctionCategory&| . TRANFUN-)
(|TriangularSetCategory&| . TSETCAT-)
(|TrigonometricFunctionCategory&| . TRIGCAT-)
(|TwoDimensionalArrayCategory&| . ARR2CAT-)
(|UnaryRecursiveAggregate&| . URAGG-)
(|UniqueFactorizationDomain&| . UFD-)
(|UnivariateLaurentSeriesConstructorCategory&| . ULSCCAT-)
(|UnivariatePolynomialCategory&| . UPOLYC-)
(|UnivariatePowerSeriesCategory&| . UPSCAT-)
(|UnivariatePuisseuxSeriesConstructorCategory&| . UPXSCCA-)
(|UnivariateSkewPolynomialCategory&| . OREPCAT-)
(|UnivariateTaylorSeriesCategory&| . UTSCAT-)
(|VectorCategory&| . VECTCAT-)
(|VectorSpace&| . VSPACE-))
```

defvar \$localExposureDataDefault

— initvars —

```
(defvar |$localExposureDataDefault|
```

```
(vector
  ;;These groups will be exposed
  (list '|basic| '|categories| '|naglink| '|anna|)
  ;;These constructors will be explicitly exposed
  (list )
  ;;These constructors will be explicitly hidden
  (list )))
```

defvar \$localExposureData

— initvars —

```
(defvar |$localExposureData| (copy-seq |$localExposureDataDefault|))
```

45.19 Functions

The top level set expose command handler

```
[displayExposedGroups p705]
[sayMSG p331]
[displayExposedConstructors p705]
[displayHiddenConstructors p705]
[sayKeyedMsg p329]
[namestring p1040]
[pathname p1042]
[qcar p??]
[qcdr p??]
[selectOptionLC p479]
[setExposeAdd p698]
[setExposeDrop p701]
[setExpose p697]
```

— defun setExpose —

```
(defun |setExpose| (arg)
  "The top level set expose command handler"
  (let (fnargs fn)
    (cond
```

```

((eq arg '|%initialize%|))
((eq arg '|%display%|) "...")
((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
  (|displayExposedGroups|)
  (|sayMSG| " ")
  (|displayExposedConstructors|)
  (|sayMSG| " ")
  (|displayHiddenConstructors|)
  (|sayMSG| " "))
((and (consp arg)
      (progn (setq fn (qcar arg)) (setq fnargs (qcdr arg)) t)
      (setq fn (|selectOptionLC| fn '(|add| |drop|) nil))))
(cond
  ((eq fn '|add|) (|setExposeAdd| fnargs))
  ((eq fn '|drop|) (|setExposeDrop| fnargs))
  (t nil)))
(t (|setExpose| nil))))

```

The top level set expose add command handler

```

[centerAndHighlight p??]
[specialChar p980]
[displayExposedGroups p705]
[sayMSG p331]
[displayExposedConstructors p705]
[sayKeyedMsg p329]
[qcar p??]
[qcdr p??]
[selectOptionLC p479]
[setExposeAddGroup p699]
[setExposeAddConstr p700]
[setExposeAdd p698]
[$linelength p774]

```

— defun setExposeAdd —

```

(defun |setExposeAdd| (arg)
  "The top level set expose add command handler"
  (declare (special $linelength))
  (let (fnargs fn)
    (cond
      ((null arg)
        (|centerAndHighlight|
          '|The add Option| $linelength (|specialChar| '|hbar|))

```

```

(|displayExposedGroups|)
(|sayMSG| " ")
(|displayExposedConstructors|)
(|sayMSG| " ")
(|sayKeyedMsg| 's2iz0049e nil))
((and (consp arg)
      (progn (setq fn (qcar arg)) (setq fnargs (qcdr arg)) t)
      (setq fn (|selectOptionLC| fn '(|group| |constructor|) nil))))
(cond
 ((eq fn '|group|) (|setExposeAddGroup| fnargs))
 ((eq fn '|constructor|) (|setExposeAddConstr| fnargs))
 (t nil)))
(t (|setExposeAdd| nil))))

```

Expose a group

Note that `$localExposureData` is a vector of lists. It consists of [exposed groups,exposed constructors,hidden constructors] [object2String p??]

```

[qcar p??]
[setelt p??]
[displayExposedGroups p705]
[sayMSG p331]
[displayExposedConstructors p705]
[displayHiddenConstructors p705]
[clearClams p??]
[getalist p??]
[sayKeyedMsg p329]
[member p1048]
[msort p??]
[centerAndHighlight p??]
[specialChar p980]
[namestring p1040]
[pathname p1042]
[sayAsManyPerLineAsPossible p??]
[$globalExposureGroupAlist p670]
[$localExposureData p697]
[$interpreterFrameName p??]
[$linelength p774]

```

— defun setExposeAddGroup —

```

(defun |setExposeAddGroup| (arg)
  "Expose a group"
  (declare (special |$globalExposureGroupAlist| |$localExposureData|

```

```

(|$interpreterFrameName| $linelength))
(if (null arg)
  (progn
    (|centerAndHighlight|
      '|The group Option| $linelength (|specialChar| '|hbar|))
    (|displayExposedGroups|)
    (|sayMSG| " ")
    (|sayAsManyPerLineAsPossible|
      (mapcar #'(lambda (x) (|object2String| (first x)))
        |$globalExposureGroupAlist|)))
  (dolist (x arg)
    (when (consp x) (setq x (qcar x)))
    (cond
      ((eq x '|all|)
        (setelt |$localExposureData| 0
          (mapcar #'first |$globalExposureGroupAlist|))
        (setelt |$localExposureData| 1 nil)
        (setelt |$localExposureData| 2 nil)
        (|displayExposedGroups|)
        (|sayMSG| " ")
        (|displayExposedConstructors|)
        (|sayMSG| " ")
        (|displayHiddenConstructors|)
        (|clearClams|))
      ((null (getalist |$globalExposureGroupAlist| x))
        (|sayKeyedMsg| 's2iz0049h (cons x nil)))
      ((|member| x (elt |$localExposureData| 0))
        (|sayKeyedMsg| 's2iz0049i (list x |$interpreterFrameName|)))
      (t
        (setelt |$localExposureData| 0
          (msort (cons x (elt |$localExposureData| 0))))
        (|sayKeyedMsg| 's2iz0049r (list x |$interpreterFrameName|))
        (|clearClams|))))))

```

The top level set expose add constructor handler

```

[unabbrev p??]
[qcar p??]
[getdatabase p1010]
[sayKeyedMsg p329]
[member p1048]
[setelt p??]
[delete p??]
[msort p??]
[clearClams p??]

```

```
[centerAndHighlight p??]
[specialChar p980]
[displayExposedConstructors p705]
[$linelength p774]
[$localExposureData p697]
[$interpreterFrameName p??]
```

— defun setExposeAddConstr —

```
(defun |setExposeAddConstr| (arg)
  "The top level set expose add constructor handler"
  (declare (special $linelength $localExposureData $interpreterFrameName))
  (if (null arg)
      (progn
        (|centerAndHighlight|
         '|The constructor Option| $linelength (|specialChar| '|hbar|))
        (|displayExposedConstructors|))
      (dolist (x arg)
        (setq x (|unabbrev| x))
        (when (consp x) (setq x (qcar x)))
        (cond
         ((null (getdatabase x 'constructorkind))
          (|sayKeyedMsg| 's2iz0049j (list x)))
         ((|member| x (elt $localExposureData 1))
          (|sayKeyedMsg| 's2iz0049k (list x $interpreterFrameName) )))
        (t
         (when (|member| x (elt $localExposureData 2))
           (setelt $localExposureData 2
            (|delete| x (elt $localExposureData 2))))
         (setelt $localExposureData 1
          (msort (cons x (elt $localExposureData 1)))))
        (|clearClams|)
        (|sayKeyedMsg| 's2iz0049p (list x $interpreterFrameName) ))))))
```

The top level set expose drop handler

```
[centerAndHighlight p??]
[specialChar p980]
[displayHiddenConstructors p705]
[sayMSG p331]
[sayKeyedMsg p329]
[qcar p??]
[qcdr p??]
[selectOptionLC p479]
```

```
[setExposeDropGroup p702]
[setExposeDropConstr p703]
[setExposeDrop p701]
[$linelength p774]
```

— defun setExposeDrop —

```
(defun |setExposeDrop| (arg)
  "The top level set expose drop handler"
  (declare (special $linelength))
  (let (fnargs fn)
    (cond
      ((null arg)
        (|centerAndHighlight|
          '|The drop Option| $linelength (|specialChar| '|hbar|))
        (|displayHiddenConstructors|)
        (|sayMSG| " ")
        (|sayKeyedMsg| 's2iz0049f nil))
      ((and (consp arg)
        (progn (setq fn (qcar arg)) (setq fnargs (qcdr arg)) t)
        (setq fn (|selectOptionLC| fn '(|group| |constructor|) nil))))
        (cond
          ((eq fn '|group|) (|setExposeDropGroup| fnargs))
          ((eq fn '|constructor|) (|setExposeDropConstr| fnargs))
          (t nil)))
      (t (|setExposeDrop| nil))))))
```

—————

The top level set expose drop group handler

```
[qcar p??]
[setelt p??]
[displayExposedGroups p705]
[sayMSG p331]
[displayExposedConstructors p705]
[displayHiddenConstructors p705]
[clearClams p??]
[member p1048]
[delete p??]
[sayKeyedMsg p329]
[getalist p??]
[centerAndHighlight p??]
[specialChar p980]
[$linelength p774]
[$localExposureData p697]
```

```
[$interpreterFrameName p??]
[$globalExposureGroupAlist p670]
```

— **defun setExposeDropGroup** —

```
(defun |setExposeDropGroup| (arg)
  "The top level set expose drop group handler"
  (declare (special $linelength |$localExposureData| |$interpreterFrameName|
                  |$globalExposureGroupAlist|))
  (if (null arg)
      (progn
        (|centerAndHighlight|
         '|The group Option| $linelength (|specialChar| '|hbar|))
        (|sayKeyedMsg| 's2iz0049l nil)
        (|sayMSG| " ")
        (|displayExposedGroups|))
      (dolist (x arg)
        (when (consp x) (setq x (qcar x)))
        (cond
          ((eq x '|all|)
           (setelt |$localExposureData| 0 nil)
           (setelt |$localExposureData| 1 nil)
           (setelt |$localExposureData| 2 nil)
           (|displayExposedGroups|)
           (|sayMSG| " ")
           (|displayExposedConstructors|)
           (|sayMSG| " ")
           (|displayHiddenConstructors|)
           (|clearClams|))
          ((|member| x (elt |$localExposureData| 0))
           (setelt |$localExposureData| 0
                    (|delete| x (elt |$localExposureData| 0)))
           (|clearClams|)
           (|sayKeyedMsg| 's2iz0049s (list x |$interpreterFrameName| )))
          ((getalist |$globalExposureGroupAlist| x)
           (|sayKeyedMsg| 's2iz0049i (list x |$interpreterFrameName| )))
          (t (|sayKeyedMsg| 's2iz0049h (list x ))))))))
```

—————

The top level set expose drop constructor handler

```
[unabbrev p??]
[qcar p??]
[getdatabase p1010]
[sayKeyedMsg p329]
[member p1048]
```



```

[setelt p??]
[delete p??]
[msort p??]
[clearClams p??]
[centerAndHighlight p??]
[specialChar p980]
[sayMSG p331]
[displayExposedConstructors p705]
[displayHiddenConstructors p705]
[$linelength p774]
[$localExposureData p697]
[$interpreterFrameName p??]

```

— defun setExposeDropConstr —

```

(defun |setExposeDropConstr| (arg)
  "The top level set expose drop constructor handler"
  (declare (special $linelength $localExposureData $interpreterFrameName))
  (if (null arg)
      (progn
        (|centerAndHighlight|
         ' |The constructor Option| $linelength (|specialChar| ' |hbar|))
        (|sayKeyedMsg| 's2iz0049n nil)
        (|sayMSG| " ")
        (|displayExposedConstructors|)
        (|sayMSG| " ")
        (|displayHiddenConstructors|))
      (dolist (x arg)
        (setq x (|unabbrev| x))
        (when (consp x) (setq x (qcar x)))
        (cond
         ((null (getdatabase x 'constructorkind))
          (|sayKeyedMsg| 's2iz0049j (list x)))
         ((|member| x (elt $localExposureData 2))
          (|sayKeyedMsg| 's2iz0049o (list x $interpreterFrameName)))
         (t
          (when (|member| x (elt $localExposureData 1))
            (setelt $localExposureData 1
              (|delete| x (elt $localExposureData 1))))
          (setelt $localExposureData 2
            (msort (cons x (elt $localExposureData 2))))
          (|clearClams|)
          (|sayKeyedMsg| 's2iz0049q (list x $interpreterFrameName)))))))

```

Display exposed groups

```
[sayKeyedMsg p329]
[centerAndHighlight p??]
[$interpreterFrameName p??]
[$localExposureData p697]
```

— defun displayExposedGroups —

```
(defun |displayExposedGroups| ()
  "Display exposed groups"
  (declare (special |$interpreterFrameName| |$localExposureData|))
  (|sayKeyedMsg| 's2iz0049a (list |$interpreterFrameName|))
  (if (null (elt |$localExposureData| 0))
      (|centerAndHighlight| "there are no exposed groups")
      (dolist (c (elt |$localExposureData| 0))
        (|centerAndHighlight| c))))
```

—————

Display exposed constructors

```
[sayKeyedMsg p329]
[centerAndHighlight p??]
[$localExposureData p697]
```

— defun displayExposedConstructors —

```
(defun |displayExposedConstructors| ()
  "Display exposed constructors"
  (declare (special |$localExposureData|))
  (|sayKeyedMsg| 's2iz0049b nil)
  (if (null (elt |$localExposureData| 1))
      (|centerAndHighlight| "there are no explicitly exposed constructors")
      (dolist (c (elt |$localExposureData| 1))
        (|centerAndHighlight| c))))
```

—————

Display hidden constructors

```
[sayKeyedMsg p329]
[centerAndHighlight p??]
[$localExposureData p697]
```

— defun displayHiddenConstructors —

```
(defun |displayHiddenConstructors| ()
  "Display hidden constructors"
  (declare (special |$localExposureData|))
  (|sayKeyedMsg| 's2iz0049c nil)
  (if (null (elt |$localExposureData| 2))
      (|centerAndHighlight| "there are no explicitly hidden constructors")
      (dolist (c (elt |$localExposureData| 2))
        (|centerAndHighlight| c))))
```

45.20 functions

Current Values of functions Variables

Variable	Description	Current Value
cache	number of function results to cache	0
compile	compile, don't just define function bodies	off
recurrence	specially compile recurrence relations	on

— functions —

```
(|functions|
  "some interpreter function options"
  |interpreter|
  TREE
  |novar|
  (
    \getchunk{functions|cache|}
    \getchunk{functions|compile|}
    \getchunk{functions|recurrence|}
  ))
```

45.21 functions cache

----- The cache Option -----

Description: number of function results to cache

)set functions cache is used to tell AXIOM how many values computed by interpreter functions should be saved. This can save quite a bit of time in recursive functions, though one must consider that the cached values will take up (perhaps valuable) room in the workspace.

The value given after cache must either be the word all or a positive integer. This may be followed by any number of function names whose cache sizes you wish to so set. If no functions are given, the default cache size is set.

Examples:)set fun cache all
)set fun cache 10 f g Legendre

In general, functions will cache no returned values.

— functionscache —

```
(|cache|
 "number of function results to cache"
 |interpreter|
 FUNCTION
 |setFunctionsCache|
 NIL
 |htSetCache|)
```

—————

45.22 Variables Used

defvar \$cacheAlist

— initvars —

```
(defvar |$cacheAlist| nil)
```

—————

45.23 Functions

The top level set functions cache handler

```

\calls{setFunctionsCache}{object2String}
\calls{setFunctionsCache}{describeSetFunctionsCache}
\calls{setFunctionsCache}{sayAllCacheCounts}
\calls{setFunctionsCache}{sayMessage}
\calls{setFunctionsCache}{bright}
\calls{setFunctionsCache}{terminateSystemCommand}
\calls{setFunctionsCache}{countCache}
\usesdollar{setFunctionsCache}{options}
\usesdollar{setFunctionsCache}{cacheCount}
\usesdollar{setFunctionsCache}{cacheAlist}
\begin{chunk}{defun setFunctionsCache}
(defun |setFunctionsCache| (arg)
  "The top level set functions cache handler"
  (let (|$options| n)
    (declare (special |$options| |$cacheCount| |$cacheAlist|))
    (cond
      ((eq arg '|%initialize%|)
        (setq |$cacheCount| 0)
        (setq |$cacheAlist| nil))
      ((eq arg '|%display%|)
        (if (null |$cacheAlist|)
          (|object2String| |$cacheCount|)
          "..."))
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
        (|describeSetFunctionsCache|)
        (terpri)
        (|sayAllCacheCounts|))
      (t
        (setq n (car arg))
        (cond
          ((and (not (eq n '|all|)) (or (null (integerp n)) (minusp n)))
            (|sayMessage|
              ("Your value of" ,@(|bright| n) "is invalid because ..."))
            (|describeSetFunctionsCache|)
            (|terminateSystemCommand|))
          (t
            (when (cdr arg) (list (cons '|vars| (cdr arg))))
            (|countCache| n))))))
    )
  )
\end{chunk}

\defunsec{countCache}{Display a particular cache count}
\calls{countCache}{qcdr}
\calls{countCache}{qcar}
\calls{countCache}{identp}

```

```

\calls{countCache}{sayKeyedMsg}
\calls{countCache}{insertAlist}
\calls{countCache}{intern1}
\calls{countCache}{sayCacheCount}
\calls{countCache}{optionError}
\usesdollar{countCache}{options}
\usesdollar{countCache}{cacheAlist}
\usesdollar{countCache}{cacheCount}
\begin{chunk}{defun countCache}
(defun |countCache| (n)
  "Display a particular cache count"
  (let (tmp1 1 cachecountname)
    (declare (special |$options| |$cacheAlist| |$cacheCount|))
    (cond
      (|$options|
        (cond
          ((and (consp |$options|)
            (eq (qcdr |$options|) nil)
            (progn
              (setq tmp1 (qcar |$options|))
              (and (consp tmp1)
                (eq (qcar tmp1) '|vars|)
                (progn (setq 1 (qcdr tmp1)) t))))
            (dolist (x 1)
              (if (null (identp x))
                (|sayKeyedMsg| 's2if0007 (list x))
                (progn
                  (setq |$cacheAlist| (|insertAlist| x n |$cacheAlist|))
                  (setq cachecountname (intern1 x ";COUNT"))
                  (set cachecountname n)
                  (|sayCacheCount| x n))))
              (t (|optionError| (caar |$options|) nil))))
            (t
              (|sayCacheCount| nil (setq |$cacheCount| n)))))))
\end{chunk}

\defun{insertAlist}{insertAlist}
\calls{insertAlist}{rplac}
\calls{insertAlist}{?order}
\begin{chunk}{defun insertAlist}
(defun |insertAlist| (a b z)
  (labels (
    (fn (a b z)
      (cond
        ((null (cdr z)) (rplac (cdr z) (list (cons a b))))
        ((equal a (elt (elt z 1) 0)) (rplac (cdr (elt z 1)) b))
        ((?order (elt (elt z 1) 0) a) (rplac (cdr z) (cons (cons a b) (cdr z))))
        (t (fn a b (cdr z))))))
    (cond

```

```

((null z) (list (cons a b)))
((equal a (elt (elt z 0) 0)) (rplac (cdar z) b) z)
((?order (elt (elt z 0) 0) a) (cons (cons a b) z))
(t (fn a b z) z)))

\end{chunk}

\defunsec{describeSetFunctionsCache}{Describe the set functions cache}
\calls{describeSetFunctionsCache}{sayBrightly}
\begin{chunk}{defun describeSetFunctionsCache}
(defun |describeSetFunctionsCache| ()
  "Describe the set functions cache"
  (|sayBrightly| (list
    '|%b| " )set functions cache"
    '|%d| "is used to tell AXIOM how many"
    '|%l| " values computed by interpreter functions should be saved. This"
    '|%l| " can save quite a bit of time in recursive functions, though one"
    '|%l| " must consider that the cached values will take up (perhaps"
    '|%l| " valuable) room in the workspace."
    '|%l|
    '|%l| " The value given after"
    '|%b| "cache"
    '|%d| "must either be the word"
    '|%b| "all"
    '|%d| "or a positive integer."
    '|%l| " This may be followed by any number of function names whose cache"
    '|%l| " sizes you wish to so set. If no functions are given, the default"
    '|%l| " cache size is set."
    '|%l|
    '|%l| " Examples:"
    '|%l| " )set fun cache all          )set fun cache 10 f g Legendre"))))

\end{chunk}

\defunsec{sayAllCacheCounts}{Display all cache counts}
\calls{sayAllCacheCounts}{sayCacheCount}
\usesdollar{sayAllCacheCounts}{cacheCount}
\usesdollar{sayAllCacheCounts}{cacheAlist}
\begin{chunk}{defun sayAllCacheCounts}
(defun |sayAllCacheCounts| ()
  "Display all cache counts"
  (let (x n)
    (declare (special |$cacheCount| |$cacheAlist|))
    (|sayCacheCount| nil |$cacheCount|)
    (when |$cacheAlist|
      (do ((t0 |$cacheAlist| (cdr t0)) (t1 nil))
          ((or (atom t0)
               (progn (setq t1 (car t0)) nil)
               (progn
                 (progn (setq x (car t1)) (setq n (cdr t1)) t1)

```

```

        nil))
      nil)
    (when (not (equal n |$cacheCount|)) (|sayCacheCount| x n))))))

\end{chunk}

\defunsec{sayCacheCount}{Describe the cache counts}
\calls{sayCacheCount}{bright}
\calls{sayCacheCount}{linearFormatName}
\calls{sayCacheCount}{sayBrightly}
\begin{chunk}{defun sayCacheCount}
(defun |sayCacheCount| (fn n)
  "Describe the cache counts"
  (let (prefix phrase)
    (setq prefix
      (cond
        (fn (cons '|function| (|bright| (|linearFormatName| fn))))
        ((eql n 0) (list '|interpreter functions|))
        (t (list '|In general, interpreter functions|))))
      (cond
        ((eql n 0)
          (cond
            (fn
              (|sayBrightly|
                '(" Caching for " ,prefix "is turned off"))
              (t
                (|sayBrightly| " In general, functions will cache no returned values."
                  )))
            (t
              (setq phrase
                (cond
                  ((eq n '|all|) '(',@(|bright| '|all|) |values.|))
                  ((eql n 1) (list '| only the last value.|))
                  (t '(| the last| ,@(|bright| n) |values.|))))
                (|sayBrightly|
                  '(" " ,@prefix "will cache" ,@phrase))))))
      )
    )
  )
\end{chunk}

\section{functions compile}
\begin{verbatim}
----- The compile Option -----

Description: compile, don't just define function bodies

The compile option may be followed by any one of the following:

-> on
    off

```


The current setting is indicated.

defvar \$compileDontDefineFunctions

— initvars —

```
(defvar |$compileDontDefineFunctions| t
  "compile, don't just define function bodies")
```

—————

— functionscompile —

```
(|compile|
  "compile, don't just define function bodies"
  |interpreter|
  LITERALS
  |$compileDontDefineFunctions|
  (|on| |off|)
  |on|)
```

—————

45.24 functions recurrence

----- The recurrence Option -----

Description: specially compile recurrence relations

The recurrence option may be followed by any one of the following:

```
-> on
    off
```

The current setting is indicated.

defvar \$compileRecurrence

— initvars —

```
(defvar |$compileRecurrence| t "specially compile recurrence relations")
```

— functionsrecurrence —

```
(|recurrence|
 "specially compile recurrence relations"
 |interpreter|
 LITERALS
 |$compileRecurrence|
 (|on| |off|)
 |on|)
```

45.25 fortran

Current Values of fortran Variables

Variable	Description	Current Value
ints2floats	where sensible, coerce integers to reals	on
fortindent	the number of characters indented	6
fortlength	the number of characters on a line	72
typedecs	print type and dimension lines	on
defaulttype	default generic type for FORTRAN object	REAL
precision	precision of generated FORTRAN objects	double
intrinsic	whether to use INTRINSIC FORTRAN functions	off
explength	character limit for FORTRAN expressions	1320
segment	split long FORTRAN expressions	on
optlevel	FORTRAN optimisation level	0
startindex	starting index for FORTRAN arrays	1
calling	options for external FORTRAN calls	...

Variables with current values of ... have further sub-options.
 For example, issue)set calling to see what the options are for calling.
 For more information, issue)help set .

— fortran —

```
(|fortran|
 "view and set options for FORTRAN output"
 |interpreter|
```

```

TREE
|novar|
(
\getchunk{fortranints2floats}
\getchunk{fortranfortindent}
\getchunk{fortranfortlength}
\getchunk{fortrantypedecs}
\getchunk{fortrandefaulttype}
\getchunk{fortranprecision}
\getchunk{fortranintrinsic}
\getchunk{fortranexplength}
\getchunk{fortransegment}
\getchunk{fortranoptlevel}
\getchunk{fortranstartindex}
\getchunk{fortrancalling}
))

```

ints2floats

----- The ints2floats Option -----

Description: where sensible, coerce integers to reals

The ints2floats option may be followed by any one of the following:

```

-> on
    off

```

The current setting is indicated.

defvar \$fortInts2Floats

— initvars —

```
(defvar |$fortInts2Floats| t "where sensible, coerce integers to reals")
```

— fortranints2floats —

```
(|ints2floats|
  "where sensible, coerce integers to reals"
  |interpreter|
  LITERALS
  |$fortInts2Floats|
  (|on| |off|)
  |on|)
```

fortindent

----- The fortindent Option -----

Description: the number of characters indented

The fortindent option may be followed by an integer in the range 0 to inclusive. The current setting is 6

defvar \$fortIndent

— initvars —

```
(defvar |$fortIndent| 6 "the number of characters indented")
```

— fortranfortindent —

```
(|fortindent|
  "the number of characters indented"
  |interpreter|
  INTEGER
  |$fortIndent|
  (0 NIL)
  6)
```

fortlength

----- The fortlength Option -----

Description: the number of characters on a line

The `fortlength` option may be followed by an integer in the range 1 to inclusive. The current setting is 72

defvar \$fortLength

— initvars —

```
(defvar |$fortLength| 72 "the number of characters on a line")
```

—————

— fortranfortlength —

```
(|fortlength|
 "the number of characters on a line"
 |interpreter|
 INTEGER
 |$fortLength|
 (1 NIL)
 72)
```

—————

typedecs

----- The typedecs Option -----

Description: print type and dimension lines

The `typedecs` option may be followed by any one of the following:

```
-> on
    off
```

The current setting is indicated.

defvar \$printFortranDecs

— initvars —

```
(defvar |$printFortranDecs| t "print type and dimension lines")
```

— **fortrantypedecs** —

```
(|typedecs|
 "print type and dimension lines"
 |interpreter|
 LITERALS
 |$printFortranDecs|
 (|on| |off|)
 |on|)
```

defaulttype

----- The defaulttype Option -----

Description: default generic type for FORTRAN object

The defaulttype option may be followed by any one of the following:

```
-> REAL
    INTEGER
    COMPLEX
    LOGICAL
    CHARACTER
```

The current setting is indicated.

defvar \$defaultFortranType

— **initvars** —

```
(defvar |$defaultFortranType| 'real "default generic type for FORTRAN object")
```

— **fortrandefaulttype** —

```
(|defaulttype|
  "default generic type for FORTRAN object"
  |interpreter|
  LITERALS
  |$defaultFortranType|
  (REAL INTEGER COMPLEX LOGICAL CHARACTER)
  REAL)

_____
```

precision

----- The precision Option -----

Description: precision of generated FORTRAN objects

The precision option may be followed by any one of the following:

```
    single
-> double
```

The current setting is indicated.

defvar \$fortranPrecision

— initvars —

```
(defvar |$fortranPrecision| '|double| "precision of generated FORTRAN objects")
```

— fortranprecision —

```
(|precision|
  "precision of generated FORTRAN objects"
  |interpreter|
  LITERALS
  |$fortranPrecision|
  (|single| |double|)
  |double|)

_____
```

intrinsic

----- The intrinsic Option -----

Description: whether to use INTRINSIC FORTRAN functions

The intrinsic option may be followed by any one of the following:

on
-> off

The current setting is indicated.

defvar \$useIntrinsicFunctions

— initvars —

```
(defvar |$useIntrinsicFunctions| nil
  "whether to use INTRINSIC FORTRAN functions")
```

— fortranintrinsic —

```
(|intrinsic|
  "whether to use INTRINSIC FORTRAN functions"
  |interpreter|
  LITERALS
  |$useIntrinsicFunctions|
  (|on| |off|)
  |off|)
```

explength

----- The explength Option -----

Description: character limit for FORTRAN expressions

The explength option may be followed by an integer in the range 0 to inclusive. The current setting is 1320

defvar \$maximumFortranExpressionLength

— initvars —

```
(defvar |$maximumFortranExpressionLength| 1320
  "character limit for FORTRAN expressions")
```

— fortranexplength —

```
(|explength|
  "character limit for FORTRAN expressions"
  |interpreter|
  INTEGER
  |$maximumFortranExpressionLength|
  (0 NIL)
  1320)
```

segment

----- The segment Option -----

Description: split long FORTRAN expressions

The segment option may be followed by any one of the following:

```
-> on
    off
```

The current setting is indicated.

defvar \$fortranSegment

— initvars —

```
(defvar |$fortranSegment| t "split long FORTRAN expressions")
```

— **fortransegment** —

```
(|segment|
 "split long FORTRAN expressions"
 |interpreter|
 LITERALS
 |$fortranSegment|
 (|on| |off|)
 |on|)
```

optlevel

----- The optlevel Option -----

Description: FORTRAN optimisation level

The optlevel option may be followed by an integer in the range 0 to 2 inclusive. The current setting is 0

defvar \$fortranOptimizationLevel

— **initvars** —

```
(defvar |$fortranOptimizationLevel| 0 "FORTRAN optimisation level")
```

— **fortranoptlevel** —

```
(|optlevel|
 "FORTRAN optimisation level"
 |interpreter|
 INTEGER
 |$fortranOptimizationLevel|
 (0 2)
 0)
```

startindex

----- The startindex Option -----

Description: starting index for FORTRAN arrays

The startindex option may be followed by an integer in the range 0 to 1 inclusive. The current setting is 1

defvar \$fortranArrayStartingIndex

— initvars —

```
(defvar |$fortranArrayStartingIndex| 1 "starting index for FORTRAN arrays")
```

— fortranstartindex —

```
(|startindex|
 "starting index for FORTRAN arrays"
 |interpreter|
 INTEGER
 |$fortranArrayStartingIndex|
 (0 1)
 1)
```

calling

Current Values of calling Variables

Variable	Description	Current Value
tempfile	set location of temporary data files	/tmp/
directory	set location of generated FORTRAN files	./
linker	linker arguments (e.g. libraries to search)	-lxlif

— fortrancalling —

```

(|calling|
"options for external FORTRAN calls"
|interpreter|
TREE
|novar|
(
\getchunk{callingtempfile}
\getchunk{callingdirectory}
\getchunk{callinglinker}
)
)

```

tempfile

----- The tempfile Option -----

Description: set location of temporary data files

)set fortran calling tempfile is used to tell AXIOM where to place intermediate FORTRAN data files . This must be the name of a valid existing directory to which you have permission to write (including the final slash).

Syntax:

)set fortran calling tempfile DIRECTORYNAME

The current setting is /tmp/

defvar \$fortranTmpDir

— initvars —

```
(defvar |$fortranTmpDir| "/tmp/" "set location of temporary data files")
```

— callingtempfile —

```

(|tempfile|
"set location of temporary data files"
|interpreter|
FUNCTION

```

```
|setFortTmpDir|
(("enter directory name for which you have write-permission"
  DIRECTORY
  |$fortranTmpDir|
  |chkDirectory|
  "/tmp/"))
NIL)
```

The top level set fortran calling tempfile handler

```
[pname p1045]
[describeSetFortTmpDir p725]
[validateOutputDirectory p724]
[sayBrightly p??]
[bright p??]
[$fortranTmpDir p723]
```

— defun setFortTmpDir —

```
(defun |setFortTmpDir| (arg)
  "The top level set fortran calling tempfile handler"
  (let (mode)
    (declare (special |$fortranTmpDir|))
    (cond
      ((eq arg '|%initialize%|) (setq |$fortranTmpDir| "/tmp/"))
      ((eq arg '|%display%|)
        (if (stringp |$fortranTmpDir|)
          |$fortranTmpDir|
          (pname |$fortranTmpDir|)))
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
        (|describeSetFortTmpDir|))
      ((null (setq mode (|validateOutputDirectory| arg)))
        (|sayBrightly|
          (" Sorry, but your argument(s)" ,@( |bright| arg)
            "is(are) not valid." |%l|))
        (|describeSetFortTmpDir|))
      (t (setq |$fortranTmpDir| mode))))))
```

Validate the output directory

— defun validateOutputDirectory —

```
(defun |validateOutputDirectory| (x)
  "Validate the output directory"
  (let ((dirname (car x)))
    (when (and (pathname-directory dirname) (null (probe-file dirname)))
      dirname)))
```

Describe the set fortran calling tempfile

```
[sayBrightly p??]
[$fortranTmpDir p723]
```

— defun describeSetFortTmpDir —

```
(defun |describeSetFortTmpDir| ()
  "Describe the set fortran calling tempfile"
  (declare (special |$fortranTmpDir|))
  (|sayBrightly| (list
    '|%b| " )set fortran calling tempfile"
    '|%d| " is used to tell AXIOM where"
    '|%l| " to place intermediate FORTRAN data files . This must be the "'
    '|%l| " name of a valid existing directory to which you have permission "'
    '|%l| " to write (including the final slash)."'
    '|%l|
    '|%l| " Syntax:"
    '|%l| " )set fortran calling tempfile DIRECTORYNAME"
    '|%l|
    '|%l| " The current setting is"
    '|%b| |$fortranTmpDir|
    '|%d|)))
```

directory

----- The directory Option -----

Description: set location of generated FORTRAN files

)set fortran calling directory is used to tell AXIOM where to place generated FORTRAN files. This must be the name of a valid existing directory to which you have permission to write (including the final slash).

Syntax:

```
)set fortran calling directory DIRECTORYNAME
```

The current setting is ./

defvar \$fortranDirectory

— initvars —

```
(defvar |$fortranDirectory| "./" "set location of generated FORTRAN files")
```

—————

— callingdirectory —

```
(|directory|
 "set location of generated FORTRAN files"
 |interpreter|
 FUNCTION
 |setFortDir|
 (("enter directory name for which you have write-permission"
  DIRECTORY
   |$fortranDirectory|
   |chkDirectory|
   "./")
  NIL)
```

—————

defun setFortDir

```
[pname p1045]
[describeSetFortDir p727]
[validateOutputDirectory p724]
[sayBrightly p??]
[bright p??]
[$fortranDirectory p726]
```

— defun setFortDir —

```
(defun |setFortDir| (arg)
 (declare (special |$fortranDirectory|))
 (let (mode)
  (COND
   ((eq arg '|%initialize%|) (setq |$fortranDirectory| "./"))
```

```

((eq arg '|%display%|)
 (if (stringp |$fortranDirectory|)
  |$fortranDirectory|
  (pname |$fortranDirectory|)))
(or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
(|describeSetFortDir|))
(null (setq mode (|validateOutputDirectory| arg)))
(|sayBrightly|
 '(" Sorry, but your argument(s)" ,@(|bright| arg)
  "is(are) not valid." |%l|))
(|describeSetFortDir|))
(t (setq |$fortranDirectory| mode))))

```

defun describeSetFortDir

```

[sayBrightly p??]
[$fortranDirectory p726]

```

— defun describeSetFortDir —

```

(defun |describeSetFortDir| ()
 (declare (special |$fortranDirectory|))
 (|sayBrightly| (list
  '|%b| " )set fortran calling directory"
  '|%d| " is used to tell AXIOM where"
  '|%l| " to place generated FORTRAN files. This must be the name "
  '|%l| " of a valid existing directory to which you have permission "
  '|%l| " to write (including the final slash)."
  '|%l|
  '|%l| " Syntax:"
  '|%l| " )set fortran calling directory DIRECTORYNAME"
  '|%l|
  '|%l| " The current setting is"
  '|%b| |$fortranDirectory|
  '|%d|)))

```

linker

----- The linker Option -----

Description: linker arguments (e.g. libraries to search)

)set fortran calling linkerargs is used to pass arguments to the linker when using mkFort to create functions which call Fortran code. For example, it might give a list of libraries to be searched, and their locations. The string is passed verbatim, so must be the correct syntax for the particular linker being used.

Example:)set fortran calling linker "-lxf"

The current setting is -lxf

defvar \$fortranLibraries

— initvars —

```
(defvar |$fortranLibraries| "-lxf"
  "linker arguments (e.g. libraries to search)")
```

—————

— callinglinker —

```
(|linker|
  "linker arguments (e.g. libraries to search)"
  |interpreter|
  FUNCTION
  |setLinkerArgs|
  (("enter linker arguments "
    STRING
    |$fortranLibraries|
    |chkDirectory|
    "-lxf"))
  NIL
  )
```

—————

defun setLinkerArgs

```
[object2String p??]
[describeSetLinkerArgs p729]
[$fortranLibraries p728]
```

— defun setLinkerArgs —

```
(defun |setLinkerArgs| (arg)
  (declare (special |$fortranLibraries|))
  (cond
    ((eq arg '|%initialize%|) (setq |$fortranLibraries| "-lxlif"))
    ((eq arg '|%display%|) (|object2String| |$fortranLibraries|))
    ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
     (|describeSetLinkerArgs|))
    ((and (listp arg) (stringp (car arg)))
     (setq |$fortranLibraries| (car arg)))
    (t (|describeSetLinkerArgs|))))
```

defun describeSetLinkerArgs

[sayBrightly p??]
 [\$fortranLibraries p728]

— defun describeSetLinkerArgs —

```
(defun |describeSetLinkerArgs| ()
  (declare (special |$fortranLibraries|))
  (|sayBrightly| (list
    '|%b| " )set fortran calling linkerargs"
    '|%d| " is used to pass arguments to the linker"
    '|%l| " when using "
    '|%b| "mkFort"
    '|%d| " to create functions which call Fortran code."
    '|%l| " For example, it might give a list of libraries to be searched,"
    '|%l| " and their locations."
    '|%l| " The string is passed verbatim, so must be the correct syntax for"
    '|%l| " the particular linker being used."
    '|%l|
    '|%l| " Example: )set fortran calling linker \"-lxlif\""'
    '|%l|
    '|%l| " The current setting is"
    '|%b| |$fortranLibraries|
    '|%d|)))
```

45.26 hyperdoc

Current Values of hyperdoc Variables

Variable	Description	Current Value

fullscreen	use full screen for this facility	off
mathwidth	screen width for history output	120

— hyperdoc —

```
(|hyperdoc|
  "options in using HyperDoc"
  |interpreter|
  TREE
  |novar|
  (
    \getchunk{hyperdocfullscreen}
    \getchunk{hyperdocmathwidth}
  ))
```

—————

fullscreen

----- The fullscreen Option -----

Description: use full screen for this facility

The fullscreen option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

defvar \$fullScreenSysVars

— initvars —

```
(defvar |$fullScreenSysVars| nil "use full screen for this facility")
```

—————

— hyperdocfullscreen —

```
(|fullscreen|
 "use full screen for this facility"
 |interpreter|
 LITERALS
 |$fullScreenSysVars|
 (|on| |off|)
 |off|)
```

mathwidth

----- The mathwidth Option -----

Description: screen width for history output

The mathwidth option may be followed by an integer in the range 0 to inclusive. The current setting is 120

defvar \$historyDisplayWidth

— initvars —

```
(defvar |$historyDisplayWidth| 120 "screen width for history output")
```

— hyperdocmathwidth —

```
(|mathwidth|
 "screen width for history output"
 |interpreter|
 INTEGER
 |$historyDisplayWidth|
 (0 NIL)
 120)
```

45.27 help

Current Values of help Variables

Variable	Description	Current Value
fullscreen	use fullscreen facility, if possible	on

— help —

```
(|help|
  "view and set some help options"
  |interpreter|
  TREE
  |novar|
  (
    \getchunk{helpfullscreen}
  ))
```

—————

fullscreen

----- The fullscreen Option -----

Description: use fullscreen facility, if possible

The fullscreen option may be followed by any one of the following:

```
-> on
    off
```

The current setting is indicated.

defvar \$useFullScreenHelp

— initvars —

```
(defvar |$useFullScreenHelp| t "use fullscreen facility, if possible")
```

—————

— helpfullscreen —

```
(|fullscreen|
 "use fullscreen facility, if possible"
 |interpreter|
 LITERALS
 |$useFullScreenHelp|
 (|on| |off|)
 |on|)
```

45.28 history

----- The history Option -----

Description: save workspace values in a history file

The history option may be followed by any one of the following:

```
-> on
    off
```

The current setting is indicated.

defvar \$HiFiAccess

— initvars —

```
(defvar |$HiFiAccess| t "save workspace values in a history file")
```

— history —

```
(|history|
 "save workspace values in a history file"
 |interpreter|
 LITERALS
 |$HiFiAccess|
 (|on| |off|)
 |on|)
```

45.29 messages

Current Values of messages Variables

Variable	Description	Current Value
autoload	print file auto-load messages	off
bottomup	display bottom up modemap selection	off
coercion	display datatype coercion messages	off
dropmap	display old map defn when replaced	off
expose	warning for unexposed functions	off
file	print msgs also to SPADMSG LISTING	off
frame	display messages about frames	off
highlighting	use highlighting in system messages	off
instant	present instantiation summary	off
insteach	present instantiation info	off
interonly	say when function code is interpreted	on
number	display message number with message	off
prompt	set type of input prompt to display	step
selection	display function selection msgs	off
set	show)set setting after assignment	off
startup	display messages on start-up	off
summary	print statistics after computation	off
testing	print system testing header	off
time	print timings after computation	off
type	print type after computation	on
void	print Void value when it occurs	off
any	print the internal type of objects of domain Any	on
naglink	show NAGLink messages	on

— messages —

```
(|messages|
  "show messages for various system features"
  |interpreter|
  TREE
  |novar|
  (
    \getchunk{messagesany}
    \getchunk{messagesautoload}
    \getchunk{messagesbottomup}
    \getchunk{messagescoercion}
    \getchunk{messagesdropmap}
    \getchunk{messagesexpose}
    \getchunk{messagesfile}
    \getchunk{messagesframe}
    \getchunk{messageshighlighting}
```

```

\getchunk{messagesinstant}
\getchunk{messagesinsteach}
\getchunk{messagesinterponly}
\getchunk{messagesnaglink}
\getchunk{messagesnumber}
\getchunk{messagesprompt}
\getchunk{messagesselelection}
\getchunk{messagesset}
\getchunk{messagesstartup}
\getchunk{messagessummary}
\getchunk{messagestesting}
\getchunk{messagestime}
\getchunk{messagestype}
\getchunk{messagesvoid}
))

```

any

----- The any Option -----

Description: print the internal type of objects of domain Any

The any option may be followed by any one of the following:

```

-> on
    off

```

The current setting is indicated.

defvar \$printAnyIfTrue

— initvars —

```

(defvar |$printAnyIfTrue| t
  "print the internal type of objects of domain Any")

```

— messagesany —

```

(|any|

```



```

"print the internal type of objects of domain Any"
|interpreter|
LITERALS
|$printAnyIfTrue|
(|on| |off|)
|on|)

```

autoload

----- The autoload Option -----

Description: print file auto-load messages

defvar \$printLoadMsgs

— initvars —

```
(defvar |$printLoadMsgs| nil "print file auto-load messages")
```

— messagesautoload —

```

(|autoload|
"print file auto-load messages"
|interpreter|
LITERALS
|$printLoadMsgs|
(|on| |off|)
|on|)

```

bottomup

----- The bottomup Option -----

Description: display bottom up modemap selection

The bottomup option may be followed by any one of the

following:

```
    on
-> off
```

The current setting is indicated.

defvar \$reportBottomUpFlag

— initvars —

```
(defvar |$reportBottomUpFlag| nil "display bottom up modemap selection")
```

—————

— messagesbottomup —

```
(|bottomup|
 "display bottom up modemap selection"
 |development|
 LITERALS
 |$reportBottomUpFlag|
 (|on| |off|)
 |off|)
```

—————

coercion

----- The coercion Option -----

Description: display datatype coercion messages

The coercion option may be followed by any one of the following:

```
    on
-> off
```

The current setting is indicated.

defvar \$reportCoerceIfTrue

— initvars —

```
(defvar |$reportCoerceIfTrue| nil "display datatype coercion messages")
```

—————

— messagescoercion —

```
(|coercion|
 "display datatype coercion messages"
 |development|
 LITERALS
 |$reportCoerceIfTrue|
 (|on| |off|)
 |off|)
```

—————

dropmap

----- The dropmap Option -----

Description: display old map defn when replaced

The dropmap option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

defvar \$displayDroppedMap

— initvars —

```
(defvar |$displayDroppedMap| nil "display old map defn when replaced")
```

—————

— messagesdropmap —

```
(|dropmap|
  "display old map defn when replaced"
  |interpreter|
  LITERALS
  |$displayDroppedMap|
  (|on| |off|)
  |off|)
```

expose

----- The expose Option -----

Description: warning for unexposed functions

The expose option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

defvar \$giveExposureWarning

— initvars —

```
(defvar |$giveExposureWarning| nil "warning for unexposed functions")
```

— messagesexpose —

```
(|expose|
  "warning for unexposed functions"
  |interpreter|
  LITERALS
  |$giveExposureWarning|
  (|on| |off|))
```

```
|off|)
```

file

----- The file Option -----

Description: print msgs also to SPADMSG LISTING

The file option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

defvar \$printMsgsToFile

— initvars —

```
(defvar |$printMsgsToFile| nil "print msgs also to SPADMSG LISTING")
```

— messagesfile —

```
(|file|
 "print msgs also to SPADMSG LISTING"
 |development|
 LITERALS
 |$printMsgsToFile|
 (|on| |off|)
 |off|)
```

frame

----- The frame Option -----

Description: display messages about frames

The frame option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

defvar \$frameMessages

— initvars —

```
(defvar |$frameMessages| nil "display messages about frames")
```

— messagesframe —

```
(|frame|
 "display messages about frames"
 |interpreter|
 LITERALS
 |$frameMessages|
 (|on| |off|)
 |off|)
```

highlighting

----- The highlighting Option -----

Description: use highlighting in system messages

The highlighting option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

defvar \$highlightAllowed

— initvars —

```
(defvar |$highlightAllowed| nil "use highlighting in system messages")
```

—————

— messageshighlighting —

```
(|highlighting|
 "use highlighting in system messages"
 |interpreter|
 LITERALS
 |$highlightAllowed|
 (|on| |off|)
 |off|)
```

—————

instant

----- The instant Option -----

Description: present instantiation summary

The instant option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

defvar \$reportInstantiations

— initvars —

```
(defvar |$reportInstantiations| nil "present instantiation summary")
```

—————

— messagesinstant —

```
(|instant|
 "present instantiation summary"
 |development|
 LITERALS
 |$reportInstantiations|
 (|on| |off|)
 |off|)
```

insteach

----- The insteach Option -----

Description: present instantiation info

The insteach option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

defvar \$reportEachInstantiation—

— initvars —

```
(defvar |$reportEachInstantiation| nil "present instantiation info")
```

— messagesinsteach —

```
(|insteach|
 "present instantiation info"
 |development|
 LITERALS
 |$reportEachInstantiation|
 (|on| |off|))
```



```
|off|)
```

interponly

----- The interponly Option -----

Description: say when function code is interpreted

The interponly option may be followed by any one of the following:

```
-> on
    off
```

The current setting is indicated.

defvar \$reportInterpOnly

— initvars —

```
(defvar |$reportInterpOnly| t "say when function code is interpreted")
```

— messagesinterponly —

```
(|interponly|
 "say when function code is interpreted"
 |interpreter|
 LITERALS
 |$reportInterpOnly|
 (|on| |off|)
 |on|)
```

naglink

----- The naglink Option -----

Description: show NAGLink messages

The naglink option may be followed by any one of the following:

```
-> on
    off
```

The current setting is indicated.

defvar \$nagMessages

— initvars —

```
(defvar |$nagMessages| t "show NAGLink messages")
```

—————

— messagesnaglink —

```
(|naglink|
 "show NAGLink messages"
 |interpreter|
 LITERALS
 |$nagMessages|
 (|on| |off|)
 |on|)
```

—————

number

----- The number Option -----

Description: display message number with message

The number option may be followed by any one of the following:

```
    on
-> off
```

The current setting is indicated.

defvar \$displayMsgNumber

— initvars —

```
(defvar |$displayMsgNumber| nil "display message number with message")
```

—————

— messagesnumber —

```
(|number|
 "display message number with message"
 |interpreter|
 LITERALS
 |$displayMsgNumber|
 (|on| |off|)
 |off|)
```

—————

prompt

----- The prompt Option -----

Description: set type of input prompt to display

The prompt option may be followed by any one of the following:

```
none
frame
plain
-> step
verbose
```

The current setting is indicated.

defvar \$inputPromptType

— initvars —

```
(defvar |$inputPromptType| '|step| "set type of input prompt to display")
```

— messagesprompt —

```
(|prompt|
 "set type of input prompt to display"
 |interpreter|
 LITERALS
 |$inputPromptType|
 (|none| |frame| |plain| |step| |verbose|)
 |step|)
```

selection

----- The selection Option -----

Description: display function selection msgs

The selection option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

TPDHERE: This is a duplicate of)set mes bot on because both use the \$reportBottomUpFlag flag

— messagesselection —

```
(|selection|
 "display function selection msgs"
 |interpreter|
 LITERALS
 |$reportBottomUpFlag|
 (|on| |off|)
 |off|)
```

set

----- The set Option -----

Description: show)set setting after assignment

The set option may be followed by any one of the following:

on
-> off

The current setting is indicated.

defvar \$displaySetValue

— initvars —

```
(defvar |$displaySetValue| nil "show )set setting after assignment")
```

—————

— messageset —

```
(|set|
 "show )set setting after assignment"
 |interpreter|
 LITERALS
 |$displaySetValue|
 (|on| |off|)
 |off|)
```

—————

startup

----- The startup Option -----

Description: display messages on start-up

The startup option may be followed by any one of the following:

on

-> off

The current setting is indicated.

defvar \$displayStartMsgs

— initvars —

```
(defvar |$displayStartMsgs| t "display messages on start-up")
```

—————

— messagesstartup —

```
(|startup|
 "display messages on start-up"
 |interpreter|
 LITERALS
 |$displayStartMsgs|
 (|on| |off|)
 |on|)
```

—————

summary

----- The summary Option -----

Description: print statistics after computation

The summary option may be followed by any one of the following:

on
-> off

The current setting is indicated.

defvar \$printStatsSummaryIfTrue

— initvars —

```
(defvar |$printStatsSummaryIfTrue| nil
  "print statistics after computation")
```

— **messagessummary** —

```
(|summary|
  "print statistics after computation"
  |interpreter|
  LITERALS
  |$printStatsSummaryIfTrue|
  (|on| |off|)
  |off|)
```

testing

----- The testing Option -----

Description: print system testing header

The testing option may be followed by any one of the following:

```
    on
-> off
```

The current setting is indicated.

defvar \$testingSystem

— **initvars** —

```
(defvar |$testingSystem| nil "print system testing header")
```

— **messagestesting** —

```
(|testing|
 "print system testing header"
 |development|
 LITERALS
 |$testingSystem|
 (|on| |off|)
 |off|)
```

time

----- The time Option -----

Description: print timings after computation

The time option may be followed by any one of the following:

```
on
-> off
long
```

The current setting is indicated.

defvar \$printTimeIfTrue

— initvars —

```
(defvar |$printTimeIfTrue| nil "print timings after computation")
```

— messagestime —

```
(|time|
 "print timings after computation"
 |interpreter|
 LITERALS
 |$printTimeIfTrue|
 (|on| |off| |long|)
 |off|)
```

type

----- The type Option -----

Description: print type after computation

The type option may be followed by any one of the following:

```
-> on
    off
```

The current setting is indicated.

defvar \$printTypeIfTrue

— initvars —

```
(defvar |$printTypeIfTrue| t "print type after computation")
```

—————

— messagestype —

```
(|type|
 "print type after computation"
 |interpreter|
 LITERALS
 |$printTypeIfTrue|
 (|on| |off|)
 |on|)
```

—————

void

----- The void Option -----

Description: print Void value when it occurs

The void option may be followed by any one of the following:

```
    on
-> off
```

The current setting is indicated.

defvar \$printVoidIfTrue

— initvars —

```
(defvar |$printVoidIfTrue| nil "print Void value when it occurs")
```

— messagesvoid —

```
(|void|
 "print Void value when it occurs"
 |interpreter|
 LITERALS
 |$printVoidIfTrue|
 (|on| |off|)
 |off|)
```

45.30 naglink

Current Values of naglink Variables

Variable	Description	Current Value
host	internet address of host for NAGLink	localhost
persistence	number of (fortran) functions to remember	1
messages	show NAGLink messages	on
double	enforce DOUBLE PRECISION ASPs	on

— naglink —

```
(|naglink|
 "options for NAGLink"
 |interpreter|
 TREE)
```

```

|novar|
(
\getchunk{naglinkhost}
\getchunk{naglinkpersistence}
\getchunk{naglinkmessages}
\getchunk{naglinkdouble}
))

```

host

----- The host Option -----

Description: internet address of host for NAGLink

)set naglink host is used to tell AXIOM which host to contact for a NAGLink request. An Internet address should be supplied. The host specified must be running the NAGLink daemon.

The current setting is localhost

defvar \$nagHost

— initvars —

```
(defvar |$nagHost| "localhost" "internet address of host for NAGLink")
```

— naglinkhost —

```

(|host|
 "internet address of host for NAGLink"
|interpreter|
FUNCTION
|setNagHost|
(("enter host name"
 DIRECTORY
 |$nagHost|
|chkDirectory|
 "localhost"))
NIL)

```

defun setNagHost

```
[object2String p??]
[describeSetNagHost p755]
[$nagHost p754]
```

— defun setNagHost —

```
(defun |setNagHost| (arg)
  (declare (special |$nagHost|))
  (cond
    ((eq arg '|%initialize%|) (setq |$nagHost| "localhost"))
    ((eq arg '|%display%|) (|object2String| |$nagHost|))
    ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
     (|describeSetNagHost|))
    (t (setq |$nagHost| (|object2String| arg))))))
```

defun describeSetNagHost

```
[sayBrightly p??]
[$nagHost p754]
```

— defun describeSetNagHost —

```
(defun |describeSetNagHost| ()
  (declare (special |$nagHost|))
  (|sayBrightly| (list
    '|%b| "set naglink host"
    '|%d| "is used to tell AXIOM which host to contact for"
    '|%l| " a NAGLink request. An Internet address should be supplied. The host"
    '|%l| " specified must be running the NAGLink daemon."
    '|%l|
    '|%l| " The current setting is"
    '|%b| |$nagHost|
    '|%d|)))
```

persistence

----- The persistence Option -----

Description: number of (fortran) functions to remember

)set naglink persistence is used to tell the nagd daemon how many ASP source and object files to keep around in case you reuse them. This helps to avoid needless recompilations. The number specified should be a non-negative integer.

The current setting is 1

defvar \$fortPersistence

— initvars —

```
(defvar |$fortPersistence| 1 "number of (fortran) functions to remember")
```

—————

— naglinkpersistence —

```
(|persistence|
 "number of (fortran) functions to remember"
 |interpreter|
 FUNCTION
 |setFortPers|
 ("Requested remote storage (for asps):"
 INTEGER
 |$fortPersistence|
 (0 NIL)
 10))
 NIL)
```

—————

defun setFortPers

```
[describeFortPersistence p757]
[sayMessage p??]
[bright p??]
[terminateSystemCommand p452]
[$fortPersistence p756]
```

— defun setFortPers —

```
(defun |setFortPers| (arg)
  (let (n)
    (declare (special |$fortPersistence|))
    (cond
      ((eq arg '|%initialize%|) (setq |$fortPersistence| 1))
      ((eq arg '|%display%|) |$fortPersistence|)
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
       (|describeFortPersistence|))
      (t
       (setq n (car arg))
       (cond
         ((or (null (integerp n)) (minusp n))
          (|sayMessage|
           '("Your value of" ,@(|bright| n) "is invalid because ..."))
          (|describeFortPersistence|)
          (|terminateSystemCommand|))
         (t (setq |$fortPersistence| (car arg))))))))
```

defun describeFortPersistence

```
[sayBrightly p??]
[$fortPersistence p756]
```

— defun describeFortPersistence —

```
(defun |describeFortPersistence| ()
  (declare (special |$fortPersistence|))
  (|sayBrightly| (list
    '|%b| "set naglink persistence"
    '|%d| "is used to tell the "
    '|%b| '|nagd|
    '|%d| '| daemon how many ASP|
    '|%l|
    " source and object files to keep around in case you reuse them. This helps"
    '|%l| " to avoid needless recompilations. The number specified should be a "
    '|%l| " non-negative integer."
    '|%l|
    '|%l| " The current setting is"
    '|%b| |$fortPersistence|
    '|%d|)))
```

messages

----- The messages Option -----

Description: show NAGLink messages

The messages option may be followed by any one of the following:

-> on
 off

The current setting is indicated.

TPDHERE: this is the same as)set nag mes on

— **naglinkmessages** —

```
(|messages|
 "show NAGLink messages"
 |interpreter|
 LITERALS
 |$nagMessages|
 (|on| |off|)
 |on|)
```

double

----- The double Option -----

Description: enforce DOUBLE PRECISION ASPs

The double option may be followed by any one of the following:

-> on
 off

The current setting is indicated.

defvar \$nagEnforceDouble

— **initvars** —

```
(defvar |$nagEnforceDouble| t "enforce DOUBLE PRECISION ASPs")
```

— naglinkdouble —

```
(|double|
 "enforce DOUBLE PRECISION ASPs"
 |interpreter|
 LITERALS
 |$nagEnforceDouble|
 (|on| |off|)
 |on|)
```

45.31 output

The result of the `)set output` command is:

Variable	Description	Current Value
abbreviate	abbreviate type names	off
algebra	display output in algebraic form	On:CONSOLE
characters	choose special output character set	plain
fortran	create output in FORTRAN format	Off:CONSOLE
fraction	how fractions are formatted	vertical
html	create output in HTML style	Off:CONSOLE
length	line length of output displays	77
mathml	create output in MathML style	Off:CONSOLE
openmath	create output in OpenMath style	Off:CONSOLE
script	display output in SCRIPT formula format	Off:CONSOLE
scripts	show subscripts,... linearly	off
showeditor	view output of <code>)show</code> in editor	off
tex	create output in TeX style	Off:CONSOLE

Since the output option has a bunch of sub-options each suboption is defined within the output structure.

— output —

```
(|output|
 "view and set some output options"
 |interpreter|
 TREE
 |novar|
```



```
(
\getchunk{outputabbreviate}
\getchunk{outputalgebra}
\getchunk{outputcharacters}
\getchunk{outputfortran}
\getchunk{outputfraction}
\getchunk{outputhtml}
\getchunk{outputlength}
\getchunk{outputmathml}
\getchunk{outputopenmath}
\getchunk{outputscript}
\getchunk{outputscripts}
\getchunk{outputshoweditor}
\getchunk{outputtex}
))
```

abbreviate

----- The abbreviate Option -----

Description: abbreviate type names

The abbreviate option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

defvar \$abbreviateTypes

— initvars —

```
(defvar |$abbreviateTypes| nil "abbreviate type names")
```

— outputabbreviate —

```
(|abbreviate|
"abbreviate type names"
```

```
|interpreter|
LITERALS
|$abbreviateTypes|
(|on| |off|)
|off|)
```

algebra

----- The algebra Option -----

Description: display output in algebraic form

)set output algebra is used to tell AXIOM to turn algebra-style output printing on and off, and where to place the output. By default, the destination for the output is the screen but printing is turned off.

Syntax:)set output algebra <arg>
 where arg can be one of
 on turn algebra printing on (default state)
 off turn algebra printing off
 console send algebra output to screen (default state)
 fp<.fe> send algebra output to file with file prefix fp
 and file extension .fe. If not given,
 .fe defaults to .spout.

If you wish to send the output to a file, you may need to issue this command twice: once with on and once with the file name. For example, to send algebra output to the file polymer.spout, issue the two commands

```
)set output algebra on
)set output algebra polymer
```

The output is placed in the directory from which you invoked AXIOM or the one you set with the)cd system command.
 The current setting is: On:CONSOLE

defvar \$algebraFormat

— initvars —

```
(defvar |$algebraFormat| t "display output in algebraic form")
```

defvar \$algebraOutputFile

— initvars —

```
(defvar |$algebraOutputFile| "CONSOLE"
  "where algebra printing goes (enter {\em console} or a pathname)?")
```

— outputalgebra —

```
(|algebra|
  "display output in algebraic form"
  |interpreter|
  FUNCTION
  |setOutputAlgebra|
  ("display output in algebraic form"
   LITERALS
   |$algebraFormat|
   (|off| |on|)
   |on|)
  (break $algebraFormat)
  ("where algebra printing goes (enter {\em console} or a pathname)?"
   FILENAME
   |$algebraOutputFile|
   |chkOutputFileName|
   "console"))
NIL)
```

defvar \$algebraOutputStream

— initvars —

```
(defvar |$algebraOutputStream| *standard-output*)
```

defun setOutputAlgebra

```

[defiostream p982]
[concat p1047]
[describeSetOutputAlgebra p765]
[qcdr p??]
[qcar p??]
[member p1048]
[upcase p??]
[sayKeyedMsg p329]
[shut p982]
[pathnameType p1040]
[pathnameDirectory p1041]
[pathnameName p1040]
[$filep p??]
[make-outstream p981]
[object2String p??]
[$algebraOutputStream p762]
[$algebraOutputFile p762]
[$filep p??]
[$algebraFormat p761]

```

— **defun setOutputAlgebra** —

```

(defun |setOutputAlgebra| (arg)
  (let (label tmp1 tmp2 ptype fn ft fm filename teststream)
    (declare (special |$algebraOutputStream| |$algebraOutputFile| $filep
      |$algebraFormat|))
    (cond
      ((eq arg '|%initialize%|)
        (setq |$algebraOutputStream|
          (defiostream '((mode . output) (device . console)) 255 0))
        (setq |$algebraOutputFile| "CONSOLE")
        (setq |$algebraFormat| t))
      ((eq arg '|%display%|)
        (if |$algebraFormat|
          (setq label "On:")
          (setq label "Off:"))
        (concat label |$algebraOutputFile|))
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
        (|describeSetOutputAlgebra|))
      (t
        (cond
          ((and (consp arg)
            (eq (qcdr arg) nil)
            (progn (setq fn (qcar arg)) t)
            (|member| fn '(y n ye yes no o on of off console
              |y| |n| |ye| |yes| |no| |o| |on| |of| |off| |console|))))

```

```

      '|ok|)
    (t (setq arg (list fn '|spout|))))
  (cond
    ((and (consp arg)
          (eq (qcdr arg) nil)
          (progn (setq fn (qcar arg)) t)))
    (cond
      ((|member| (upcase fn) '(y n ye o of))
       (|sayKeyedMsg| 's2iv0002 '(|algebra| |algebra|)))
      ((|member| (upcase fn) '(no off)) (setq |$algebraFormat| nil))
      ((|member| (upcase fn) '(yes on)) (setq |$algebraFormat| t))
      ((eq (upcase fn) 'console)
       (shut |$algebraOutputStream|)
       (setq |$algebraOutputStream|
             (defiostream '((mode . output) (device . console)) 255 0))
       (setq |$algebraOutputFile| "CONSOLE"))))
    ((or
      (and (consp arg)
          (progn
            (setq fn (qcar arg))
            (setq tmp1 (qcdr arg))
            (and (consp tmp1)
                 (eq (qcdr tmp1) nil)
                 (progn (setq ft (qcar tmp1)) t))))
      (and (consp arg)
          (progn (setq fn (qcar arg))
                 (setq tmp1 (qcdr arg))
                 (and (consp tmp1)
                     (progn (setq ft (qcar tmp1))
                           (setq tmp2 (qcdr tmp1))
                           (and (consp tmp2)
                               (eq (qcdr tmp2) nil)
                               (progn
                                (setq fm (qcar tmp2))
                                t))))))))
      (when (setq ptype (|pathnameType| fn))
        (setq fn (concat (|pathnameDirectory| fn) (|pathnameName| fn)))
        (setq ft ptype))
      (unless fm (setq fm 'a))
      (setq filename ($filep fn ft fm))
      (cond
        ((null filename)
         (|sayKeyedMsg| 's2iv0003 (list fn ft fm)))
        ((setq teststream (make-outstream filename 255 0))
         (shut |$algebraOutputStream|)
         (setq |$algebraOutputStream| teststream)
         (setq |$algebraOutputFile| (|object2String| filename))
         (|sayKeyedMsg| 's2iv0004 (list "Algebra" |$algebraOutputFile|)))
        (t (|sayKeyedMsg| 's2iv0003 (list fn ft fm))))))
    (t

```

```
(|sayKeyedMsg| 's2iv0005 nil)
(|describeSetOutputAlgebra|))))))
```

defun describeSetOutputAlgebra

```
[sayBrightly p??]
[setOutputAlgebra p763]
```

— defun describeSetOutputAlgebra —

```
(defun |describeSetOutputAlgebra| ()
  (|sayBrightly| (list
    '|%b| ")set output algebra"
    '|%d| "is used to tell AXIOM to turn algebra-style output"
    '|%l| "printing on and off, and where to place the output. By default, the"
    '|%l| "destination for the output is the screen but printing is turned off."
    '|%l|
    '|%l| "Syntax:   )set output algebra <arg>"
    '|%l| "   where arg can be one of"
    '|%l| "   on           turn algebra printing on (default state)"
    '|%l| "   off          turn algebra printing off"
    '|%l| "   console       send algebra output to screen (default state)"
    '|%l| "   fp<.fe>       send algebra output to file with file prefix fp"
    '|%l|
    "               and file extension .fe. If not given, .fe defaults to .spout."
    '|%l|
    '|%l|
    "If you wish to send the output to a file, you may need to issue this command"
    '|%l| "twice: once with"
    '|%b| "on"
    '|%d| "and once with the file name. For example, to send"
    '|%l| "algebra output to the file"
    '|%b| "polymer.spout,"
    '|%d| "issue the two commands"
    '|%l|
    '|%l| "   )set output algebra on"
    '|%l| "   )set output algebra polymer"
    '|%l|
    '|%l| "The output is placed in the directory from which you invoked AXIOM or"
    '|%l| "the one you set with the )cd system command."
    '|%l| "The current setting is: "
    '|%b| (|setOutputAlgebra| '|%display%|)
    '|%d|)))
```

characters

----- The characters Option -----

Description: choose special output character set

The characters option may be followed by any one of the following:

default
-> plain

The current setting is indicated. This option determines the special characters used for algebraic output. This is what the current choice of special characters looks like:

ulc is shown as +	urc is shown as +
llc is shown as +	lrc is shown as +
vbar is shown as	hbar is shown as -
quad is shown as ?	lbrk is shown as [
rbrk is shown as]	lbrc is shown as {
rbrc is shown as }	ttee is shown as +
btee is shown as +	rtee is shown as +
ltee is shown as +	ctee is shown as +
bslash is shown as \	

— outputcharacters —

```
(|characters|
 "choose special output character set"
 |interpreter|
 FUNCTION
 |setOutputCharacters|
 NIL
 |htSetOutputCharacters|)
```

defun setOutputCharacters

```
[sayMessage p??]
[bright p??]
[sayBrightly p??]
[concat p1047]
[pname p1045]
```

```

[specialChar p980]
[sayAsManyPerLineAsPossible p??]
[qcdr p??]
[qcar p??]
[downcase p??]
[setOutputCharacters p766]
[$specialCharacters p979]
[$plainRTspecialCharacters p978]
[$RTspecialCharacters p978]
[$specialCharacterAlist p979]

```

— defun setOutputCharacters —

```

(defun |setOutputCharacters| (arg)
  (let (current char s l fn)
    (declare (special |$specialCharacters| |$plainRTspecialCharacters|
      |$RTspecialCharacters| |$specialCharacterAlist|))
    (if (eq arg '|%initialize%|)
      (setq |$specialCharacters| |$plainRTspecialCharacters|)
      (progn
        (setq current
          (cond
            ((eq |$specialCharacters| |$RTspecialCharacters|) "default")
            ((eq |$specialCharacters| |$plainRTspecialCharacters|) "plain")
            (t "unknown")))
          (cond
            ((eq arg '|%display%|) current)
            ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
              (|sayMessage|
                '(" The" ,@( |bright| "characters")
                  "option may be followed by any one of the following:"))
              (dolist (name '("default" "plain"))
                (if (string= (string current) name)
                  (|sayBrightly| '(" ->" ,@( |bright| name)))
                  (|sayBrightly| (list " " name))))
              (terpri)
              (|sayBrightly|
                " The current setting is indicated within the list. This option determines ")
              (|sayBrightly|
                " the special characters used for algebraic output. This is what the")
              (|sayBrightly|
                " current choice of special characters looks like:")
              (do ((t1 |$specialCharacterAlist| (CDR t1)) (t2 nil))
                ((or (atom t1)
                     (progn (setq t2 (car t1)) nil)
                     (progn (progn (setq char (car t2)) t2) nil)) nil)
                (setq s
                  (concat " " (pname char) " is shown as "
                    (pname (|specialChar| char))))

```



```

      (setq l (cons s l)))
    (|sayAsManyPerLineAsPossible| (reverse l)))
  ((and (consp arg)
        (eq (qcdr arg) NIL)
        (progn (setq fn (qcar arg)) t)
        (setq fn (downcase fn))))
  (cond
   ((eq fn '|default|)
    (setq |$specialCharacters| |$RTspecialCharacters|))
   ((eq fn '|plain|)
    (setq |$specialCharacters| |$plainRTspecialCharacters|))
   (t (|setOutputCharacters| nil))))
  (t (|setOutputCharacters| nil))))))

```

fortran

----- The fortran Option -----

Description: create output in FORTRAN format

)set output fortran is used to tell AXIOM to turn FORTRAN-style output printing on and off, and where to place the output. By default, the destination for the output is the screen but printing is turned off.

Also See:)set fortran

Syntax:)set output fortran <arg>

where arg can be one of

on	turn FORTRAN printing on
off	turn FORTRAN printing off (default state)
console	send FORTRAN output to screen (default state)
fp<.fe>	send FORTRAN output to file with file prefix fp and file extension .fe. If not given, .fe defaults to .sfort.

If you wish to send the output to a file, you must issue this command twice: once with on and once with the file name. For example, to send FORTRAN output to the file polymer.sfort, issue the two commands

```

)set output fortran on
)set output fortran polymer

```

The output is placed in the directory from which you invoked AXIOM or the one you set with the)cd system command.

The current setting is: Off:CONSOLE

defvar \$fortranFormat

— initvars —

```
(defvar |$fortranFormat| nil "create output in FORTRAN format")
```

—————

defvar \$fortranOutputFile

— initvars —

```
(defvar |$fortranOutputFile| "CONSOLE"
  "where FORTRAN output goes (enter {\em console} or a a pathname)")
```

—————

— outputfortran —

```
(|fortran|
  "create output in FORTRAN format"
  |interpreter|
  FUNCTION
  |setOutputFortran|
  ("create output in FORTRAN format"
   LITERALS
   |$fortranFormat|
   (|off| |on|)
   |off|)
  (|break| |$fortranFormat|)
  ("where FORTRAN output goes (enter {\em console} or a a pathname)"
   FILENAME
   |$fortranOutputFile|
   |chkOutputFileName|
   "console"))
NIL)
```

—————

defun setOutputFortran

```

[defiostream p982]
[concat p1047]
[describeSetOutputFortran p772]
[upcase p??]
[qcdr p??]
[qcar p??]
[member p1048]
[sayKeyedMsg p329]
[shut p982]
[pathnameType p1040]
[pathnameDirectory p1041]
[pathnameName p1040]
[$filep p??]
[makeStream p983]
[object2String p??]
[$fortranOutputStream p??]
[$fortranOutputFile p769]
[$filep p??]
[$fortranFormat p769]

```

— **defun setOutputFortran** —

```

(defun |setOutputFortran| (arg)
  (let (label APPEND quiet tmp1 tmp2 ptype fn ft fm filename teststream)
    (declare (special |$fortranOutputStream| |$fortranOutputFile| $filep
      |$fortranFormat|))
    (cond
      ((eq arg '|%initialize%|)
        (setq |$fortranOutputStream|
          (defiostream '((mode . output) (device . console)) 255 0))
        (setq |$fortranOutputFile| "CONSOLE")
        (setq |$fortranFormat| nil))
      ((eq arg '|%display%|)
        (if |$fortranFormat|
          (setq label "On:")
          (setq label "Off:"))
        (concat label |$fortranOutputFile|))
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
        (|describeSetOutputFortran|))
      (t
        (DO ()
          ((null (and (listp arg)
            (|member| (upcase (car arg)) '(append quiet))))
            nil)
          (cond
            ((eq (upcase (car arg)) 'append) (setq append t))

```

```

    ((eq (upcase (car arg)) 'quiet) (setq quiet t))
    (t nil))
  (setq arg (cdr arg)))
(cond
  ((and (consp arg)
        (eq (qcdr arg) nil)
        (progn (setq fn (qcar arg)) t)
        (|member| fn '(Y N YE YES NO O ON OF OFF CONSOLE
                      |y| |n| |ye| |yes| |no| |o| |on| |of| |off| |console|)))
   '|ok|)
   (t (setq arg (list fn '|sfort|)))))
(cond
  ((and (consp arg) (eq (qcdr arg) nil) (progn (setq fn (qcar arg)) t))
   (cond
    ((|member| (upcase fn) '(y n ye o of))
     (|sayKeyedMsg| 's2iv0002 '(fortran |fortran|)))
    ((|member| (upcase fn) '(no off)) (setq |$fortranFormat| nil))
    ((|member| (upcase fn) '(yes on)) (setq |$fortranFormat| t))
    ((eq (upcase fn) 'console)
     (shut |$fortranOutputStream|)
     (setq |$fortranOutputStream|
           (defiostream '((mode . output) (device . console)) 255 0))
     (setq |$fortranOutputFile| "CONSOLE"))))
   ((or
    (and (consp arg)
         (progn
          (setq fn (qcar arg))
          (setq tmp1 (qcdr arg))
          (and (consp tmp1)
               (eq (qcdr tmp1) nil)
               (progn (setq ft (qcar tmp1)) t))))
    (and (consp arg)
         (progn
          (setq fn (qcar arg))
          (setq tmp1 (qcdr arg))
          (and (consp tmp1)
               (progn
                (setq ft (qcar tmp1))
                (setq tmp2 (qcdr tmp1))
                (and (consp tmp2)
                     (eq (qcdr tmp2) nil)
                     (progn (setq fm (qcar tmp2)) t)))))))
    (when (setq ptype (|pathnameType| fn))
      (setq fn (concat (|pathnameDirectory| fn) (|pathnameName| fn))
            (setq ft ptype))
    (unless fm (setq fm 'a))
    (setq filename ($filep fn ft fm))
    (cond
      ((null filename)
       (|sayKeyedMsg| 'S2IV0003 (list fn ft fm)))

```

```

((setq teststream (|makeStream| append filename 255 0))
 (SHUT |$fortranOutputStream|)
 (setq |$fortranOutputStream| teststream)
 (setq |$fortranOutputFile| (|object2String| filename))
 (unless quiet
  (|sayKeyedMsg| 'S2IV0004 (list 'fortran |$fortranOutputFile|))))
(null quiet)
(|sayKeyedMsg| 'S2IV0003 (list fn ft fm))
(t nil)))
(t
 (unless quiet (|sayKeyedMsg| 'S2IV0005 nil))
 (|describeSetOutputFortran|))))))

```

defun describeSetOutputFortran

```

[sayBrightly p??]
[setOutputFortran p770]

```

— defun describeSetOutputFortran —

```

(defun |describeSetOutputFortran| ()
  (|sayBrightly| (list
    '|%b| ")set output fortran"
    '|%d| "is used to tell AXIOM to turn FORTRAN-style output"
    '|%l| "printing on and off, and where to place the output. By default, the"
    '|%l| "destination for the output is the screen but printing is turned off."
    '|%l|
    '|%l| "Also See: )set fortran"
    '|%l|
    '|%l| "Syntax: )set output fortran <arg>"
    '|%l| "  where arg can be one of"
    '|%l| "  on          turn FORTRAN printing on"
    '|%l| "  off          turn FORTRAN printing off (default state)"
    '|%l| "  console      send FORTRAN output to screen (default state)"
    '|%l|
    "  fp<.fe>      send FORTRAN output to file with file prefix fp and file"
    '|%l| "                  extension .fe. If not given, .fe defaults to .sfort."
    '|%l|
    '|%l| "If you wish to send the output to a file, you must issue this command"
    '|%l| "twice: once with"
    '|%b| "on"
    '|%d| "and once with the file name. For example, to send"
    '|%l| "FORTRAN output to the file"
    '|%b| "polymer.sfort,"
    '|%d| "issue the two commands"
  ))

```

```
'|%l|
'|%l| " )set output fortran on"
'|%l| " )set output fortran polymer"
'|%l|
'|%l| "The output is placed in the directory from which you invoked AXIOM or"
'|%l| "the one you set with the )cd system command."
'|%l| "The current setting is: "
'|%b| (|setOutputFortran| '|%display%|)
'|%d|)))
```

fraction

----- The fraction Option -----

Description: how fractions are formatted

The fraction option may be followed by any one of the following:

```
-> vertical
    horizontal
```

The current setting is indicated.

defvar \$fractionDisplayType

— initvars —

```
(defvar |$fractionDisplayType| '|vertical| "how fractions are formatted")
```

— outputfraction —

```
(|fraction|
 "how fractions are formatted"
 |interpreter|
 LITERALS
 |$fractionDisplayType|
 (|vertical| |horizontal|)
 |vertical|)
```

length

----- The length Option -----

Description: line length of output displays

The length option may be followed by an integer in the range 10 to 245 inclusive. The current setting is 77

defvar \$margin

— initvars —

```
(defvar $margin 3)
```

defvar \$linelength

— initvars —

```
(defvar $linelength 77 "line length of output displays")
```

— outputlength —

```
(|length|
 "line length of output displays"
 |interpreter|
 INTEGER
 $LINELENGTH
 (10 245)
 77)
```

mathml

----- The mathml Option -----

Description: create output in MathML style

)set output mathml is used to tell AXIOM to turn MathML-style output printing on and off, and where to place the output. By default, the destination for the output is the screen but printing is turned off.

Syntax:)set output mathml <arg>

where arg can be one of

on	turn MathML printing on
off	turn MathML printing off (default state)
console	send MathML output to screen (default state)
fp<.fe>	send MathML output to file with file prefix fp and file extension .fe. If not given, .fe defaults to .smml.

If you wish to send the output to a file, you must issue this command twice: once with on and once with the file name. For example, to send MathML output to the file polymer.smml, issue the two commands

```
)set output mathml on
)set output mathml polymer
```

The output is placed in the directory from which you invoked AXIOM or the one you set with the)cd system command. The current setting is: Off:CONSOLE

defvar \$mathmlFormat

— initvars —

```
(defvar |$mathmlFormat| nil "create output in MathML format")
```

defvar \$mathmlOutputFile

— initvars —

```
(defvar |$mathmlOutputFile| "CONSOLE")
```


"where MathML output goes (enter {\em console} or a pathname)")

— outputmathml —

```
(|mathml|
  "create output in MathML style"
  |interpreter|
  FUNCTION
  |setOutputMathml|
  ("create output in MathML format"
    LITERALS
    |$mathmlFormat|
    (|off| |on|)
    |off|)
  (|break| |$mathmlFormat|)
  ("where MathML output goes (enter {\em console} or a pathname)"
    FILENAME
    |$mathmlOutputFile|
    |chkOutputFileName|
    "console"))
  NIL)
```

defun setOutputMathml

```
[defiostream p982]
[concat p1047]
[describeSetOutputMathml p778]
[qcdr p??]
[qcar p??]
[member p1048]
[upcase p??]
[sayKeyedMsg p329]
[shut p982]
[pathnameType p1040]
[pathnameDirectory p1041]
[pathnameName p1040]
[$filep p??]
[make-outstream p981]
[object2String p??]
[$mathmlOutputStream p??]
[$mathmlOutputFile p775]
```

[*\$mathmlFormat* p775]

[*\$filep* p??]

— **defun setOutputMathml** —

```
(defun |setOutputMathml| (arg)
  (let (label tmp1 tmp2 ptype fn ft fm filename teststream)
    (declare (special |$mathmlOutputStream| |$mathmlOutputFile| |$mathmlFormat|
                      $filep))
    (cond
      ((eq arg '|%initialize%|)
       (setq |$mathmlOutputStream|
             (defiostream '((mode . output) (device . console)) 255 0))
       (setq |$mathmlOutputFile| "CONSOLE")
       (setq |$mathmlFormat| nil))
      ((eq arg '|%display%|)
       (if |$mathmlFormat|
         (setq label "On:")
         (setq label "Off:"))
       (concat label |$mathmlOutputFile|))
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
       (|describeSetOutputMathml|))
      (t
       (cond
         ((and (consp arg)
                (eq (qcdr arg) nil)
                (progn (setq fn (qcar arg)) t)
                (|member| fn '(y n ye yes no o on of off console
                               |y| |n| |ye| |yes| |no| |o| |on| |of| |off| |console|)))
          '|ok|)
         (t (setq arg (list fn '|smml|)))))
       (cond
         ((and (consp arg)
                (eq (qcdr arg) nil)
                (progn (setq fn (qcar arg)) t))
          (cond
            ((|member| (upcase fn) '(y n ye o of))
             (|sayKeyedMsg| 's2iv0002 '(|MathML| |mathml|)))
            ((|member| (upcase fn) '(no off)) (setq |$mathmlFormat| nil))
            ((|member| (upcase fn) '(yes on)) (setq |$mathmlFormat| t))
            ((eq (upcase fn) 'console)
             (shut |$mathmlOutputStream|)
             (setq |$mathmlOutputStream|
                   (defiostream '((mode . output) (device . console)) 255 0))
             (setq |$mathmlOutputFile| "CONSOLE"))))
          (or
            (and (consp arg)
                 (progn
                  (setq fn (qcar arg))
                  (setq tmp1 (qcdr arg))
```

```

      (and (consp tmp1)
            (eq (qcdr tmp1) nil)
            (progn (setq ft (qcar tmp1)) t))))
    (and (consp arg)
          (progn (setq fn (qcar arg))
                  (setq tmp1 (qcdr arg))
                  (and (consp tmp1)
                        (progn
                          (setq ft (qcar tmp1))
                          (setq tmp2 (qcdr tmp1))
                          (and (consp tmp2)
                                (eq (qcdr tmp2) nil)
                                (progn
                                  (setq fm (qcar tmp2))
                                  t)))))))
    (when (setq ptype (|pathnameType| fn))
      (setq fn
        (concat (|pathnameDirectory| fn) (|pathnameName| fn)))
      (setq ft ptype))
    (unless fm (setq fm 'a))
    (setq filename ($filep fn ft fm))
    (cond
      ((null filename) (|sayKeyedMsg| 's2iv0003 (list fn ft fm)))
      ((setq teststream (make-outstream filename 255 0))
        (shut |$mathmlOutputStream|)
        (setq |$mathmlOutputStream| teststream)
        (setq |$mathmlOutputFile| (|object2String| filename))
        (|sayKeyedMsg| 's2iv0004 (list "MathML" |$mathmlOutputFile|)))
      (t (|sayKeyedMsg| 's2iv0003 (list fn ft fm))))
    (t
      (|sayKeyedMsg| 's2iv0005 nil)
      (|describeSetOutputMathml|))))))

```

defun describeSetOutputMathml

[sayBrightly p??]
 [setOutputMathml p776]

— defun describeSetOutputMathml —

```

(defun |describeSetOutputMathml| ()
  (|sayBrightly| (LIST
    '|%b| ")set output mathml"
    '|%d| "is used to tell AXIOM to turn MathML-style output"
    '|%l| "printing on and off, and where to place the output. By default, the"

```

```
'|%l| "destination for the output is the screen but printing is turned off."
'|%l|
'|%l| "Syntax:  )set output mathml <arg>"
'|%l| "    where arg can be one of"
'|%l| "    on          turn MathML printing on"
'|%l| "    off         turn MathML printing off (default state)"
'|%l| "    console      send MathML output to screen (default state)"
'|%l| "    fp<.fe>       send MathML output to file with file prefix fp and file"
'|%l| "                   extension .fe. If not given, .fe defaults to .stex."
'|%l|
'|%l| "If you wish to send the output to a file, you must issue this command"
'|%l| "twice: once with"
'|%b| "on"
'|%d| "and once with the file name. For example, to send"
'|%l| "MathML output to the file"
'|%b| "polymer.smml,"
'|%d| "issue the two commands"
'|%l|
'|%l| " )set output mathml on"
'|%l| " )set output mathml polymer"
'|%l|
'|%l| "The output is placed in the directory from which you invoked AXIOM or"
'|%l| "the one you set with the )cd system command."
'|%l| "The current setting is: "
'|%b| (|setOutputMathml| ' |%display%|)
'|%d|)))
```

html

----- The html Option -----

Description: create output in html style

)set output html is used to tell AXIOM to turn html-style output printing on and off, and where to place the output. By default, the destination for the output is the screen but printing is turned off.

```
Syntax:  )set output html <arg>
         where arg can be one of
         on          turn html printing on
         off         turn html printing off (default state)
         console      send html output to screen (default state)
         fp<.fe>       send html output to file with file prefix fp
                       and file extension .fe. If not given,
                       .fe defaults to .html.
```

If you wish to send the output to a file, you must issue this command twice: once with `on` and once with the file name. For example, to send MathML output to the file `polymer.html`, issue the two commands

```
)set output html on
)set output html polymer
```

The output is placed in the directory from which you invoked Axiom or the one you set with the `)cd` system command. The current setting is: `Off:CONSOLE`

defvar \$htmlFormat

— initvars —

```
(defvar |$htmlFormat| nil "create output in HTML format")
```

—————

defvar \$htmlOutputFile

— initvars —

```
(defvar |$htmlOutputFile| "CONSOLE"
  "where HTML output goes (enter {\em console} or a pathname)")
```

—————

— outputhtml —

```
(|html|
  "create output in HTML style"
  |interpreter|
  FUNCTION
  |setOutputHtml|
  ("create output in HTML format"
   LITERALS
   |$htmlFormat|
   (|off| |on|)
   |off|)
  (|break| |$htmlFormat|)
```

```

    ("where HTML output goes (enter {\em console} or a pathname)"
     FILENAME
     |$htmlOutputFile|
     |chkOutputFileName|
     "console"))
  NIL)

```

defun setOutputHtml

```

[defiostream p982]
[concat p1047]
[describeSetOutputHtml p783]
[qcdr p??]
[qcar p??]
[member p1048]
[upcase p??]
[sayKeyedMsg p329]
[shut p982]
[pathnameType p1040]
[pathnameDirectory p1041]
[pathnameName p1040]
[$filep p??]
[make-outstream p981]
[object2String p??]
[$htmlOutputStream p??]
[$htmlOutputFile p780]
[$htmlFormat p780]
[$filep p??]

```

— defun setOutputHtml —

```

(defun |setOutputHtml| (arg)
  (let (label tmp1 tmp2 ptype fn ft fm filename teststream)
    (declare (special |$htmlOutputStream| |$htmlOutputFile| |$htmlFormat|
                      $filep))
    (cond
      ((eq arg '|%initialize%|)
       (setq |$htmlOutputStream|
              (defiostream '((mode . output) (device . console)) 255 0))
       (setq |$htmlOutputFile| "CONSOLE")
       (setq |$htmlFormat| nil))
      ((eq arg '|%display%|)
       (if |$htmlFormat|
           (setq label "On:"))

```

```

(setq label "Off:")
(concat label |$htmlOutputFile|))
((or (null arg) (eq arg '|%describe%|') (eq (car arg) '?'))
(|describeSetOutputHtml|))
(t
(cond
((and (consp arg)
(eq (qcdr arg) nil)
(progn (setq fn (qcar arg)) t)
(|member| fn '(y n ye yes no o on of off console
|y| |n| |ye| |yes| |no| |o| |on| |of| |off| |console|)))
'|ok|)
(t (setq arg (list fn '|smml|'))))
(cond
((and (consp arg)
(eq (qcdr arg) nil)
(progn (setq fn (qcar arg)) t))
(cond
((|member| (upcase fn) '(y n ye o of))
(|sayKeyedMsg| 's2iv0002 '(|HTML| |html|)))
((|member| (upcase fn) '(no off)) (setq |$htmlFormat| nil))
((|member| (upcase fn) '(yes on)) (setq |$htmlFormat| t))
((eq (upcase fn) 'console)
(shut |$htmlOutputStream|)
(setq |$htmlOutputStream|
(defiostream '((mode . output) (device . console)) 255 0))
(setq |$htmlOutputFile| "CONSOLE"))))
((or
(and (consp arg)
(progn
(setq fn (qcar arg))
(setq tmp1 (qcdr arg))
(and (consp tmp1)
(eq (qcdr tmp1) nil)
(progn (setq ft (qcar tmp1)) t))))
(and (consp arg)
(progn (setq fn (qcar arg))
(setq tmp1 (qcdr arg))
(and (consp tmp1)
(progn
(setq ft (qcar tmp1))
(setq tmp2 (qcdr tmp1))
(and (consp tmp2)
(eq (qcdr tmp2) nil)
(progn
(setq fm (qcar tmp2))
t))))))
(when (setq ptype (|pathnameType| fn))
(setq fn
(concat (|pathnameDirectory| fn) (|pathnameName| fn)))

```

```

      (setq ft ptype))
    (unless fm (setq fm 'a))
    (setq filename ($filep fn ft fm))
    (cond
      ((null filename) (|sayKeyedMsg| 's2iv0003 (list fn ft fm)))
      ((setq teststream (make-outstream filename 255 0))
        (shut |$htmlOutputStream|)
        (setq |$htmlOutputStream| teststream)
        (setq |$htmlOutputFile| (|object2String| filename))
        (|sayKeyedMsg| 's2iv0004 (list "HTML" |$htmlOutputFile|)))
      (t (|sayKeyedMsg| 's2iv0003 (list fn ft fm)))))
  (t
    (|sayKeyedMsg| 's2iv0005 nil)
    (|describeSetOutputHtml|))))))

```

defun describeSetOutputHtml

```

[|sayBrightly| p??]
[setOutputHtml p781]

```

— defun describeSetOutputHtml —

```

(defun |describeSetOutputHtml| ()
  (|sayBrightly| (LIST
    '|%b| ")set output html"
    '|%d| "is used to tell AXIOM to turn HTML-style output"
    '|%l| "printing on and off, and where to place the output. By default, the"
    '|%l| "destination for the output is the screen but printing is turned off."
    '|%l|
    '|%l| "Syntax:   )set output html <arg>"
    '|%l| "   where arg can be one of"
    '|%l| "   on       turn HTML printing on"
    '|%l| "   off      turn HTML printing off (default state)"
    '|%l| "   console   send HTML output to screen (default state)"
    '|%l| "   fp<.fe>    send HTML output to file with file prefix fp and file"
    '|%l| "               extension .fe. If not given, .fe defaults to .stex."
    '|%l|
    '|%l| "If you wish to send the output to a file, you must issue this command"
    '|%l| "twice: once with"
    '|%b| "on"
    '|%d| "and once with the file name. For example, to send"
    '|%l| "HTML output to the file"
    '|%b| "polymer.smml,"
    '|%d| "issue the two commands"
    '|%l|

```



```
'|%l| " )set output html on"
'|%l| " )set output html polymer"
'|%l|
'|%l| "The output is placed in the directory from which you invoked AXIOM or"
'|%l| "the one you set with the )cd system command."
'|%l| "The current setting is: "
'|%b| (|setOutputHtml| '|%display%|)
'|%d|)))
```

openmath

----- The openmath Option -----

Description: create output in OpenMath style

)set output tex is used to tell AXIOM to turn OpenMath output printing on and off, and where to place the output. By default, the destination for the output is the screen but printing is turned off.

Syntax:)set output tex <arg>

where arg can be one of

on	turn OpenMath printing on
off	turn OpenMath printing off (default state)
console	send OpenMath output to screen (default state)
fp<.fe>	send OpenMath output to file with file prefix fp and file extension .fe. If not given, .fe defaults to .sopen.

If you wish to send the output to a file, you must issue this command twice: once with on and once with the file name. For example, to send OpenMath output to the file polymer.sopen, issue the two commands

```
)set output openmath on
)set output openmath polymer
```

The output is placed in the directory from which you invoked AXIOM or the one you set with the)cd system command. The current setting is: Off:CONSOLE

defvar \$openMathFormat

— initvars —

```
(defvar |$openMathFormat| nil "create output in OpenMath format")
```

defvar \$openMathOutputFile

— initvars —

```
(defvar |$openMathOutputFile| "CONSOLE"
  "where TeX output goes (enter {\em console} or a pathname)")
```

— outputopenmath —

```
(|openmath|
  "create output in OpenMath style"
  |interpreter|
  FUNCTION
  |setOutputOpenMath|
  (("create output in OpenMath format"
    LITERALS
    |$openMathFormat|
    (|off| |on|)
    |off|)
  (|break| |$openMathFormat|)
  ("where TeX output goes (enter {\em console} or a pathname)"
   FILENAME
   |$openMathOutputFile|
   |chkOutputFileName|
   "console"))
  NIL)
```

defun setOutputOpenMath

```
[defiostream p982]
[concat p1047]
[describeSetOutputOpenMath p788]
[qcdr p??]
[qcar p??]
```

```

[member p1048]
[upcase p??]
[sayKeyedMsg p329]
[shut p982]
[pathnameType p1040]
[pathnameDirectory p1041]
[pathnameName p1040]
[$filep p??]
[make-outstream p981]
[object2String p??]
[$openMathOutputStream p??]
[$openMathFormat p784]
[$filep p??]
[$openMathOutputFile p785]

```

— defun setOutputOpenMath —

```

(defun |setOutputOpenMath| (arg)
  (let (label tmp1 tmp2 ptype fn ft fm filename teststream)
    (declare (special |$openMathOutputStream| |$openMathFormat| $filep
      |$openMathOutputFile|))
    (cond
      ((eq arg '|%initialize%|)
       (setq |$openMathOutputStream|
         (defiostream '((mode . output) (device . console)) 255 0))
       (setq |$openMathOutputFile| "CONSOLE")
       (setq |$openMathFormat| NIL))
      ((eq arg '|%display%|)
       (if |$openMathFormat|
         (setq label "On:")
         (setq label "Off:"))
       (concat label |$openMathOutputFile|))
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
       (|describeSetOutputOpenMath|))
      (t
       (cond
         ((and (consp arg)
          (eq (qcdr arg) nil)
          (progn (setq fn (qcar arg)) t)
          (|member| fn '(y n ye yes no o on of off console
            |y| |n| |ye| |yes| |no| |o| |on| |of| |off| |console|)))
          '|ok|)
         (t (setq arg (list fn '|som|))))
       (cond
         ((and (consp arg)
          (eq (qcdr arg) nil)
          (progn (setq fn (qcar arg)) t))
          (cond

```

```

((|member| (upcase fn) '(y n ye o of))
 (|sayKeyedMsg| 's2iv0002 '(|OpenMath| |openmath|)))
((|member| (upcase fn) '(no off)) (setq |$openMathFormat| nil))
((|member| (upcase fn) '(yes on)) (setq |$openMathFormat| t))
((eq (upcase fn) 'console)
 (shut |$openMathOutputStream|)
 (setq |$openMathOutputStream|
  (defiostream '((mode . output) (device . console)) 255 0))
 (setq |$openMathOutputFile| "CONSOLE"))))
((or
 (and (consp arg)
  (progn (setq fn (qcar arg))
   (setq tmp1 (qcdr arg))
   (and (consp tmp1)
    (eq (qcdr tmp1) nil)
    (progn (setq ft (qcar tmp1)) t))))
 (and (consp arg)
  (progn
   (setq fn (qcar arg))
   (setq tmp1 (qcdr arg))
   (and (consp tmp1)
    (progn (setq ft (qcar tmp1))
     (setq tmp2 (qcdr tmp1))
     (and (consp tmp2)
      (eq (qcdr tmp2) nil)
      (progn (setq fm (qcar tmp2)) t)))))))
 (when (setq ptype (|pathnameType| fn))
  (setq fn (concat (|pathnameDirectory| fn) (|pathnameName| fn)))
  (setq ft ptype))
 (unless fm (setq fm 'a))
 (setq filename ($filep fn ft fm))
 (cond
  ((null filename)
   (|sayKeyedMsg| 's2iv0003 (list fn ft fm)))
  ((setq teststream (make-outstream filename 255 0))
   (shut |$openMathOutputStream|)
   (setq |$openMathOutputStream| teststream)
   (setq |$openMathOutputFile| (|object2String| filename))
   (|sayKeyedMsg| 's2iv0004 (list "OpenMath" |$openMathOutputFile|)))
  (t
   (|sayKeyedMsg| 's2iv0003 (list fn ft fm))))
 (t
  (|sayKeyedMsg| 's2iv0005 nil)
  (|describeSetOutputOpenMath|))))))

```

defun describeSetOutputOpenMath

```
[sayBrightly p??]
[setOutputOpenMath p785]
```

— defun describeSetOutputOpenMath —

```
(defun |describeSetOutputOpenMath| ()
  (|sayBrightly| (list
    '|%b| ")set output openmath"
    '|%d| "is used to tell AXIOM to turn OpenMath output"
    '|%l| "printing on and off, and where to place the output. By default, the"
    '|%l| "destination for the output is the screen but printing is turned off."
    '|%l|
    '|%l| "Syntax: )set output openmath <arg>"
    '|%l| "      where arg can be one of"
    '|%l| "      on          turn OpenMath printing on"
    '|%l| "      off          turn OpenMath printing off (default state)"
    '|%l| "      console      send OpenMath output to screen (default state)"
    '|%l|
    "      fp<.fe>      send OpenMath output to file with file prefix fp and file"
    '|%l| "                        extension .fe. If not given, .fe defaults to .som."
    '|%l|
    '|%l| "If you wish to send the output to a file, you must issue this command"
    '|%l| "twice: once with"
    '|%b| "on"
    '|%d| "and once with the file name. For example, to send"
    '|%l| "OpenMath output to the file"
    '|%b| "polymer.som,"
    '|%d| "issue the two commands"
    '|%l|
    '|%l| " )set output openmath on"
    '|%l| " )set output openmath polymer"
    '|%l|
    '|%l| "The output is placed in the directory from which you invoked AXIOM or"
    '|%l| "the one you set with the )cd system command."
    '|%l| "The current setting is: "
    '|%b| (|setOutputOpenMath| '|%display%|)
    '|%d|)))
```

script

----- The script Option -----

Description: display output in SCRIPT formula format

)set output script is used to tell AXIOM to turn IBM Script formula-style output printing on and off, and where to place the output. By default, the destination for the output is the screen but printing is turned off.

Syntax:)set output script <arg>
 where arg can be one of
 on turn IBM Script formula printing on
 off turn IBM Script formula printing off
 (default state)
 console send IBM Script formula output to screen
 (default state)
 fp<.fe> send IBM Script formula output to file with file
 prefix fp and file extension .fe. If not given,
 .fe defaults to .sform.

If you wish to send the output to a file, you must issue this command twice: once with on and once with the file name. For example, to send IBM Script formula output to the file polymer.sform, issue the two commands

```
)set output script on
)set output script polymer
```

The output is placed in the directory from which you invoked AXIOM or the one you set with the)cd system command. The current setting is: Off:CONSOLE

defvar \$formulaFormat

— initvars —

```
(defvar |$formulaFormat| nil "display output in SCRIPT format")
```

defvar \$formulaOutputFile

— initvars —

```
(defvar |$formulaOutputFile| "CONSOLE"
  "where script output goes (enter {\em console} or a a pathname)")
```

— **outputscript** —

```
(|script|
  "display output in SCRIPT formula format"
  |interpreter|
  FUNCTION
  |setOutputFormula|
  ("display output in SCRIPT format"
    LITERALS
    |$formulaFormat|
    (|off| |on|)
    |off|)
  (|break| |$formulaFormat|)
  ("where script output goes (enter {\em console} or a a pathname)"
    FILENAME
    |$formulaOutputFile|
    |chkOutputFileName|
    "console"))
  NIL)
```

defun setOutputFormula

```
[defiostream p982]
[concat p1047]
[describeSetOutputFormula p792]
[qcdr p??]
[qcar p??]
[member p1048]
[upcase p??]
[sayKeyedMsg p329]
[shut p982]
[pathnameType p1040]
[pathnameDirectory p1041]
[pathnameName p1040]
[$filep p??]
[make-outstream p981]
[object2String p??]
[$formulaOutputStream p??]
[$formulaOutputFile p789]
[$filep p??]
[$formulaFormat p789]
```

— defun setOutputFormula —

```

(defun |setOutputFormula| (arg)
  (let (label tmp1 tmp2 ptype fn ft fm filename teststream)
    (declare (special |$formulaOutputStream| |$formulaOutputFile| $filep
      |$formulaFormat|))
    (cond
      ((eq arg '|%initialize%|)
        (setq |$formulaOutputStream|
          (defiostream '((mode . output) (device . console)) 255 0))
        (setq |$formulaOutputFile| "CONSOLE")
        (setq |$formulaFormat| nil))
      ((eq arg '|%display%|)
        (if |$formulaFormat|
          (setq label "On:")
          (setq label "Off:"))
        (concat label |$formulaOutputFile|))
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
        (|describeSetOutputFormula|))
      (t
        (cond
          ((and (consp arg)
            (eq (qcdr arg) nil)
            (progn (setq fn (qcar arg)) t)
            (|member| fn '(y n ye yes no o on of off console
              |y| |n| |ye| |yes| |no| |o| |on| |of| |off| |console|))))
            'ok|)
          (t (setq arg (list fn '|sform|))))
        (cond
          ((and (consp arg)
            (eq (qcdr arg) nil)
            (progn (setq fn (qcar arg)) t))
            (cond
              ((|member| (upcase fn) '(y n ye o of))
                (|sayKeyedMsg| 's2iv0002 '(|script| |script|)))
              ((|member| (upcase fn) '(no off)) (setq |$formulaFormat| nil))
              ((|member| (upcase fn) '(yes on)) (setq |$formulaFormat| t))
              ((eq (upcase fn) 'console)
                (SHUT |$formulaOutputStream|)
                (setq |$formulaOutputStream|
                  (defiostream '((mode . output) (device . console)) 255 0))
                (setq |$formulaOutputFile| "CONSOLE")))))
          ((or
            (and (consp arg)
              (progn (setq fn (qcar arg))
                (setq tmp1 (qcdr arg))
                (and (consp tmp1)
                  (eq (qcdr tmp1) nil)
                  (progn (setq ft (qcar tmp1)) t))))
            (progn (setq ft (qcar tmp1)) t)))))))

```



```

    (and (consp arg)
      (progn (setq fn (qcar arg))
        (setq tmp1 (qcdr arg))
        (and (consp tmp1)
          (progn (setq ft (qcar tmp1))
            (setq tmp2 (qcdr tmp1))
            (and (consp tmp2)
              (eq (qcdr tmp2) nil)
              (progn
                (setq fm (qcar tmp2)) t))))))
    (if (setq ptype (|pathnameType| fn))
      (setq fn (concat (|pathnameDirectory| fn) (|pathnameName| fn)))
      (setq ft ptype))
    (unless fm (setq fm 'a))
    (setq filename ($filep fn ft fm))
    (cond
      ((null filename) (|sayKeyedMsg| 's2iv0003 (list fn ft fm)))
      ((setq teststream (make-outstream filename 255 0))
        (shut |$formulaOutputStream|)
        (setq |$formulaOutputStream| teststream)
        (setq |$formulaOutputFile| (|object2String| filename))
        (|sayKeyedMsg| 's2iv0004
          (list "IBM Script formula" |$formulaOutputFile| )))
      (t
        (|sayKeyedMsg| 's2iv0003 (list fn ft fm))))
    (t
      (|sayKeyedMsg| 's2iv0005 nil)
      (|describeSetOutputFormula|))))))

```

defun describeSetOutputFormula

[sayBrightly p??]
 [setOutputFormula p790]

— defun describeSetOutputFormula —

```

(defun |describeSetOutputFormula| ()
  (|sayBrightly| (list
    '|%b| "set output script"
    '|%d| "is used to tell AXIOM to turn IBM Script formula-style"
    '|%l|
    "output printing on and off, and where to place the output. By default, the"
    '|%l| "destination for the output is the screen but printing is turned off."
    '|%l|
    '|%l| "Syntax:  )set output script <arg>"

```

```
'|%l| "   where arg can be one of"
'|%l| "  on           turn IBM Script formula printing on"
'|%l| "  off          turn IBM Script formula printing off (default state)"
'|%l| "  console      send IBM Script formula output to screen (default state)"
'|%l|
"  fp<.fe>          send IBM Script formula output to file with file prefix fp"
'|%l|
"                  and file extension .fe. If not given, .fe defaults to .sform."
'|%l|
'|%l| "If you wish to send the output to a file, you must issue this command"
'|%l| "twice: once with"
'|%b| "on"
'|%d| "and once with the file name. For example, to send"
'|%l| "IBM Script formula output to the file"
'|%b| "polymer.sform,"
'|%d| "issue the two commands"
'|%l|
'|%l| " )set output script on"
'|%l| " )set output script polymer"
'|%l|
'|%l| "The output is placed in the directory from which you invoked AXIOM or"
'|%l| "the one you set with the )cd system command."
'|%l| "The current setting is: "
'|%b| (|setOutputFormula| '|%display%|)
'|%d|)))
```

scripts

----- The scripts Option -----

Description: show subscripts,... linearly

The scripts option may be followed by any one of the following:

```
yes
no
```

The current setting is indicated.

defvar \$linearFormatScripts

— initvars —

```
(defvar |$linearFormatScripts| nil "show subscripts,... linearly")
```

— outputscripts —

```
(|scripts|
 "show subscripts,... linearly"
 |interpreter|
 LITERALS
 |$linearFormatScripts|
 (|on| |off|)
 |off|)
```

showeditor

----- The showeditor Option -----

Description: view output of)show in editor

The showeditor option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

defvar \$useEditorForShowOutput

— initvars —

```
(defvar |$useEditorForShowOutput| nil "view output of )show in editor")
```

— outputshoweditor —

```
(|showeditor|
```

```
"view output of )show in editor"
|interpreter|
LITERALS
|$useEditorForShowOutput|
(|on| |off|)
|off|)
```

tex

----- The tex Option -----

Description: create output in TeX style

)set output tex is used to tell AXIOM to turn TeX-style output printing on and off, and where to place the output. By default, the destination for the output is the screen but printing is turned off.

Syntax:)set output tex <arg>

where arg can be one of

on	turn TeX printing on
off	turn TeX printing off (default state)
console	send TeX output to screen (default state)
fp<.fe>	send TeX output to file with file prefix fp and file extension .fe. If not given, .fe defaults to .stex.

If you wish to send the output to a file, you must issue this command twice: once with on and once with the file name. For example, to send TeX output to the file polymer.stex, issue the two commands

```
)set output tex on
)set output tex polymer
```

The output is placed in the directory from which you invoked AXIOM or the one you set with the)cd system command. The current setting is: Off:CONSOLE

defvar \$texFormat

— initvars —

```
(defvar |$texFormat| nil "create output in TeX format")
```

defvar \$texOutputFile

— initvars —

```
(defvar |$texOutputFile| "CONSOLE"
  "where TeX output goes (enter {\em console} or a pathname)")
```

— outputtex —

```
(|tex|
  "create output in TeX style"
  |interpreter|
  FUNCTION
  |setOutputTex|
  ("create output in TeX format"
   LITERALS
   |$texFormat|
   (|off| |on|)
   |off|)
  (|break| |$texFormat|)
  ("where TeX output goes (enter {\em console} or a pathname)"
   FILENAME
   |$texOutputFile|
   |chkOutputFileName|
   "console"))
  NIL)
```

defun setOutputTex

```
[defiostream p982]
[concat p1047]
[describeSetOutputTex p798]
[qcdr p??]
[qcar p??]
[member p1048]
```

```
[upcase p??]
[sayKeyedMsg p329]
[shut p982]
[pathnameType p1040]
[pathnameDirectory p1041]
[pathnameName p1040]
[$filep p??]
[make-outstream p981]
[object2String p??]
[$texOutputStream p??]
[$texOutputFile p796]
[$texFormat p795]
[$filep p??]
```

— defun setOutputTex —

```
(defun |setOutputTex| (arg)
  (let (label tmp1 tmp2 ptype fn ft fm filename teststream)
    (declare (special |$texOutputStream| |$texOutputFile| |$texFormat| $filep))
    (cond
      ((eq arg '|%initialize%|)
       (setq |$texOutputStream|
             (defiostream '((mode . output) (device . console)) 255 0))
       (setq |$texOutputFile| "CONSOLE")
       (setq |$texFormat| nil))
      ((eq arg '|%display%|)
       (if |$texFormat|
          (setq label "On:")
          (setq label "Off:"))
       (concat label |$texOutputFile|))
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
       (|describeSetOutputTex|))
      (t
       (cond
         ((and (consp arg)
              (eq (qcdr arg) nil)
              (progn (setq fn (qcar arg)) t)
              (|member| fn '(y n ye yes no o on of off console
                             |y| |n| |ye| |yes| |no| |o| |on| |of| |off| |console|))))
          '|ok|)
         (t (setq arg (list fn '|stex| nil))))
       (cond
         ((and (consp arg)
              (eq (qcdr arg) nil)
              (progn (setq fn (qcar arg)) t))
          (cond
            ((|member| (upcase fn) '(y n ye o of))
             (|sayKeyedMsg| 's2iv0002 '(|TeX| |tex|)))
            ((|member| (upcase fn) '(no off)) (setq |$texFormat| nil))
```

```

((|member| (upcase fn) '(yes on)) (setq |$texFormat| t))
((eq (upcase fn) 'console)
 (shut |$texOutputStream|)
 (setq |$texOutputStream|
  (defiostream '((mode . output) (device . console)) 255 0))
 (setq |$texOutputFile| "CONSOLE"))))
((or
 (and (consp arg)
  (progn (setq fn (qcar arg))
   (setq tmp1 (qcdr arg))
   (and (consp tmp1)
    (eq (qcdr tmp1) nil)
    (progn (setq ft (qcar tmp1)) t))))
 (and (consp arg)
  (progn (setq fn (qcar arg))
   (setq tmp1 (qcdr arg))
   (and (consp tmp1)
    (progn (setq ft (qcar tmp1))
     (setq tmp2 (qcdr tmp1))
     (and (consp tmp2)
      (eq (qcdr tmp2) nil)
      (progn (setq fm (qcar tmp2)) t)))))))
 (when (setq ptype (|pathnameType| fn))
  (setq fn (concat (|pathnameDirectory| fn) (|pathnameName| fn)))
  (setq ft ptype))
 (unless fm (setq fm 'A))
 (setq filename ($filep fn ft fm))
 (cond
  ((null filename) (|sayKeyedMsg| 's2iv0003 (list fn ft fm)))
  ((setq teststream (make-outstream filename 255 0))
   (shut |$texOutputStream|)
   (setq |$texOutputStream| teststream)
   (setq |$texOutputFile| (|object2String| filename))
   (|sayKeyedMsg| 's2iv0004 (list "TeX" |$texOutputFile|)))
  (t (|sayKeyedMsg| 'S2IV0003 (list fn ft fm)))))
(t
 (|sayKeyedMsg| 's2iv0005 nil)
 (|describeSetOutputTex|))))))

```

defun describeSetOutputTex

```

[sayBrightly p??]
[setOutputTex p796]

```

— defun describeSetOutputTex —

```
(defun |describeSetOutputTex| ()
  (|sayBrightly| (list
    '|%b| ")set output tex"
    '|%d| "is used to tell AXIOM to turn TeX-style output"
    '|%l| "printing on and off, and where to place the output. By default, the"
    '|%l| "destination for the output is the screen but printing is turned off."
    '|%l|
    '|%l| "Syntax:   )set output tex <arg>"
    '|%l| "      where arg can be one of"
    '|%l| "  on          turn TeX printing on"
    '|%l| "  off          turn TeX printing off (default state)"
    '|%l| "  console      send TeX output to screen (default state)"
    '|%l| "  fp<.fe>       send TeX output to file with file prefix fp and file"
    '|%l| "                  extension .fe. If not given, .fe defaults to .stex."
    '|%l|
    '|%l| "If you wish to send the output to a file, you must issue this command"
    '|%l| "twice: once with"
    '|%b| "on"
    '|%d| "and once with the file name. For example, to send"
    '|%l| "TeX output to the file"
    '|%b| "polymer.stex,"
    '|%d| "issue the two commands"
    '|%l|
    '|%l| "  )set output tex on"
    '|%l| "  )set output tex polymer"
    '|%l|
    '|%l| "The output is placed in the directory from which you invoked AXIOM or"
    '|%l| "the one you set with the )cd system command."
    '|%l| "The current setting is: "
    '|%b| (|setOutputTex| '|%display%|)
    '|%d|)))
```

45.32 quit

----- The quit Option -----

Description: protected or unprotected quit

The quit option may be followed by any one of the following:

```
protected
-> unprotected
```

The current setting is indicated.

defvar \$quitCommandType

— initvars —

```
(defvar |$quitCommandType| ' |protected| "protected or unprotected quit")
```

—————

— quit —

```
(|quit|
 "protected or unprotected quit"
 |interpreter|
 LITERALS
 |$quitCommandType|
 (|protected| |unprotected|)
 |protected|)
```

—————

45.33 streams

Current Values of streams Variables

Variable	Description	Current Value

calculate	specify number of elements to calculate	10
showall	display all stream elements computed	off

— streams —

```
(|streams|
 "set some options for working with streams"
 |interpreter|
 TREE
 |novar|
 (
 \getchunk{streamscalculat}
 \getchunk{streamsshowall}
 ))
```

—————

calculate

----- The calculate Option -----

Description: specify number of elements to calculate

)set streams calculate is used to tell AXIOM how many elements of a stream to calculate when a computation uses the stream. The value given after calculate must either be the word all or a positive integer.

The current setting is 10 .

defvar \$streamCount

— initvars —

```
(defvar |$streamCount| 10
  "number of initial stream elements you want calculated")
```

—————

— streamscalculate —

```
(|calculate|
  "specify number of elements to calculate"
  |interpreter|
  FUNCTION
  |setStreamsCalculate|
  (("number of initial stream elements you want calculated"
    INTEGER
    |$streamCount|
    (0 NIL)
    10))
  NIL)
```

—————

defun setStreamsCalculate

```
[object2String p??]
[describeSetStreamsCalculate p802]
[sayMessage p??]
[bright p??]
```

[terminateSystemCommand p452]
 [\$streamCount p801]

— defun setStreamsCalculate —

```
(defun |setStreamsCalculate| (arg)
  (let (n)
    (declare (special |$streamCount|))
    (cond
      ((eq arg '|%initialize%|) (setq |$streamCount| 10))
      ((eq arg '|%display%|) (|object2String| |$streamCount|))
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
        (|describeSetStreamsCalculate|))
      (t
        (setq n (car arg))
        (cond
          ((and (not (eq n '|all|)) (or (null (integerp n)) (minusp n)))
            (|sayMessage|
              ("Your value of" ,@( |bright| n) "is invalid because ..."))
            (|describeSetStreamsCalculate|)
            (|terminateSystemCommand|))
          (t (setq |$streamCount| n)))))))
```

—————

defun describeSetStreamsCalculate

[sayKeyedMsg p329]
 [\$streamCount p801]

— defun describeSetStreamsCalculate —

```
(defun |describeSetStreamsCalculate| ()
  (declare (special |$streamCount|))
  (|sayKeyedMsg| 's2iv0001 (list |$streamCount|)))
```

—————

showall

----- The showall Option -----

Description: display all stream elements computed

The showall option may be followed by any one of the following:

```

on
-> off

```

The current setting is indicated.

defvar \$streamsShowAll

— initvars —

```
(defvar |$streamsShowAll| nil "display all stream elements computed")
```

— streamsshowall —

```

(|showall|
 "display all stream elements computed"
 |interpreter|
 LITERALS
 |$streamsShowAll|
 (|on| |off|)
 |off|)

```

45.34 system

Current Values of system Variables

Variable	Description	Current Value
functioncode	show gen. LISP for functions when compiled	off
optimization	show optimized LISP code	off
prettyprint	prettyprint BOOT func's as they compile	off

— system —

```

(|system|
 "set some system development variables"

```

```

      |development|
      TREE
      |novar|
      (
\getchunk{systemfunctioncode}
\getchunk{systemoptimization}
\getchunk{systemprettyprint}
      ))

```

functioncode

----- The functioncode Option -----

Description: show gen. LISP for functions when compiled

The functioncode option may be followed by any one of the following:

```

      on
-> off

```

The current setting is indicated.

defvar \$reportCompilation

— initvars —

```
(defvar |$reportCompilation| nil "show gen. LISP for functions when compiled")
```

— systemfunctioncode —

```

(|functioncode|
 "show gen. LISP for functions when compiled"
 |development|
 LITERALS
 |$reportCompilation|
 (|on| |off|)
 |off|)

```

optimization

----- The optimization Option -----

Description: show optimized LISP code

The optimization option may be followed by any one of the following:

on
-> off

The current setting is indicated.

defvar \$reportOptimization

— initvars —

```
(defvar |$reportOptimization| nil "show optimized LISP code")
```

— systemoptimization —

```
(|optimization|
 "show optimized LISP code"
 |development|
 LITERALS
 |$reportOptimization|
 (|on| |off|)
 |off|)
```

prettyprint

----- The prettyprint Option -----

Description: prettyprint BOOT func's as they compile

The `prettyprint` option may be followed by any one of the following:

```
    on
-> off
```

The current setting is indicated.

defvar \$prettyprint

— initvars —

```
(defvar $prettyprint t "prettyprint BOOT func's as they compile")
```

—————

— systemprettyprint —

```
(|prettyprint|
 "prettyprint BOOT func's as they compile"
 |development|
 LITERALS
 $prettyprint
 (|on| |off|)
 |on|)
```

—————

45.35 userlevel

----- The userlevel Option -----

Description: operation access level of system user

The `userlevel` option may be followed by any one of the following:

```
    interpreter
    compiler
-> development
```

The current setting is indicated.

defvar \$UserLevel

— initvars —

```
(defvar |$UserLevel| 'development "operation access level of system user")
```

— userlevel —

```
(|userlevel|
 "operation access level of system user"
 |interpreter|
 LITERALS
 |$UserLevel|
 (|interpreter| |compiler| |development|)
 |development|)
```

— initvars —

```
(defvar |$setOptions| '(
 \getchunk{breakmode}
 \getchunk{compile}
 \getchunk{debug}
 \getchunk{expose}
 \getchunk{functions}
 \getchunk{fortran}
 \getchunk{kernel}
 \getchunk{hyperdoc}
 \getchunk{help}
 \getchunk{history}
 \getchunk{messages}
 \getchunk{naglink}
 \getchunk{output}
 \getchunk{quit}
 \getchunk{streams}
 \getchunk{system}
 \getchunk{userlevel}
 ))
```

defvar \$setOptionNames

— initvars —

```
(defvar |$setOptionNames| (mapcar #'car |$setOptions|))
```

—————

— postvars —

```
(eval-when (eval load)
  (|initializeSetVariables| |$setOptions|))
```

—————

45.36 Set code**defun set**

```
[set1 p808]
|$setOptions p??]
```

— defun set —

```
(defun |set| (l)
  (declare (special |$setOptions|))
  (|set1| l |$setOptions|))
```

—————

defun set1

This function will be called with the top level arguments to)set. For instance, given the command

```
)set break break
```

this function gets

```
(set1 (|break| |break|) ....)
```

and given the command

```
)set mes auto off
```

this function gets

```
(set1 (|mes| |auto| |off|) ....)
```

which, because “message” is a TREE, generates the recursive call:

```
(set1 (|auto| |off|) <the message subtree>)
```

The “autoload” subtree contains a FUNCTION called `printLoadMessages`, which gets called with `%describe%` [`displaySetVariableSettings` p657]

```
[seq p??]
[exit p??]
[selectOption p479]
[downcase p??]
[lassoc p??]
[satisfiesUserLevel p451]
[sayKeyedMsg p329]
[poundsign p??]
[displaySetOptionInformation p655]
[kdr p??]
[sayMSG p331]
[sayMessage p??]
[bright p??]
[object2String p??]
[translateYesNo2TrueFalse p658]
[use-fast-links p??]
[literals p??]
[tree p??]
[set1 p808]
[$setOptionNames p808]
[$UserLevel p807]
[$displaySetValue p748]
```

— **defun set1** —

```
(defun |set1| (l settree)
  (let (|$setOptionNames| arg setdata st setfunarg num upperlimit arg2)
    (declare (special |$setOptionNames| |$UserLevel| |$displaySetValue|))
    (cond
      ((null l) (|displaySetVariableSettings| settree '||))
      (t
       (setq |$setOptionNames|
              (do ((t1 settree (cdr t1)) t0 (x nil))
```

```

      ((or (atom t1) (progn (setq x (car t1)) nil)) (nreverse0 t0))
    (seq
      (exit
        (setq t0 (cons (elt x 0) t0))))))
  (setq arg
    (|selectOption| (downcase (car l)) |$setOptionNames| '|optionError|))
  (setq setdata (cons arg (lassoc arg settree)))
  (cond
    ((null (|satisfiesUserLevel| (third setdata)))
      (|sayKeyedMsg| 's2iz0007 (list |$UserLevel| "set option" nil)))
    ((eql 1 (|#| l)) (|displaySetOptionInformation| arg setdata))
    (t
      (setq st (fourth setdata))
      (case (fourth setdata)
        (function
          (setq setfunarg
            (if (eq (elt l 1) 'default)
              '|%initialize%|
              (kdr l)))
          (if (canFuncall? (fifth setdata))
            (funcall (fifth setdata) setfunarg)
            (|sayMSG| (concatenate 'string "    Function not implemented. "
              (string (fifth setdata))))))
          (when |$displaySetValue|
            (|displaySetOptionInformation| arg setdata))
          NIL)
        (string
          (setq arg2 (elt l 1))
          (cond
            ((eq arg2 'default) (set (fifth setdata) (seventh setdata)))
            (arg2 (set (fifth setdata) arg2))
            (t nil))
          (when (or |$displaySetValue| (null arg2))
            (|displaySetOptionInformation| arg setdata))
          NIL)
        (integer
          (setq arg2
            (progn
              (setq num (elt l 1))
              (cond
                ((and (integerp num)
                  (>= num (elt (sixth setdata) 0))
                  (or (null (setq upperlimit (elt (sixth setdata) 1)))
                    (<= num upperlimit)))
                  num)
              (t
                (|selectOption|
                  (elt l 1)
                  (cons '|default| (sixth setdata)) nil))))))
          (cond

```

```

((eq arg2 'default) (set (fifth setdata) (seventh setdata)))
(arg2 (set (fifth setdata) arg2))
(t nil))
(cond
  ((or |$displaySetValue| (null arg2))
   (|displaySetOptionInformation| arg setdata)))
(cond
  ((null arg2)
   (|sayMessage|
    '(" Your value" ,@( |bright| (|object2String| (elt 1 1)))
      "is not among the valid choices.")))
  (t nil)))
(literals
 (cond
  ((setq arg2
   (|selectOption| (elt 1 1)
    (cons '|default| (sixth setdata)) nil))
   (cond
    ((eq arg2 'default)
     (set (fifth setdata)
      (|translateYesNo2TrueFalse| (seventh setdata))))
    (t
     (cond ((eq arg2 '|nobreak|)
              #+:GCL (si::use-fast-links t)))
      (cond
       ((eq arg2 '|fastlinks|)
        #+:GCL (si::use-fast-links nil)
        (setq arg2 '|break|)))
       (set (fifth setdata) (|translateYesNo2TrueFalse| arg2))))))
  (when (or |$displaySetValue| (null arg2))
   (|displaySetOptionInformation| arg setdata))
  (cond
   ((null arg2)
    (|sayMessage|
     (cons " Your value"
      (append (|bright| (|object2String| (elt 1 1)))
       (cons "is not among the valid choices." nil)))))
    (t nil)))
  (tree (|set1| (kdr 1) (sixth setdata)) nil)
  (t
   (|sayMessage|
    '("Cannot handle set tree node type" ,@( |bright| st) |yet|)
    nil))))))

```

Chapter 46

)show help page Command

46.1 show help page man page

— show.help —

```
=====
A.22. )show
=====
```

User Level Required: interpreter

Command Syntax:

-)show nameOrAbbrev
-)show nameOrAbbrev)operations
-)show nameOrAbbrev)attributes

Command Description:

This command displays information about AXIOM domain, package and category constructors. If no options are given, the)operations option is assumed. For example,

```
)show POLY
)show POLY )operations
)show Polynomial
)show Polynomial )operations
```

each display basic information about the Polynomial domain constructor and then provide a listing of operations. Since Polynomial requires a Ring (for example, Integer) as argument, the above commands all refer to a unspecified ring R. In the list of operations, \$ means Polynomial(R).

The basic information displayed includes the signature of the constructor (the name and arguments), the constructor abbreviation, the exposure status of the constructor, and the name of the library source file for the constructor.

If operation information about a specific domain is wanted, the full or abbreviated domain name may be used. For example,

```
)show POLY INT
)show POLY INT )operations
)show Polynomial Integer
)show Polynomial Integer )operations
```

are among the combinations that will display the operations exported by the domain Polynomial(Integer) (as opposed to the general domain constructor Polynomial). Attributes may be listed by using the)attributes option.

Also See:

- o)display
- o)set
- o)what

¹

defun The)show command

[showSpad2Cmd p814]

— defun show —

```
(defun |show| (arg) (|showSpad2Cmd| arg))
```

defun The internal)show command

[member p1048]
 [helpSpad2Cmd p572]
 [sayKeyedMsg p329]
 [qcar p??]
 [reportOperations p815]
 [\$showOptions p??]

¹ “display” (29.2 p 535) “set” (45.36 p 808) “what” (54.1 p 939)

```
[Se p??]
[$env p??]
[$InteractiveFrame p??]
[$options p??]
```

— defun showSpad2Cmd —

```
(defun |showSpad2Cmd| (arg)
  (let (|showOptions| |$e| |$env| constr)
    (declare (special |showOptions| |$e| |$env| |$InteractiveFrame| |$options|))
    (if (equal arg (list nil))
      (|helpSpad2Cmd| '(|show|))
      (progn
        (setq |showOptions| '(|attributes| |operations|))
        (unless |$options| (setq |$options| '(|operations|)))
        (setq |$e| |$InteractiveFrame|)
        (setq |$env| |$InteractiveFrame|)
        (cond
          ((and (consp arg) (eq (qcdr arg) nil) (progn (setq constr (qcar arg)) t))
            (cond
              ((|member| constr '(|Union| |Record| |Mapping|))
                (cond
                  ((eq constr '|Record|)
                    (|sayKeyedMsg| 'S2IZ0044R
                      (list constr ")show Record(a: Integer, b: String)" )))
                  ((eq constr '|Mapping|) (|sayKeyedMsg| 'S2IZ0044M nil))
                  (t
                    (|sayKeyedMsg| 'S2IZ0045T
                      (list constr ")show Union(a: Integer, b: String)" )))
                    (|sayKeyedMsg| 'S2IZ0045U
                      (list constr ")show Union(Integer, String)" ))))
              ((and (consp constr) (eq (qcar constr) '|Mapping|)
                (|sayKeyedMsg| 'S2IZ0044M nil))
                (t (|reportOperations| constr constr))))
              (t (|reportOperations| arg arg)))))))
```

—————

defun reportOperations

```
[sayBrightly p??]
[bright p??]
[sayKeyedMsg p329]
[qcar p??]
[isNameOfType p??]
[isDomainValuedVariable p959]
[reportOpsFromUnitDirectly0 p821]
```



```

[opOf p??]
[unabbrev p??]
[reportOpsFromLisplib0 p817]
[evaluateType p916]
[mkAtree p??]
[removeZeroOneDestructively p??]
[isType p??]
[$env p??]
[$eval p??]
[$genValue p51]
[$quadSymbol p??]
[$doNotAddEmptyModeIfTrue p??]

```

— defun reportOperations —

```

(defun |reportOperations| (oldArg u)
  (let (|$env| |$eval| |$genValue| |$doNotAddEmptyModeIfTrue|
        tmp1 v unitForm tree unitFormp)
    (declare (special |$env| |$eval| |$genValue| |$quadSymbol|
                      |$doNotAddEmptyModeIfTrue|))
    (setq |$env| (list (list nil)))
    (setq |$eval| t)
    (setq |$genValue| t)
    (when u
      (setq |$doNotAddEmptyModeIfTrue| t)
      (cond
        ((equal u |$quadSymbol|)
         (|sayBrightly|
          (cons " mode denotes" (append (|bright| "any") (list '|type|)))))
        ((eq u '|%)
         (|sayKeyedMsg| 'S2IZ0063 nil)
         (|sayKeyedMsg| 'S2IZ0064 nil))
        ((and (null (and (consp u) (eq (qcar u) '|Record|)))
              (null (and (consp u) (eq (qcar u) '|Union|)))
              (null (|isNameOfType| u))
              (null (and (consp u)
                        (eq (qcar u) '|typeOf|)
                        (progn
                          (setq tmp1 (qcdr u))
                          (and (consp tmp1) (eq (qcdr tmp1) nil))))))
         (when (atom oldArg) (setq oldArg (list oldArg)))
         (|sayKeyedMsg| 'S2IZ0063 nil)
         (dolist (op oldArg)
           (|sayKeyedMsg| 'S2IZ0062 (list (|opOf| op)))))
        ((setq v (|isDomainValuedVariable| u)) (|reportOpsFromUnitDirectly0| v))
        (t
         (if (atom u)
              (setq unitForm (|opOf| (|unabbrev| u)))
              (setq unitForm (|unabbrev| u))))

```

```
(if (atom unitForm)
  (|reportOpsFromLisplib0| unitForm u)
  (progn
    (setq unitFormp (|evaluateType| unitForm))
    (setq tree (|mkAtree| (|removeZeroOneDestructively| unitForm)))
    (if (setq unitFormp (|isType| tree))
      (|reportOpsFromUnitDirectly0| unitFormp)
      (|sayKeyedMsg| 'S2IZ0041 (list unitForm))))))
```

defun reportOpsFromLisplib0

[reportOpsFromLisplib1 p817]
 [reportOpsFromLisplib p818]
 [\$useEditorForShowOutput p794]

— defun reportOpsFromLisplib0 —

```
(defun |reportOpsFromLisplib0| (unitForm u)
  (declare (special |$useEditorForShowOutput|))
  (if |$useEditorForShowOutput|
    (|reportOpsFromLisplib1| unitForm u)
    (|reportOpsFromLisplib| unitForm u)))
```

defun reportOpsFromLisplib1

[pathname p1042]
 [erase p??]
 [defiostream p982]
 [sayShowWarning p826]
 [reportOpsFromLisplib p818]
 [shut p982]
 [editFile p545]
 [\$sayBrightlyStream p??]
 [\$erase p??]

— defun reportOpsFromLisplib1 —

```
(defun |reportOpsFromLisplib1| (unitForm u)
  (let (|$sayBrightlyStream| showFile)
    (declare (special |$sayBrightlyStream| $erase)))
```

```
(setq showFile (|pathname| (list 'show 'listing 'a)))
($erase showFile)
(setq |$sayBrightlyStream|
  (defiostream '((file ,showFile) (mode . output)) 255 0))
(|sayShowWarning|)
(|reportOpsFromLisplib| unitForm u)
(shut |$sayBrightlyStream|)
(|editFile| showFile)))
```

—————→

defun reportOpsFromLisplib

```
[constructor? p??]
[sayKeyedMsg p329]
[getConstructorSignature p??]
[kdr p??]
[getdatabase p1010]
[eqsubstlist p??]
[nreverse0 p??]
[sayBrightly p??]
[concat p1047]
[bright p??]
[form2StringWithWhere p??]
[isExposedConstructor p820]
[strconc p??]
[namestring p1040]
[selectOptionLC p479]
[dc1 p??]
[centerAndHighlight p??]
[specialChar p980]
[remdup p??]
[msort p??]
[form2String p??]
[say2PerLine p??]
[formatAttribute p??]
[displayOperationsFromLisplib p820]
[$linelength p774]
[$showOptions p??]
[$options p??]
[$FormalMapVariableList p??]
```

— defun reportOpsFromLisplib —

```
(defun |reportOpsFromLisplib| (op u)
```

```

(let (fn s typ nArgs argList functorForm argml tmp1 functorFormWithDecl
      verb sourceFile opt attList)
  (declare (special $linelength |$showOptions| |$options|
                  |$FormalMapVariableList|))
  (if (null (setq fn (|constructor?| op)))
      (|sayKeyedMsg| 'S2IZ0054 (list u))
      (progn
        (setq argml (when (setq s (|getConstructorSignature| op)) (kdr s)))
        (setq typ (getdatabase op 'constructorkind))
        (setq nArgs (|#| argml))
        (setq argList (kdr (getdatabase op 'constructorform)))
        (setq functorForm (cons op argList))
        (setq argml (eqsubstlist argList |$FormalMapVariableList| argml))
        (mapcar #'(lambda (a m) (push (list ' |:| a m) tmp1)) argList argml)
        (setq functorFormWithDecl (cons op (nreverse0 tmp1)))
        (|sayBrightly|
         (|concat| (|bright| (|form2StringWithWhere| functorFormWithDecl))
                   " is a" (|bright| typ) "constructor"))
        (|sayBrightly|
         (cons " Abbreviation for"
              (append (|bright| op) (cons "is" (|bright| fn))))))
      (if (|isExposedConstructor| op)
          (setq verb "is")
          (setq verb "is not"))
      (|sayBrightly|
       (cons " This constructor"
            (append (|bright| verb) (list "exposed in this frame."))))
      (setq sourceFile (getdatabase op 'sourcefile))
      (|sayBrightly|
       (cons " Issue"
            (append (|bright| (strconc ")edit " (|namestring| sourceFile))
                    (cons "to see algebra source code for"
                          (append (|bright| fn) (list '|%l|)))))))
      (dolist (item |$options|)
        (setq opt (|selectOptionLC| (car item) |$showOptions| '|optionError|))
        (cond
         ((eq opt '|layout|) (|dc1| fn))
         ((eq opt '|views|)
          (|sayBrightly|
           (cons "To get" (append (|bright| "views")
                                   (list "you must give parameters of constructor")))))
         ((eq opt '|attributes|)
          (|centerAndHighlight| "Attributes" $linelength (|specialChar| '|hbar|))
          (|sayBrightly| ""))
         (setq attList
          (remdup
           (msort
            (mapcar #'(lambda (x) (caar x))
                     (reverse (getdatabase op 'attributes))))))
          (if (null attList)

```

```
(|sayBrightly|
  (|concat| '|%b| (|form2String| functorForm)
            '|%d| '|has no attributes.| '|%l|))
  (|say2PerLine| (mapcar #'|formatAttribute| attList))))
((eq opt '|operations|)
  (|displayOperationsFromLisplib| functorForm))))))
```

defun isExposedConstructor

```
[getalist p??]
[$localExposureData p697]
[$globalExposureGroupAlist p670]
```

— defun isExposedConstructor —

```
(defun |isExposedConstructor| (name)
  (let (x found)
    (declare (special |$globalExposureGroupAlist| |$localExposureData|))
    (cond
      ((member name '(|Union| |Record| |Mapping|)) t)
      ((member name (elt |$localExposureData| 2)) nil)
      ((member name (elt |$localExposureData| 1)) t)
      (t
       (loop for g in (elt |$localExposureData| 0)
             when (not found)
             do
               (setq x (getalist |$globalExposureGroupAlist| g))
               (when (and x (getalist x name)) (setq found t)))
       found))))
```

defun displayOperationsFromLisplib

```
[getdatabase p1010]
[centerAndHighlight p??]
[specialChar p980]
[reportOpsFromUnitDirectly p821]
[remdup p??]
[msort p??]
[eqsubstlist p??]
[formatOperationAlistEntry p??]
```

```
[say2PerLine p??]
[$FormalMapVariableList p??]
[$linelength p774]
```

— defun displayOperationsFromLisplib —

```
(defun |displayOperationsFromLisplib| (form)
  (let (name argl kind opList opl ops)
    (declare (special |$FormalMapVariableList| $linelength))
    (setq name (car form))
    (setq argl (cdr form))
    (setq kind (getdatabase name 'constructorkind))
    (|centerAndHighlight| "Operations" $linelength (|specialChar| '|hbar|))
    (setq opList (getdatabase name 'operationalist))
    (if (null opList)
        (|reportOpsFromUnitDirectly| form)
        (progn
          (setq opl
            (remdup (msort (eqsubstlist argl |$FormalMapVariableList| opList))))
          (setq ops nil)
          (dolist (x opl)
            (setq ops (append ops (|formatOperationAlistEntry| x))))
          (|say2PerLine| ops))))))
```

defun reportOpsFromUnitDirectly0

```
[reportOpsFromUnitDirectly1 p825]
[reportOpsFromUnitDirectly p821]
[$useEditorForShowOutput p794]
```

— defun reportOpsFromUnitDirectly0 —

```
(defun |reportOpsFromUnitDirectly0| (D)
  (declare (special |$useEditorForShowOutput|))
  (if |$useEditorForShowOutput|
      (|reportOpsFromUnitDirectly1| D)
      (|reportOpsFromUnitDirectly| D)))
```

defun reportOpsFromUnitDirectly

```
[member p1048]
[qcar p??]
```

```

[evalDomain p913]
[getdatabase p1010]
[sayBrightly p??]
[concat p1047]
[formatOpType p??]
[isExposedConstructor p820]
[bright p??]
[sayBrightly p??]
[strconc p??]
[namestring p1040]
[selectOptionLC p479]
[centerAndHighlight p??]
[specialChar p980]
[remdup p??]
[msort p??]
[formatAttribute p??]
[centerAndHighlight p??]
[getl p1050]
[systemErrorHere p??]
[nreverse0 p??]
[getOplistForConstructorForm p824]
[say2PerLine p??]
[formatOperation p??]
[$commentedOps p??]
[$CategoryFrame p??]
[$linelength p774]
[$options p??]
[$showOptions p??]

```

— defun reportOpsFromUnitDirectly —

```

(defun |reportOpsFromUnitDirectly| (unitForm)
  (let (|$commentedOps| isRecordOrUnion unit top kind abb sourceFile verb opt
        attList constructorFunction tmp1 funlist a sigList tmp2)
    (declare (special |$commentedOps| |$CategoryFrame| $linelength |$options|
                      |$showOptions|))
    (setq isRecordOrUnion
          (and (consp unitForm)
               (progn (setq a (qcar unitForm)) t)
               (|member| a '(|Record| |Union|))))
    (setq unit (|evalDomain| unitForm))
    (setq top (car unitForm))
    (setq kind (getdatabase top 'constructorkind))
    (|sayBrightly|
     (|concat| '|%b| (|formatOpType| unitForm) '|%d|
               "is a" '|%b| kind '|%d| "constructor."))
    (unless isRecordOrUnion

```

```

(setq abb (getdatabase top 'abbreviation))
(setq sourceFile (getdatabase top 'sourcefile))
(|sayBrightly|
  (cons " Abbreviation for"
    (append (|bright| top) (cons "is" (|bright| abb)))))
(if (|isExposedConstructor| top)
  (setq verb "is")
  (setq verb "is not"))
(|sayBrightly|
  (cons " This constructor"
    (append (|bright| verb) (list "exposed in this frame." ))))
(|sayBrightly|
  (cons " Issue"
    (append (|bright| (strconc ")edit " (|namestring| sourceFile))
      (cons "to see algebra source code for"
        (append (|bright| abb) (list '|%l|)))))))
(dolist (item |$options|)
  (setq opt (|selectOptionLC| (car item) |$showOptions| '|optionError|))
  (cond
    ((eq opt '|attributes|)
      (|centerAndHighlight| "Attributes" $linelength (|specialChar| '|hbar|))
      (if isRecordOrUnion
        (|sayBrightly| "  Records and Unions have no attributes.")
        (progn
          (|sayBrightly| "")
          (setq attList
            (remdup
              (msort
                (mapcar #'(lambda (unit2) (car unit2)) (reverse (elt unit 2))))))
          (|say2PerLine|
            (mapcar #'|formatAttribute| attList))
          nil)))
      ((eq opt '|operations|)
        (setq |$commentedOps| 0)
        ; --new form is (<op> <signature> <slotNumber> <condition> <kind>)
        (|centerAndHighlight| "Operations" $linelength (|specialChar| '|hbar|))
        (|sayBrightly| "")
        (cond
          (isRecordOrUnion
            (setq constructorFunction (get1 top '|makeFunctionList|))
            (unless constructorFunction
              (|systemErrorHere| "reportOpsFromUnitDirectly"))
            (setq tmp1
              (funcall constructorFunction '$ unitForm |$CategoryFrame|))
            (setq funlist (car tmp1))
            (setq sigList
              (remdup
                (msort
                  (dolist (fun funlist (nreverse0 tmp2))
                    (push '(((, (caar fun) ,(cadar fun)) t (, (caddar fun) 0 1)))

```



```

        tmp2))))))
      (t
       (setq sigList
        (remdup (msort (|getOplistForConstructorForm| unitForm))))))
      (|say2PerLine|
       (mapcar #'(lambda (x) (|formatOperation| x unit)) sigList))
      (unless (= |$commentedOps| 0)
       (|sayBrightly|
        (list "Functions that are not yet implemented are preceded by"
              (|bright| "--"))))
      (|sayBrightly| "")))
    nil))

```

defun getOplistForConstructorForm

The new form is an op-Alist which has entries

```
(<op> . signature-Alist)
```

where signature-Alist has entries

```
(<signature> . item)
```

where item has form (|slotNumber_{*i*} |condition_{*i*} |kind_{*i*})

```
(<slotNumber> <condition> <kind>)
```

where |kind_{*i*} = ELT — CONST — Subsumed — (XLAM..) ..

```
<kind> = ELT | CONST | Subsumed | (XLAM..) ..
```

— defun getOplistForConstructorForm —

```

(defun |getOplistForConstructorForm| (form)
  (let (argl pairlis opAlist op signatureAlist result)
    (declare (special |$FormalMapVariableList|))
    (setq op (car form))
    (setq argl (cdr form))
    (setq pairlis
     (loop for fv in |$FormalMapVariableList|
           for arg in argl
           collect (cons fv arg)))
    (setq opAlist (|getOperationAlistFromLisplib| op))

```

```
(loop for item in opAlist do
  (setq op (car item))
  (setq signatureAlist (cdr item))
  (setq result
    (append result
      (|getOplistWithUniqueSignatures| op pairlis signatureAlist))))
result))
```

defun getOplistWithUniqueSignatures

— defun getOplistWithUniqueSignatures —

```
(defun |getOplistWithUniqueSignatures| (op pairlis signatureAlist)
  (let (sig slotNumber pred kind alist)
    (loop for item in signatureAlist
      when (not (eq (fourth item) '|Subsumed|))
      do
        (setq sig (first item))
        (setq slotNumber (second item))
        (setq pred (third item))
        (setq kind (fourth item))
        (setq alist
          (|insertAlist|
            (sublis pairlis (list op sig))
            (sublis pairlis (list pred (list kind nil slotNumber)))
            alist)))
    alist))
```

defun reportOpsFromUnitDirectly1

```
[pathname p1042]
[erase p??]
[defiostream p982]
[sayShowWarning p826]
[reportOpsFromUnitDirectly p821]
[shut p982]
[editFile p545]
[$sayBrightlyStream p??]
[$erase p??]
```

— defun reportOpsFromUnitDirectly1 —

```
(defun |reportOpsFromUnitDirectly1| (D)
  (let (|$sayBrightlyStream| showFile)
    (declare (special |$sayBrightlyStream| $erase))
    (setq showFile (|pathname| (list 'show 'listing 'a)))
    ($erase showFile)
    (setq |$sayBrightlyStream|
      (defiostream '((file ,showFile) (mode . output)) 255 0))
    (|sayShowWarning|)
    (|reportOpsFromUnitDirectly| D)
    (shut |$sayBrightlyStream|)
    (|editFile| showFile)))
```

—————

defun sayShowWarning

[sayBrightly p??]

— defun sayShowWarning —

```
(defun |sayShowWarning| ()
  (|sayBrightly|
    "Warning: this is a temporary file and will be deleted the next")
  (|sayBrightly|
    "      time you use )show. Rename it and FILE if you wish to")
  (|sayBrightly| "      save the contents.")
  (|sayBrightly| ""))
```

—————

Chapter 47

)spool help page Command

47.1 spool help page man page

— spool.help —

```
=====
A.23. )spool
=====
```

User Level Required: interpreter

Command Syntax:

-)spool [fileName]
-)spool

Command Description:

This command is used to save (spool) all AXIOM input and output into a file, called a spool file. You can only have one spool file active at a time. To start spool, issue this command with a filename. For example,

```
)spool integrate.out
```

To stop spooling, issue)spool with no filename.

If the filename is qualified with a directory, then the output will be placed in that directory. If no directory information is given, the spool file will be placed in the current directory. The current directory is the directory from which you started AXIOM or is the directory you specified using the)cd command.

Also See:

- o)cd

[1](#)

¹ “cd” (?? p ??)

Chapter 48

)summary help page Command

48.1 summary help page man page

— summary.help —

```
)credits      : list the people who have contributed to Axiom

)help <command> gives more information
)quit        : exit AXIOM

)abbreviation : query, set and remove abbreviations for constructors
)cd           : set working directory
)clear        : remove declarations, definitions or values
)close        : throw away an interpreter client and workspace
)compile      : invoke constructor compiler
)copyright    : show copyright and trademark information
)describe     : show database information for a category, domain, or package
)display      : display Library operations and objects in your workspace
)edit         : edit a file
)frame        : manage interpreter workspaces
)history      : manage aspects of interactive session
)library      : introduce new constructors
)lisp         : evaluate a LISP expression
)read         : execute AXIOM commands from a file
)savesystem   : save LISP image to a file
)set          : view and set system variables
)show         : show constructor information
)spool        : log input and output to a file
)synonym      : define an abbreviation for system commands
)system       : issue shell commands
)trace        : trace execution of functions
)undo         : restore workspace to earlier state
```

)what : search for various things by name

defun summary

[obey p??]
 [concat p[1047](#)]
 [getenvirom p[29](#)]

— defun summary —

```
(defun |summary| (l)
  (declare (ignore l))
  (obey (concat "cat " (getenvirom "AXIOM") "/doc/spadhelp/summary.help")))
```

Chapter 49

)synonym help page Command

49.1 synonym help page man page

— synonym.help —

```
=====
A.24. )synonym
=====
```

User Level Required: interpreter

Command Syntax:

-)synonym
-)synonym synonym fullCommand
-)what synonyms

Command Description:

This command is used to create short synonyms for system command expressions. For example, the following synonyms might simplify commands you often use.

```
)synonym save      history )save
)synonym restore   history )restore
)synonym mail      system mail
)synonym ls        system ls
)synonym fortran   set output fortran
```

Once defined, synonyms can be used in place of the longer command expressions. Thus

```
)fortran on
```


is the same as the longer

```
)set fortran output on
```

To list all defined synonyms, issue either of

```
)synonyms
)what synonyms
```

To list, say, all synonyms that contain the substring ‘‘ap’’, issue

```
)what synonyms ap
```

Also See:

- o)set
- o)what

¹

defun The)synonym command

[synonymSpad2Cmd p832]

— defun synonym —

```
(defun |synonym| (&rest ignore)
  (declare (ignore ignore))
  (|synonymSpad2Cmd|))
```

defun The)synonym command implementation

```
[getSystemCommandLine p833]
[printSynonyms p474]
[processSynonymLine p835]
[putalist p??]
[terminateSystemCommand p452]
[$CommandSynonymAlist p478]
```

— defun synonymSpad2Cmd —

¹ “set” (45.36 p 808) “what” (54.1 p 939)

```
(defun |synonymSpad2Cmd| ()
  (let (line pair)
    (declare (special |$CommandSynonymAlist|))
    (setq line (|getSystemCommandLine|))
    (if (string= line "")
      (|printSynonyms| nil)
      (progn
        (setq pair (|processSynonymLine| line))
        (if |$CommandSynonymAlist|
          (putalist |$CommandSynonymAlist| (car pair) (cdr pair))
          (setq |$CommandSynonymAlist| (cons pair nil))))))
    (|terminateSystemCommand|)))
```

defun Return a sublist of applicable synonyms

The argument is a list of synonyms, and this returns a sublist of applicable synonyms at the current user level. [string2id-n p??]

[selectOptionLC p479]

[commandsForUserLevel p448]

[\$systemCommands p443]

[\$UserLevel p807]

— defun synonymsForUserLevel —

```
(defun |synonymsForUserLevel| (arg)
  (let (cmd nl)
    (declare (special |$systemCommands| |$UserLevel|))
    (if (eq |$UserLevel| '|development|)
      arg
      (dolist (syn (reverse arg))
        (setq cmd (string2id-n (cdr syn) 1))
        (when (|selectOptionLC| cmd (|commandsForUserLevel| |$systemCommands|) nil)
          (push syn nl))))
    nl))
```

defun Get the system command from the input line

[strpos p1045]

[substring p??]

[\$currentLine p??]

— defun `getSystemCommandLine` —

```
(defun |getSystemCommandLine| ()
  (let (p line)
    (declare (special |$currentLine|))
    (setq p (strpos ")" |$currentLine| 0 nil))
    (if p
      (setq line (substring |$currentLine| p nil))
      (setq line |$currentLine|))
    (string-left-trim '#\space) line)))
```

—————

defun Remove system keyword

```
[dropLeadingBlanks p??]
[maxindex p??]
```

— defun `processSynonymLine,removeKeyFromLine` —

```
(defun |processSynonymLine,removeKeyFromLine| (line)
  (prog (mx)
    (return
      (seq
        (setq line (|dropLeadingBlanks| line))
        (setq mx (maxindex line))
        (exit
          (do ((i 0 (1+ i)))
            ((> i mx) nil)
            (seq
              (exit
                (if (char= (elt line i) #\space)
                  (exit
                    (return
                     (do ((j (1+ i) (1+ j)))
                       ((> j mx) nil)
                       (seq
                        (exit
                          (if (char\= (elt line j) #\space)
                            (exit
                              (return
                               (substring line j nil))))))))))))))))))
```

—————

defun processSynonymLine[processSynonymLine,removeKeyFromLine p[834](#)]

— defun processSynonymLine —

```
(defun |processSynonymLine| (line)
  (cons
    (string2id-n line 1)
    (|processSynonymLine,removeKeyFromLine| line)))
```

—————

This command is in the list of `$noParseCommands` [18.1](#) which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` [18.2](#)

Chapter 50

)system help page Command

50.1 system help page man page

— system.help —

```
=====
A.25. )system
=====
```

User Level Required: interpreter

Command Syntax:

-)system cmdExpression

Command Description:

This command may be used to issue commands to the operating system while remaining in AXIOM. The cmdExpression is passed to the operating system for execution.

To get an operating system shell, issue, for example,)system sh. When you enter the key combination, Ctrl-D (pressing and holding the Ctrl key and then pressing the D key) the shell will terminate and you will return to AXIOM. We do not recommend this way of creating a shell because Lisp may field some interrupts instead of the shell. If possible, use a shell running in another window.

If you execute programs that misbehave you may not be able to return to AXIOM. If this happens, you may have no other choice than to restart AXIOM and restore the environment via)history)restore, if possible.

Also See:

- o `)boot`
- o `)fin`
- o `)lisp`
- o `)pquit`
- o `)quit`

¹

This command is in the list of `$noParseCommands` [18.1](#) which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` [18.2](#)

¹ “boot” ([4.1 p 23](#)) “fin” ([31.1 p 548](#)) “lisp” (?? p ??) “pquit” ([40.2 p 634](#)) “quit” ([41.2 p 638](#))

Chapter 51

)tangle help page Command

51.1 tangle help page man page

— tangle.help —

```
=====
A.19. )tangle
=====
```

User Level Required: interpreter

Command Syntax:

-)tangle [fileName]

Command Description:

This command is used to tangle pamphlet files.

)tangle matrix.input.pamphlet

will tangle the contents of the file matrix.input.pamphlet into matrix.input. The ‘.input.pamphlet’ is optional.

—————

— defun tangle —

```
(defun |tangle| (arg)
  (let (|$InteractiveMode| namestring dot1 dot2 outfile
```



```

      (chunkname "*" (extension "input"))
(declare (special |$InteractiveMode| |$Options|))
(setq |$InteractiveMode| t)
(setq namestring (symbol-name (car arg)))
(setq dot1 (position #\. namestring))
(if dot1
  (setq outfile
    (concatenate 'string (subseq namestring 0 dot1) "." extension))
  (setq outfile
    (concatenate 'string (subseq namestring 0) "." extension)))
(setq dot2 (position #\. namestring :from-end t))
(cond
  ((and (numberp dot1) (numberp dot2) (< dot1 dot2)))
  ((and (numberp dot1) (numberp dot2) (= dot1 dot2))
   (setq namestring (concatenate 'string namestring ".pamphlet")))
  (t
   (setq namestring (concatenate 'string namestring ".input.pamphlet"))))
(if (probe-file namestring)
  (progn
    (tangle namestring chunkname outfile)
    (format t (concatenate 'string outfile " created from " namestring "%"))))
  (format t (concatenate 'string namestring " file not found~%"))))

```

Chapter 52

)trace help page Command

52.1 trace help page man page

— trace.help —

```
=====
A.26. )trace
=====
```

User Level Required: interpreter

Command Syntax:

-)trace
-)trace)off

-)trace function [options]
-)trace constructor [options]
-)trace domainOrPackage [options]

where options can be one or more of

-)after S-expression
-)before S-expression
-)break after
-)break before
-)cond S-expression
-)count
-)count n
-)depth n
-)local op1 [... opN]
-)nonquietly

```

- )nt
- )off
- )only listOfDataToDisplay
- )ops
- )ops op1 [... opN ]
- )restore
- )stats
- )stats reset
- )timer
- )varbreak
- )varbreak var1 [... varN ]
- )vars
- )vars var1 [... varN ]
- )within executingFunction

```

Command Description:

This command is used to trace the execution of functions that make up the AXIOM system, functions defined by users, and functions from the system library. Almost all options are available for each type of function but exceptions will be noted below.

To list all functions, constructors, domains and packages that are traced, simply issue

```
)trace
```

To untrace everything that is traced, issue

```
)trace )off
```

When a function is traced, the default system action is to display the arguments to the function and the return value when the function is exited. Note that if a function is left via an action such as a THROW, no return value will be displayed. Also, optimization of tail recursion may decrease the number of times a function is actually invoked and so may cause less trace information to be displayed. Other information can be displayed or collected when a function is traced and this is controlled by the various options. Most options will be of interest only to AXIOM system developers. If a domain or package is traced, the default action is to trace all functions exported.

Individual interpreter, lisp or boot functions can be traced by listing their names after)trace. Any options that are present must follow the functions to be traced.

```
)trace f
```

traces the function f. To untrace f, issue

```
)trace f )off
```

Note that if a function name contains a special character, it will be necessary to escape the character with an underscore

```
)trace _/D_,1
```

To trace all domains or packages that are or will be created from a particular constructor, give the constructor name or abbreviation after)trace.

```
)trace MATRIX
```

```
)trace List Integer
```

The first command traces all domains currently instantiated with Matrix. If additional domains are instantiated with this constructor (for example, if you have used Matrix(Integer) and Matrix(Float)), they will be automatically traced. The second command traces List(Integer). It is possible to trace individual functions in a domain or package. See the)ops option below.

The following are the general options for the)trace command.

```
)break after
```

causes a Lisp break loop to be entered after exiting the traced function.

```
)break before
```

causes a Lisp break loop to be entered before entering the traced function.

```
)break
```

is the same as)break before.

```
)count
```

causes the system to keep a count of the number of times the traced function is entered. The total can be displayed with)trace)stats and cleared with)trace)stats reset.

```
)count n
```

causes information about the traced function to be displayed for the first n executions. After the nth execution, the function is untraced.

```
)depth n
```

causes trace information to be shown for only n levels of recursion of the traced function. The command

```
)trace fib )depth 10
```

will cause the display of only 10 levels of trace information for the recursive execution of a user function fib.

)math
causes the function arguments and return value to be displayed in the AXIOM monospace two-dimensional math format.

)nonquietly
causes the display of additional messages when a function is traced.

)nt
This suppresses all normal trace information. This option is useful if the **)count** or **)timer** options are used and you are interested in the statistics but not the function calling information.

)off
causes untracing of all or specific functions. Without an argument, all functions, constructors, domains and packages are untraced. Otherwise, the given functions and other objects are untraced. To immediately retrace the untraced functions, issue **)trace** **)restore**.

)only listOfDataToDisplay
causes only specific trace information to be shown. The items are listed by using the following abbreviations:

a	display all arguments
v	display return value
1	display first argument
2	display second argument
15	display the 15th argument, and so on

)restore
causes the last untraced functions to be retraced. If additional options are present, they are added to those previously in effect.

)stats
causes the display of statistics collected by the use of the **)count** and **)timer** options.

)stats reset
resets to 0 the statistics collected by the use of the **)count** and **)timer** options.

)timer
causes the system to keep a count of execution times for the traced function. The total can be displayed with **)trace** **)stats** and cleared with **)trace** **)stats reset**.

)varbreak var1 [... varN]
causes a Lisp break loop to be entered after the assignment to any of the listed variables in the traced function.

)vars

causes the display of the value of any variable after it is assigned in the traced function. Note that library code must have been compiled (see description of command `)compile`) using the `)vartrace` option in order to support this option.

`)vars var1 [... varN]`

causes the display of the value of any of the specified variables after they are assigned in the traced function. Note that library code must have been compiled (see description of command `)compile`) using the `)vartrace` option in order to support this option.

`)within executingFunction`

causes the display of trace information only if the traced function is called when the given `executingFunction` is running.

The following are the options for tracing constructors, domains and packages.

`)local [op1 [... opN]]`

causes local functions of the constructor to be traced. Note that to untrace an individual local function, you must use the fully qualified internal name, using the escape character `_` before the semicolon.

`)trace FRAC)local`

`)trace FRAC_;cancelGcd)off`

`)ops op1 [... opN]`

By default, all operations from a domain or package are traced when the domain or package is traced. This option allows you to specify that only particular operations should be traced. The command

`)trace Integer)ops min max _+ _-`

traces four operations from the domain `Integer`. Since `+` and `-` are special characters, it is necessary to escape them with an underscore.

Also See:

- o `)boot`
- o `)lisp`
- o `)ltrace`

1

The trace global variables

This decides when to give trace and untrace messages.

¹ “boot” (4.1 p 23) “lisp” (?? p ??) “ltrace” (39.1 p 632)

defvar \$traceNoisely

— initvars —

`(defvar |$traceNoisely| nil)`

—————

defvar \$reportSpadtrace

This reports the traced functions

— initvars —

`(defvar |$reportSpadtrace| nil)`

—————

defvar \$optionAlist

— initvars —

`(defvar |$optionAlist| nil)`

—————

defvar \$tracedMapSignatures

— initvars —

`(defvar |$tracedMapSignatures| nil)`

—————

defvar \$traceOptionList

— initvars —

```
(defvar |$traceOptionList|
  '(|after| |before| |break| |cond| |count| |depth| |local| |mathprint|
    |nonquietly| |nt| |of| |only| |ops| |restore| |timer| |varbreak|
    |vars| |within|))
```

defun trace

[traceSpad2Cmd p847]

— defun trace —

```
(defun |trace| (l)
  (|traceSpad2Cmd| l))
```

defun traceSpad2Cmd

```
[qcar p??]
[qcdr p??]
[getMapSubNames p869]
[trace1 p848]
[augmentTraceNames p872]
[traceReply p899]
[$mapSubNameAlist p??]
```

— defun traceSpad2Cmd —

```
(defun |traceSpad2Cmd| (l)
  (let (tmp1 l1)
    (declare (special |$mapSubNameAlist|))
    (cond
      ((and (consp l)
        (eq (qcar l) '|Tuple|)
        (progn
          (setq tmp1 (qcdr l))
          (and (consp tmp1)
            (eq (qcdr tmp1) nil)
            (progn
              (setq l1 (qcar tmp1))
              t))))
        (setq l l1)))
    (setq |$mapSubNameAlist| (|getMapSubNames| l))
```



```
(|trace1| (|augmentTraceNames| 1))
(|traceReply|)))
```

defun trace1

```
[hasOption p451]
[throwKeyedMsg p??]
[unabbrev p??]
[isFunctor p??]
[getTraceOption p854]
[untraceDomainLocalOps p880]
[qslessp p1068]
[poundsign p??]
[untrace p862]
[centerAndHighlight p??]
[ptimers p859]
[say p??]
[pcounters p860]
[selectOptionLC p479]
[resetSpacers p858]
[resetTimers p858]
[resetCounters p858]
[qcar p??]
[qcdr p??]
[vecp p??]
[sayKeyedMsg p329]
[devaluate p??]
[lassoc p??]
[trace1 p848]
[delete p??]
[?t p902]
[seq p??]
[exit p??]
[transTraceItem p863]
[addassoc p??]
[getTraceOptions p852]
[/trace,0 p??]
[saveMapSig p853]
[$traceNoisely p846]
[$options p??]
[$lastUntraced p??]
[$optionAlist p846]
```

— defun trace1 —

```
(defun |trace1| (arg)
  (prog (|$traceNoisely| constructor ops lops temp1 opt a
        oldl newoptions domain tracelist optionlist domainlist
        oplist y varlist argument)
    (declare (special |$traceNoisely| |$options| |$lastUntraced|
                      |$optionAlist|))
    (return
     (seq
      (progn
       (setq |$traceNoisely| nil)
       (cond
        ((|hasOption| |$options| '|nonquietly|)
         (setq |$traceNoisely| t)))
       (cond
        ((|hasOption| |$options| '|off|)
         (cond
          ((or (setq ops (|hasOption| |$options| '|ops|))
               (setq lops (|hasOption| |$options| '|local|)))
           (cond
            ((null arg) (|throwKeyedMsg| 's2it0019 nil))
            (t
             (setq constructor
                    (|unabbrev|
                     (cond
                      ((atom arg) arg)
                      ((null (cdr arg))
                       (cond
                        ((atom (car arg)) (car arg))
                        (t (car (car arg))))
                     (t nil))))))
            (cond
             ((null (|isFunction| constructor))
              (|throwKeyedMsg| 's2it0020 nil))
             (t
              (cond (ops (setq ops (|getTraceOption| ops)) nil))
              (cond
               (lops
                (setq lops (cdr (|getTraceOption| lops)))
                (|untraceDomainLocalOps|)
                (t nil)))))))
            ((and (qslessp 1 (|#| |$options|))
                  (null (|hasOption| |$options| '|nonquietly|)))
             (|throwKeyedMsg| 's2it0021 nil))
            (t (|untrace| arg))))
        ((|hasOption| |$options| '|stats|)
         (cond
          ((qslessp 1 (|#| |$options|))
```

```

(|throwKeyedMsg| 's2it0001 (cons ")trace ... )stats" nil)))
(t
  (setq temp1 (car |$options|))
  (setq opt (cdr temp1))
  (cond
    ((null opt)
      (|centerAndHighlight| "Traced function execution times" 78 '-)
      (|ptimers|)
      (say " ")
      (|centerAndHighlight| "Traced function execution counts" 78 '-)
      (|pcounters|))
    (t
      (|selectOptionLC| (car opt) '(|reset|) '|optionError|)
      (|resetSpacers|)
      (|resetTimers|)
      (|resetCounters|)
      (|throwKeyedMsg| 's2it0002 nil))))))
((setq a (|hasOption| |$options| '|restore|))
  (unless (setq oldl |$lastUntraced|)
    (setq newoptions (|delete| a |$options|))
    (if (null arg)
      (|trace1| oldl)
      (progn
        (dolist (x arg)
          (if (and (consp x)
                    (progn
                     (setq domain (qcar x))
                     (setq oplist (qcdr x))
                     t)
                (vecp domain)))
            (|sayKeyedMsg| 's2it0003 (cons (|devalue| domain) nil))
            (progn
              (setq |$options| (append newoptions (lassoc x |$optionAlist|)))
              (|trace1| (list x))))))))))
((null arg) nil)
((and (consp arg) (eq (qcdr arg) nil) (eq (qcar arg) '?)) (|?t|))
(t
  (setq tracelist
    (or
      (prog (t1)
        (setq t1 nil)
        (return
          (do ((t2 arg (cdr t2)) (x nil))
            ((or (atom t2)
                  (progn (setq x (car t2)) nil))
              (nreverse0 t1))
            (seq
              (exit
                (setq t1 (cons (|transTraceItem| x) t1)))))))
      (return nil)))

```

```

(do ((t3 tracelist (cdr t3)) (x nil))
  ((or (atom t3) (progn (setq x (car t3)) nil)) nil)
  (seq
   (exit
    (setq |$optionAlist| (addassoc x |$options| |$optionAlist|))))))
(setq optionlist (|getTraceOptions| |$options|))
(setq argument
 (cond
  ((setq domainlist (lassoc '|of| optionlist))
   (cond
    ((lassoc '|ops| optionlist)
     (|throwKeyedMsg| 's2it0004 nil))
    (t
     (setq oplist
      (cond
       (tracelist (list (cons '|ops| tracelist)))
       (t nil)))
      (setq varlist
       (cond
        ((setq y (lassoc '|vars| optionlist))
         (list (cons '|vars| y)))
        (t nil)))
       (append domainlist (append oplist varlist))))))
  (optionlist (append tracelist optionlist))
  (t tracelist)))
(|/TRACE,0|
 (prog (t4)
  (setq t4 nil)
  (return
   (do ((t5 argument (cdr t5)) (|funName| nil))
     ((or (atom t5)
      (progn (setq |funName| (car t5)) nil))
      (nreverse0 t4))
     (seq
      (exit
       (setq t4 (cons |funName| t4))))))))
(|saveMapSig|
 (prog (t6)
  (setq t6 nil)
  (return
   (do ((t7 argument (cdr t7)) (|funName| nil))
     ((or (atom t7)
      (progn (setq |funName| (car t7)) nil))
      (nreverse0 t6))
     (seq
      (exit
       (setq t6 (cons |funName| t6))))))))))

```

defun getTraceOptions

```
[throwKeyedMsg p??]
[throwListOfKeyedMsgs p??]
[poundsign p??]
[seq p??]
[exit p??]
[getTraceOption p854]
[$traceErrorStack p??]
```

— defun getTraceOptions —

```
(defun |getTraceOptions| (|options|)
  (prog (|$traceErrorStack| optionlist temp1 key |parms|)
    (declare (special |$traceErrorStack|))
    (return
      (seq
        (progn
          (setq |$traceErrorStack| nil)
          (setq optionlist
            (prog (t0)
              (setq t0 nil)
              (return
                (do ((t1 |options| (cdr t1)) (x nil))
                  ((or (atom t1) (progn (setq x (car t1)) nil)) (nreverse0 t0))
                (seq
                  (exit
                    (setq t0 (cons (|getTraceOption| x) t0))))))))))
          (cond
            (|$traceErrorStack|
              (cond
                ((null (cdr |$traceErrorStack|))
                  (setq temp1 (car |$traceErrorStack|))
                  (setq key (car temp1))
                  (setq |parms| (cadr temp1))
                  (|throwKeyedMsg| key (cons "" |parms|)))
                (t
                  (|throwListOfKeyedMsgs| 's2it0017
                    (cons (|#| |$traceErrorStack|) nil)
                    (nreverse |$traceErrorStack|))))
              (t optionlist))))))
```

defun saveMapSig

```
[rassoc p??]
[addassoc p??]
[getMapSig p853]
[$tracedMapSignatures p846]
[$mapSubNameAlist p??]
```

— defun saveMapSig —

```
(defun |saveMapSig| (funnames)
  (let (map)
    (declare (special |$tracedMapSignatures| |$mapSubNameAlist|))
    (dolist (name funnames)
      (when (setq map (|rassoc| name |$mapSubNameAlist|))
        (setq |$tracedMapSignatures|
              (addassoc name (|getMapSig| map name) |$tracedMapSignatures|))))))
```

—————

defun getMapSig

```
[get p??]
[boot-equal p??]
[$InteractiveFrame p??]
```

— defun getMapSig —

```
(defun |getMapSig| (mapname subname)
  (let (lmms sig)
    (declare (special |$InteractiveFrame|))
    (when (setq lmms (|get| mapname '|localModemap| |$InteractiveFrame|))
      (do ((t0 lmms (cdr t0)) (|mm| nil) (t1 nil sig))
          ((or (atom t0) (progn (setq |mm| (car t0)) nil) t1) nil)
        (when (boot-equal (cadr |mm|) subname) (setq sig (cdar |mm|))))
      sig)))
```

—————

defun getTraceOption,hn

```
[seq p??]
[exit p??]
[isDomainOrPackage p875]
```

[stackTraceOptionError p861]
 [domainToGenvar p861]

— defun getTraceOption,hn —

```
(defun |getTraceOption,hn| (x)
  (prog (g)
    (return
      (seq
        (if (and (atom x) (null (upper-case-p (elt (princ-to-string x) 0))))
          (exit
            (seq
              (if (|isDomainOrPackage| (eval x)) (exit x))
              (exit
                (|stackTraceOptionError|
                  (cons 's2it0013 (cons (cons x nil) nil)))))))
          (if (setq g (|domainToGenvar| x)) (exit g))
          (exit
            (|stackTraceOptionError| (cons 's2it0013 (cons (cons x nil) nil)))))))
```

—————

defun getTraceOption

[seq p??]
 [exit p??]
 [selectOptionLC p479]
 [identp p1046]
 [stackTraceOptionError p861]
 [concat p1047]
 [object2String p??]
 [transOnlyOption p860]
 [qcdr p??]
 [qcar p??]
 [getTraceOption,hn p853]
 [isListOfIdentifiersOrStrings p869]
 [isListOfIdentifiers p868]
 [throwKeyedMsg p??]
 [\$traceOptionList p846]

— defun getTraceOption —

```
(defun |getTraceOption| (arg)
  (prog (l |opts| key a |n|)
    (declare (special |$traceOptionList|))
    (return
```

```

(seq
  (progn
    (setq key (car arg))
    (setq l (cdr arg))
    (setq key
      (|selectOptionLC| key |$traceOptionList| '|traceOptionError|))
    (setq arg (cons key l))
    (cond
      ((member key '(|nonquietly| |timer| |nt|)) arg)
      ((eq key '|break|)
        (cond
          ((null l) (cons '|break| (cons '|before| nil)))
          (t
            (setq |opts|
              (prog (t0)
                (setq t0 nil)
                (return
                  (do ((t1 l (cdr t1)) (y nil))
                    ((or (atom t1)
                        (progn (setq y (car t1)) nil))
                     (nreverse0 t0))
                  (seq
                    (exit
                     (setq t0
                       (cons
                        (|selectOptionLC| y '(|before| |after|) nil) t0))))))))
            (cond
              ((prog (t2)
                (setq t2 t)
                (return
                  (do ((t3 nil (null t2)) (t4 |opts| (cdr t4)) (y nil))
                    ((or t3 (atom t4) (progn (setq y (car t4)) nil)) t2)
                  (seq
                    (exit
                     (setq t2 (and t2 (identp y))))))))
                (cons '|break| |opts|))
              (t
                (|stackTraceOptionError| (cons 's2it0008 (cons nil nil))))))
          ((eq key '|restore|)
            (cond
              ((null l) arg)
              (t
                (|stackTraceOptionError|
                  (cons 's2it0009
                    (cons (cons (concat ")" (|object2String| key)) nil) nil))))))
          ((eq key '|only|) (cons '|only| (|transOnlyOption| 1)))
          ((eq key '|within|)
            (cond
              ((and (consp l)
                (eq (qcdr l) nil)

```



```

        (progn (setq a (qcar 1)) t)
        (identp a))
    arg)
  (t
    (|stackTraceOptionError|
      (cons 's2it0010 (cons (cons ")within" nil) nil))))))
  ((member key '(|cond| |before| |after|))
    (setq key
      (cond
        ((eq key '(|cond|) '|when|)
          (t key)))
      (cond
        ((and (consp 1)
              (eq (qcdr 1) nil)
              (progn (setq a (qcar 1)) t))
          (cons key 1))
        (t
          (|stackTraceOptionError|
            (cons 's2it0011
              (cons
                (cons (concat ")")
                  (|object2String| key)) nil) nil))))))
    ((eq key '|depth|)
      (cond
        ((and (consp 1)
              (eq (qcdr 1) nil)
              (progn (setq |n| (qcar 1)) t)
              (integerp |n|))
          arg)
        (t
          (|stackTraceOptionError|
            (cons 's2it0012 (cons (cons ")depth" nil) nil))))))
    ((eq key '|count|)
      (cond
        ((or (null 1)
              (and (consp 1)
                    (eq (qcdr 1) nil)
                    (progn (setq |n| (qcar 1)) t)
                    (integerp |n|)))
          arg)
        (t
          (|stackTraceOptionError|
            (cons 's2it0012 (cons (cons ")count" nil) nil))))))
    ((eq key '|of|)
      (cons '|of|
        (prog (t5)
          (setq t5 nil)
          (return
            (do ((t6 1 (cdr t6)) (y nil))
              ((or (atom t6) (progn (setq y (car t6)) nil)) (nreverse0 t5))

```

```

      (seq
        (exit
          (setq t5 (cons (|getTraceOption,hn| y) t5)))))))))
((member key '(|local| ops |vars|))
 (cond
  ((or (null 1)
        (and (consp 1) (eq (qcdr 1) nil) (eq (qcar 1) '|all|)))
   (cons key '|all|))
  ((|isListOfIdentifiersOrStrings| 1) arg)
  (t
   (|stackTraceOptionError|
    (cons 's2it0015
      (cons
        (cons (concat ")") (|object2String| key)) nil) nil))))))
((eq key '|varbreak|)
 (cond
  ((or (null 1)
        (and (consp 1) (eq (qcdr 1) nil) (eq (qcar 1) '|all|)))
   (cons '|varbreak| '|all|))
  ((|isListOfIdentifiers| 1) arg)
  (t
   (|stackTraceOptionError|
    (cons 's2it0016
      (cons
        (cons (concat ")") (|object2String| key)) nil) nil))))))
((eq key '|mathprint|)
 (cond
  ((null 1) arg)
  (t
   (|stackTraceOptionError|
    (cons 's2it0009
      (cons
        (cons (concat ")") (|object2String| key)) nil) nil))))))
(key (|throwKeyedMsg| 's2it0005 (cons key nil)))))))))

```

defun traceOptionError

[stackTraceOptionError p861]
[commandAmbiguityError p452]

— defun traceOptionError —

```

(defun |traceOptionError| (opt keys)
  (if (null keys)
      (|stackTraceOptionError| (cons 's2it0007 (cons (cons opt nil) nil)))

```

```
(|commandAmbiguityError| '|trace option| opt keys)))
```

defun resetTimers

```
[concat p1047]
[/timerlist p??]
```

— defun resetTimers —

```
(defun |resetTimers| ()
  (declare (special /timerlist))
  (dolist (timer /timerlist)
    (set (intern (concat timer ",TIMER")) 0)))
```

defun resetSpacers

```
[concat p1047]
[/spacelist p??]
```

— defun resetSpacers —

```
(defun |resetSpacers| ()
  (declare (special /spacelist))
  (dolist (spacer /spacelist)
    (set (intern (concat spacer ",SPACE")) 0)))
```

defun resetCounters

```
[concat p1047]
[/countlist p??]
```

— defun resetCounters —

```
(defun |resetCounters| ()
  (declare (special /countlist))
  (dolist (k /countlist)
    (set (intern (concat k ",COUNT")) 0)))
```

defun ptimers

```
[sayBrightly p??]
[bright p??]
[quotient p??]
[concat p1047]
[float p??]
[/timerlist p??]
```

— defun ptimers —

```
(defun |ptimers| ()
  (declare (special /timerlist |$timerTicksPerSecond|))
  (if (null /timerlist)
    (|sayBrightly| " no functions are timed")
    (dolist (timer /timerlist)
      (|sayBrightly|
        '(" " ,@( |bright| timer) |:| " "
          ,(quotient (eval (intern (concat timer " ,TIMER"))
            (|float| |$timerTicksPerSecond|)) " sec."))))))
```

defun pspacers

```
[sayBrightly p??]
[bright p??]
[concat p1047]
[/spacelist p??]
```

— defun pspacers —

```
(defun |pspacers| ()
  (declare (special /spacelist))
  (if (null /spacelist)
    (|sayBrightly| " no functions have space monitored")
    (dolist (spacer /spacelist)
      (|sayBrightly|
        '(" " ,@( |bright| spacer) |:|
          ,(eval (intern (concat spacer " ,SPACE")) " bytes")))))
```

defun pcounters

```
[sayBrightly p??]
[bright p??]
[concat p1047]
[/countlist p??]
```

— defun pcounters —

```
(defun |pcounters| ()
  (declare (special /countlist))
  (if (null /countlist)
      (|sayBrightly| " no functions are being counted")
      (dolist (k /countlist)
        (|sayBrightly|
         '(" " ,@(|bright| k) |:| " " ,(eval (intern (concat k ",COUNT"))))
         " times")))))
```

defun transOnlyOption

```
[transOnlyOption p860]
[upcase p??]
[stackTraceOptionError p861]
[qcar p??]
[qcdr p??]
```

— defun transOnlyOption —

```
(defun |transOnlyOption| (arg)
  (let (y n)
    (when (and (consp arg) (progn (setq n (qcar arg)) (setq y (qcdr arg)) t))
      (cond
        ((integerp n) (cons n (|transOnlyOption| y)))
        ((member (setq n (upcase n)) '(v a c)) (cons n (|transOnlyOption| y)))
        (t
         (|stackTraceOptionError| (cons 's2it0006 (list (list n))))
         (|transOnlyOption| y)))))
```

defun stackTraceOptionError

[[\\$traceErrorStack p??](#)]

— defun stackTraceOptionError —

```
(defun |stackTraceOptionError| (x)
  (declare (special |$traceErrorStack|))
  (push x |$traceErrorStack|)
  nil)
```

—————

defun removeOption

— defun removeOption —

```
(defun |removeOption| (op options)
  (let (opt t0)
    (do ((t1 options (cdr t1)) (optentry nil))
        ((or (atom t1)
              (progn (setq optentry (car t1)) nil)
                    (progn (progn (setq opt (car optentry)) optentry) nil))
         (nreverse0 t0))
      (when (not (equal opt op)) (setq t0 (cons optentry t0))))))
```

—————

defun domainToGenvar

[[unabbrevAndLoad p??](#)]
 [[getdatabase p1010](#)]
 [[opOf p??](#)]
 [[genDomainTraceName p862](#)]
 [[evalDomain p913](#)]
 [[\\$doNotAddEmptyModeIfTrue p??](#)]

— defun domainToGenvar —

```
(defun |domainToGenvar| (arg)
  (let (|$doNotAddEmptyModeIfTrue| y g)
    (declare (special |$doNotAddEmptyModeIfTrue|))
    (setq |$doNotAddEmptyModeIfTrue| t)
```

```
(when
  (and (setq y (|unabbrevAndLoad| arg))
        (eq (getdatabase (|opOf| y) 'constructorkind) '|domain|))
  (setq g (|genDomainTraceName| y))
  (set g (|evalDomain| y))
  g)))
```

defun genDomainTraceName

```
[lassoc p??]
[genvar p??]
[$domainTraceNameAssoc p??]
```

— defun genDomainTraceName —

```
(defun |genDomainTraceName| (y)
  (let (u g)
    (declare (special |$domainTraceNameAssoc|))
    (if (setq u (lassoc y |$domainTraceNameAssoc|))
        u
        (progn
          (setq g (genvar))
          (setq |$domainTraceNameAssoc| (cons (cons y g) |$domainTraceNameAssoc|))
          g))))
```

defun untrace

```
[copy p??]
[transTraceItem p863]
[/untrace,0 p??]
[lassocSub p871]
[removeTracedMapSigs p864]
[$lastUntraced p??]
[$mapSubNameAlist p??]
[/tracenames p??]
```

— defun untrace —

```
(defun |untrace| (arg)
  (let (untracelist)
```

```
(declare (special |$lastUntraced| /tracenames |$mapSubNameAlist|))
(if arg
  (setq |$lastUntraced| arg)
  (setq |$lastUntraced| (copy /tracenames)))
(setq untracelist
  (do ((t1 arg (cdr t1)) (x nil) (t0 nil))
      ((or (atom t1) (progn (setq x (car t1)) nil))
       (nreverse0 t0))
      (push (|transTraceItem| x) t0)))
(|/UNTRACE,0|
  (do ((t3 untracelist (cdr t3)) (|funName| nil) (t2 nil))
      ((or (atom t3) (progn (setq |funName| (car t3)) nil))
       (nreverse0 t2))
      (push (|lassocSub| |funName| |$mapSubNameAlist|) t2)))
  (|removeTracedMapSigs| untracelist)))
```

defun transTraceItem

```
[get p??]
[member p1048]
[objMode p??]
[objVal p??]
[domainToGenvar p861]
[unabbrev p??]
[constructor? p??]
[vecp p??]
[transTraceItem p863]
[devaluate p??]
[throwKeyedMsg p??]
[$doNotAddEmptyModeIfTrue p??]
```

— defun transTraceItem —

```
(defun |transTraceItem| (x)
  (prog (|$doNotAddEmptyModeIfTrue| |value| y)
    (declare (special |$doNotAddEmptyModeIfTrue|))
    (return
      (progn
        (setq |$doNotAddEmptyModeIfTrue| t)
        (cond
          ((atom x)
            (cond
              ((and (setq |value| (|get| x '|value| |$InteractiveFrame|))
                    (|member| (|objMode| |value|)
                              '(|Mode|) (|Domain|) (|SubDomain| (|Domain|)))))
```



```

(setq x (|objVal| |value|))
(cond
  ((setq y (|domainToGenvar| x)) y)
  (t x)))
(upper-case-p (elt (princ-to-string x) 0))
(setq y (|unabbrev| x))
(cond
  ((|constructor?| y) y)
  ((and (consp y) (|constructor?| (car y))) (car y))
  ((setq y (|domainToGenvar| x)) y)
  (t x)))
((vecp (car x)) (|transTraceItem| (|devaluate| (car x))))
((setq y (|domainToGenvar| x)) y)
(t (|throwKeyedMsg| 's2it0018 (cons x nil))))))

```

defun removeTracedMapSigs

[[\\$tracedMapSignatures](#) p846]

— defun removeTracedMapSigs —

```

(defun |removeTracedMapSigs| (untraceList)
  (declare (special |$tracedMapSignatures|))
  (dolist (name untraceList)
    (remprop name |$tracedMapSignatures|)))

```

defun coerceTraceArgs2E

[[spadsysnamep](#) p??]
 [[pname](#) p1045]
 [[coerceSpadArgs2E](#) p865]
 [[objValUnwrap](#) p??]
 [[coerceInteractive](#) p??]
 [[objNewWrap](#) p??]
 [[\\$OutputForm](#) p??]
 [[\\$mathTraceList](#) p??]
 [[\\$tracedMapSignatures](#) p846]

— defun coerceTraceArgs2E —

```

(defun |coerceTraceArgs2E| (tracename subname args)
  (declare (ignore tracename))
  (let (name)
    (declare (special |$OutputForm| |$mathTraceList| |$tracedMapSignatures|))
    (cond
      ((member (setq name subname) |$mathTraceList|)
        (if (spadsysnamep (pname name))
          (|coerceSpadArgs2E| (reverse (cdr (reverse args))))
          (do ((t1 '(|arg1| |arg2| |arg3| |arg4| |arg5| |arg6| |arg7| |arg8|
                    |arg9| |arg10| |arg11| |arg12| |arg13| |arg14| |arg15|
                    |arg16| |arg17| |arg18| |arg19|) (cdr t1))
              (name nil)
              (t2 args (cdr t2))
              (arg nil)
              (t3 (cdr (lassoc subname |$tracedMapSignatures|)) (cdr t3))
              (type nil)
              (t0 nil))
            ((or (atom t1)
                 (progn (setq name (car t1)) nil)
                 (atom t2)
                 (progn (setq arg (car t2)) nil)
                 (atom t3)
                 (progn (setq type (car t3)) nil))
              (nreverse0 t0))
          (setq t0
            (cons
              (list '= name
                (|objValUnwrap|
                  (|coerceInteractive|
                    (|objNewWrap| arg type) |$OutputForm|))) t0))))
        ((spadsysnamep (pname name)) (reverse (cdr (reverse args))))
        (t args))))

```

defun coerceSpadArgs2E

```

[seq p??]
[exit p??]
[objValUnwrap p??]
[coerceInteractive p??]
[objNewWrap p??]
[$streamCount p801]
[$OutputForm p??]
[$tracedSpadModemap p??]

```

— defun coerceSpadArgs2E —

```

(defun |coerceSpadArgs2E| (args)
  (let ((|$streamCount| 0))
    (declare (special |$streamCount| |$OutputForm| |$tracedSpadModemap|))
    (do ((t1 '(|arg1| |arg2| |arg3| |arg4| |arg5| |arg6| |arg7| |arg8|
                |arg9| |arg10| |arg11| |arg12| |arg13| |arg14| |arg15|
                |arg16| |arg17| |arg18| |arg19|) (cdr t1))
        (name nil)
        (t2 args (cdr t2))
        (arg nil)
        (t3 (cdr |$tracedSpadModemap|) (cdr t3))
        (type nil)
        (t0 nil))
      ((or (atom t1)
          (progn (setq name (car t1)) nil)
          (atom t2)
          (progn (setq arg (car t2)) nil)
          (atom t3)
          (progn (setq type (car t3)) nil))
       (nreverse0 t0))
      (seq
       (exit
        (setq t0
         (cons
          (cons '=
              (cons name
                    (cons (|objValUnwrap|
                          (|coerceInteractive|
                           (|objNewWrap| arg type)
                           |$OutputForm|)) nil)))
          t0))))))

```

defun subTypes

```

[lassoc p??]
[seq p??]
[exit p??]
[subTypes p866]

```

— defun subTypes —

```

(defun |subTypes| (|mm| |sublist|)
  (prog (s)
    (return
     (seq
      (cond

```

```

((atom |mm|)
 (cond ((setq s (lassoc |mm| |sublist|)) s) (t |mm|)))
(t
 (prog (t0)
  (setq t0 nil)
  (return
   (do ((t1 |mm| (cdr t1)) (|m| nil))
    ((or (atom t1) (progn (setq |m| (car t1)) nil)) (nreverse0 t0))
    (seq
     (exit
      (setq t0 (cons (|subTypes| |m| |sublist|) t0))))))))))

```

defun coerceTraceFunValue2E

```

[spadsysnamep p??]
[pname p1045]
[coerceSpadFunValue2E p868]
[lassoc p??]
[objValUnwrap p??]
[coerceInteractive p??]
[objNewWrap p??]
[$tracedMapSignatures p846]
[$OutputForm p??]
[$mathTraceList p??]

```

— defun coerceTraceFunValue2E —

```

(defun |coerceTraceFunValue2E| (tracename subname |value|)
  (let (name u)
    (declare (special |$tracedMapSignatures| |$OutputForm| |$mathTraceList|))
    (if (member (setq name subname) |$mathTraceList|)
        (cond
         ((spadsysnamep (pname tracename)) (|coerceSpadFunValue2E| |value|))
         ((setq u (lassoc subname |$tracedMapSignatures|))
          (|objValUnwrap|
           (|coerceInteractive| (|objNewWrap| |value| (car u)) |$OutputForm|)))
         (t |value|)))
    |value|)))

```

defun coerceSpadFunValue2E

```
[objValUnwrap p??]
[coerceInteractive p??]
[objNewWrap p??]
[$streamCount p801]
[$tracedSpadModemap p??]
[$OutputForm p??]
```

— **defun coerceSpadFunValue2E** —

```
(defun |coerceSpadFunValue2E| (|value|)
  (let (|$streamCount|)
    (declare (special |$streamCount| |$tracedSpadModemap| |$OutputForm|))
    (setq |$streamCount| 0)
    (|objValUnwrap|
     (|coerceInteractive|
      (|objNewWrap| |value| (car |$tracedSpadModemap|))
      |$OutputForm|))))
```

—————

defun isListOfIdentifiers

```
[seq p??]
[exit p??]
[identp p1046]
```

— **defun isListOfIdentifiers** —

```
(defun |isListOfIdentifiers| (arg)
  (prog ()
    (return
     (seq
      (prog (t0)
        (setq t0 t)
        (return
         (do ((t1 nil (null t0)) (t2 arg (cdr t2)) (x nil))
              ((or t1 (atom t2) (progn (setq x (car t2)) nil)) t0)
          (seq
           (exit
            (setq t0 (and t0 (identp x))))))))))))
```

—————

defun isListOfIdentifiersOrStrings

```
[seq p??]
[exit p??]
[identp p1046]
```

— defun isListOfIdentifiersOrStrings —

```
(defun |isListOfIdentifiersOrStrings| (arg)
  (prog ()
    (return
      (seq
        (prog (t0)
          (setq t0 t)
          (return
            (do ((t1 nil (null t0)) (t2 arg (cdr t2)) (x nil))
              ((or t1 (atom t2) (progn (setq x (car t2)) nil)) t0)
            (seq
              (exit
                (setq t0 (and t0 (or (identp x) (stringp x))))))))))))))
```

defun getMapSubNames

```
[get p??]
[union p??]
[getPreviousMapSubNames p870]
[unionq p??]
[$lastUntraced p??]
[$InteractiveFrame p??]
[/tracenames p??]
```

— defun getMapSubNames —

```
(defun |getMapSubNames| (arg)
  (let (lmm subs)
    (declare (special /tracenames |$lastUntraced| |$InteractiveFrame|))
    (setq subs nil)
    (dolist (mapname arg)
      (when (setq lmm (|get| mapname '|localModemap| |$InteractiveFrame|))
        (setq subs
          (append
            (do ((t2 lmm (cdr t2)) (t1 nil) (lmm nil))
              ((or (atom t2)
                (progn (setq lmm (CAR t2)) nil)) (nreverse0 t1))
```

```

      (setq t1 (cons (cons mapname (cadr |mm|)) t1)))
    subs))))
  (|union| subs
    (|getPreviousMapSubNames| (unionq /tracenames |$lastUntraced|))))))

```

defun getPreviousMapSubNames

```

[get p??]
[exit p??]
[seq p??]

```

— defun getPreviousMapSubNames —

```

(defun |getPreviousMapSubNames| (|traceNames|)
  (prog (lmm subs)
    (return
      (seq
        (progn
          (setq subs nil)
          (seq
            (do ((t0 (assocleft (caar |$InteractiveFrame|)) (cdr t0))
              (mapname nil))
              ((or (atom t0) (progn (setq mapname (car t0)) nil)) nil)
            (seq
              (exit
                (cond
                  ((setq lmm
                     (|get| mapname '|localModemap| |$InteractiveFrame|))
                  (exit
                    (cond
                      ((member (cadar lmm) |traceNames|)
                       (exit
                        (do ((t1 lmm (cdr t1)) (|lmm| nil))
                          ((or (atom t1) (progn (setq |lmm| (car t1)) nil)) nil)
                        (seq
                          (exit
                            (setq subs
                              (cons (cons mapname (cadr |mm|)) subs))))))))))))
                    (exit subs))))))

```

defun lassocSub

[lassq p??]

— defun lassocSub —

```
(defun |lassocSub| (x subs)
  (let (y)
    (if (setq y (lassq x subs))
        y
        x)))
```

—————

defun rassocSub

[rassoc p??]

— defun rassocSub —

```
(defun |rassocSub| (x subs)
  (let (y)
    (if (setq y (|rassoc| x subs))
        y
        x)))
```

—————

defun isUncompiledMap

[get p??]

[\$InteractiveFrame p??]

— defun isUncompiledMap —

```
(defun |isUncompiledMap| (x)
  (let (y)
    (declare (special |$InteractiveFrame|))
    (when (setq y (|get| x 'value |$InteractiveFrame|))
      (and
        (eq (caar y) 'map)
        (null (|get| x 'localModemap |$InteractiveFrame|))))))
```

—————

defun isInterpOnlyMap

```
[get p??]
[$InteractiveFrame p??]
```

— defun isInterpOnlyMap —

```
(defun |isInterpOnlyMap| (map)
  (let (x)
    (declare (special |$InteractiveFrame|))
    (when (setq x (|get| map '|localModemap| |$InteractiveFrame|))
      (eq (caaar x) '|interpOnly|))))
```

defun augmentTraceNames

```
[get p??]
[$InteractiveFrame p??]
```

— defun augmentTraceNames —

```
(defun |augmentTraceNames| (arg)
  (let (mml res)
    (declare (special |$InteractiveFrame|))
    (dolist (tracename arg)
      (if (setq mml (|get| tracename '|localModemap| |$InteractiveFrame|))
        (setq res
          (append
            (prog (t1)
              (setq t1 nil)
              (return
                (do ((t2 mml (cdr t2)) (|mm| nil))
                  ((or (atom t2)
                      (progn (setq |mm| (CAR t2)) nil))
                   (nreverse0 t1))
                (setq t1 (cons (cadr |mm|) t1))))))
            res))
        (setq res (cons tracename res))))
  res))
```

defun isSubForRedundantMapName

```
[rassocSub p871]
[member p1048]
[assocleft p??]
[$mapSubNameAlist p??]
```

— **defun isSubForRedundantMapName** —

```
(defun |isSubForRedundantMapName| (subname)
  (let (mapname tail)
    (declare (special |$mapSubNameAlist|))
    (when (setq mapname (|rassocSub| subname |$mapSubNameAlist|))
      (when (setq tail (|member| (cons mapname subname) |$mapSubNameAlist|))
        (member mapname (cdr (assocleft tail)))))))
```

—————

defun untraceMapSubNames

```
[assocright p??]
[/untrace,2 p??]
[setdifference p??]
[getPreviousMapSubNames p870]
[$mapSubNameAlist p??]
[$lastUntraced p??]
```

— **defun untraceMapSubNames** —

```
(defun |untraceMapSubNames| (|traceNames|)
  (let (|$mapSubNameAlist| subs)
    (declare (special |$mapSubNameAlist| |$lastUntraced|))
    (if
      (null (setq |$mapSubNameAlist| (|getPreviousMapSubNames| |traceNames|)))
      nil
      (dolist (name (setq subs (assocright |$mapSubNameAlist|)))
        (when (member name /tracenames)
          (|/UNTRACE,2| name nil)
          (setq |$lastUntraced| (setdifference |$lastUntraced| subs)))))))
```

—————

defun funfind,LAM

```
[qcar p??]
[SEQ p??]
[isFunctor p??]
[exit p??]
```

— defun funfind,LAM —

```
(defun |funfind,LAM| (functor opname)
  (prog (ops tmp1)
    (return
      (seq
        (progn
          (setq ops (|isFunctor| functor))
          (prog (t0)
            (setq t0 nil)
            (return
              (do ((t1 ops (cdr t1)) (u nil))
                ((or (atom t1) (progn (setq u (car t1)) nil)) (nreverse0 t0))
              (seq
                (exit
                  (cond
                    ((and (consp u)
                        (progn
                          (setq tmp1 (qcar u))
                          (and (consp tmp1) (equal (qcar tmp1) opname))))
                     (setq t0 (cons u t0))))))))))))))
```

—————

defmacro funfind

— defmacro funfind —

```
(defmacro |funfind| (&whole t0 &rest notused &aux t1)
  (declare (ignore notused))
  (dsetq t1 t0)
  (cons '|funfind,LAM| (wrap (cdr t1) '(quote quote))))
```

—————

defun isDomainOrPackage

[refvecp p??]
 [poundsign p??]
 [isFunction p??]
 [opOf p??]

— defun isDomainOrPackage —

```
(defun |isDomainOrPackage| (dom)
  (and
    (refvecp dom)
    (> (|#| dom) 0)
    (|isFunction| (|opOf| (elt dom 0)))))
```

—————

defun isTraceGensym

[gensymp p??]

— defun isTraceGensym —

```
(defun |isTraceGensym| (x)
  (gensymp x))
```

—————

defun spadTrace,g

— defun spadTrace,g —

```
(defun |spadTrace,g| (x)
  (if (stringp x) (intern x) x))
```

—————

defun spadTrace,isTraceable

[seq p??]
 [exit p??]

```
[gensymp p??]
[reportSpadTrace p892]
[bpiname p??]
```

— **defun spadTrace,isTraceable** —

```
(defun |spadTrace,isTraceable| (x |domain|)
  (prog (n |functionSlot|)
    (return
      (seq
        (progn
          (setq n (caddr x))
          x
          (seq
            (if (atom (elt |domain| n)) (exit nil))
            (setq |functionSlot| (car (elt |domain| n)))
            (if (gensymp |functionSlot|)
              (exit (seq (|reportSpadTrace| '|Already Traced| x) (exit nil))))
            (if (null (bpiname |functionSlot|))
              (exit
                (seq
                  (|reportSpadTrace| '|No function for| x)
                  (exit nil))))
              (exit t)))))))
```

—————→

defun spadTrace

```
[refvecp p??]
[aldorTrace p??]
[isDomainOrPackage p875]
[userError p??]
[seq p??]
[exit p??]
[spadTrace,g p875]
[getOption p892]
[removeOption p861]
[opOf p??]
[assoc p??]
[kdr p??]
[flattenOperationAlist p883]
[getOperationAlistFromLisplib p??]
[spadTrace,isTraceable p875]
[as-insert p??]
[bpiname p??]
```

[\[spadTraceAlias p891\]](#)
[\[subTypes p866\]](#)
[\[constructSubst p434\]](#)
[\[bpitrace p??\]](#)
[\[rplac p??\]](#)
[\[printDashedLine p??\]](#)
[\[reportSpadTrace p892\]](#)
[\[setletprintflag p??\]](#)
[\[spadReply p895\]](#)
[\[\\$tracedModemap p??\]](#)
[\[\\$fromSpadTrace p??\]](#)
[\[\\$letAssoc p??\]](#)
[\[\\$reportSpadTrace p892\]](#)
[\[\\$traceNoisely p846\]](#)
[\[/tracenames p??\]](#)

— defun `spadTrace` —

```

(defun |spadTrace| (domain options)
  (let (|$tracedModemap| listofoperations listofvariables
        listofbreakvars anyiftrue domainid currententry
        currentalist opstructurelist sig kind triple fn op
        mm n alias tracename sigslotnumberalist)
    (declare (special |$tracedModemap| /tracenames |$fromSpadTrace| |$letAssoc|
                      |$reportSpadtrace| |$traceNoisely|))
    (setq |$fromSpadTrace| t)
    (setq |$tracedModemap| nil)
    (cond
      ((and (consp domain)
            (refvecp (car domain))
            (eql (elt (car domain) 0) 0))
       (|aldorTrace| domain options))
      ((null (|isDomainOrPackage| domain))
       (|userError| "bad argument to trace"))
      (t
       (setq listofoperations
              (prog (t0)
                    (setq t0 nil)
                    (return
                     (do ((t1 (|getOption| 'ops options) (cdr t1)) (x nil))
                         ((or (atom t1) (progn (setq x (car t1)) nil)) (nreverse0 t0))
                     (seq
                      (exit
                       (setq t0 (cons (|spadTrace,g| x) t0))))))))))
      (cond
        ((setq listofvariables (|getOption| 'vars options))
         (setq options (|removeOption| 'vars options))))
      (cond

```

```

((setq listofbreakvars (|getOption| 'varbreak options))
 (setq options (|removeOption| 'varbreak options)))
(setq anyiftrue (null listofoperations))
(setq domainid (|opOf| (elt domain 0)))
(setq currententry (|assoc| domain /tracenames))
(setq currentalist (kdr currententry))
(setq opstructurelist
 (|flattenOperationAlist| (|getOperationAlistFromLisplib| domainid)))
(setq sigslotnumberalist
 (prog (t2)
 (setq t2 nil)
 (return
 (do ((t3 opstructurelist (cdr t3)) (t4 nil))
 ((or (atom t3)
      (progn (setq t4 (CAR t3)) nil)
      (progn
        (progn
          (setq op (car t4))
          (setq sig (cadr t4))
          (setq n (caddr t4))
          (setq kind (car (cddddr t4))) t4)
        nil))
      (nreverse0 t2))
 (seq
  (exit
   (cond
    ((and (eq kind 'elt)
          (or anyiftrue (member op listofoperations))
          (integerp n)
          (|spadTrace, isTraceable|
           (setq triple
            (cons op (cons sig (cons n nil)))))) domain))
    (setq t2 (cons triple t2))))))))))
(cond
 (listofvariables
  (do ((t5 sigslotnumberalist (cdr t5)) (t6 nil))
    ((or (atom t5)
         (progn (setq t6 (car t5)) nil)
         (progn (progn (setq n (caddr t6)) t6) nil))
     nil)
   (seq
    (exit
     (progn
      (setq fn (car (elt domain n)))
      (setq |$letAssoc|
       (as-insert (bpiname fn) listofvariables |$letAssoc|))))))
 (cond
  (listofbreakvars
   (do ((t7 sigslotnumberalist (cdr t7)) (t8 nil))
     ((or (atom t7)

```

```

        (progn (setq t8 (car t7)) nil)
        (progn (progn (setq n (caddr t8)) t8) nil))
    nil)
(seq
 (exit
  (progn
   (setq fn (car (elt domain n)))
   (setq |$letAssoc|
    (as-insert (bpiname fn)
     (cons (cons 'break listofbreakvars) nil) |$letAssoc|))))))
(do ((t9 sigslotnumberalist (cdr t9)) (|pair| nil))
 ((or (atom t9)
      (progn (setq |pair| (car t9)) nil)
      (progn
       (progn
        (setq op (car |pair|))
        (setq mm (cadr |pair|))
        (setq n (caddr |pair|))
        |pair|)
       nil))
      nil)
  nil)
(seq
 (exit
  (progn
   (setq alias (|spadTraceAlias| domainid op n))
   (setq |$tracedModemap|
    (|subTypes| mm (|constructSubst| (elt domain 0))))
   (setq tracename
    (bpitrace (car (elt domain n)) alias options))
   (nconc |pair|
    (cons listofvariables
     (cons (car (elt domain n))
      (cons tracename (cons alias nil)))))
   (rplac (car (elt domain n)) tracename))))
(setq sigslotnumberalist
 (prog (t10)
  (setq t10 nil)
  (return
   (do ((t11 sigslotnumberalist (cdr t11)) (x nil))
    ((or (atom t11) (progn (setq x (car t11)) nil)) (nreverse0 t10))
    (seq
     (exit
      (cond ((cdddr x) (setq t10 (cons x t10))))))))))
(cond
 (|$reportSpadtrace|
  (cond (|$traceNoisely| (|printDashedLine|))
  (do ((t12 (|orderBySlotNumber| sigslotnumberalist) (cdr t12))
      (x nil))
   ((or (atom t12)
        (progn (setq x (car t12)) nil))
    (progn (setq x (car t12)) nil))

```



```

        nil)
      (seq (exit (|reportSpadTrace| 'tracing x))))))
    (cond (|$letAssoc| (setletprintflag t)))
  (cond
    (currententry
      (rplac (cdr currententry)
        (append sigslotnumberalist currentalist)))
    (t
      (setq /tracenames
        (cons (cons domain sigslotnumberalist) /tracenames))
        (|spadReply|))))))

```

defun traceDomainLocalOps

[sayMSG [p331](#)]

— defun traceDomainLocalOps —

```

(defun |traceDomainLocalOps| ()
  (|sayMSG| '(" The )local option has been withdrawn"))
  (|sayMSG| '(" Use )ltr to trace local functions.")))

```

defun untraceDomainLocalOps

[sayMSG [p331](#)]

— defun untraceDomainLocalOps —

```

(defun |untraceDomainLocalOps| ()
  (|sayMSG| '(" The )local option has been withdrawn"))
  (|sayMSG| '(" Use )ltr to trace local functions.")))

```

defun traceDomainConstructor

[getOption [p892](#)]

[seq p??]

[exit p??]

```

[spadTrace p876]
[concat p1047]
[embed p??]
[mkq p??]
[loadFunctor p1038]
[traceDomainLocalOps p880]
[$ConstructorCache p??]

```

— defun traceDomainConstructor —

```

(defun |traceDomainConstructor| (domainConstructor options)
  (prog (listOfLocalOps argl domain innerDomainConstructor)
    (declare (special |$ConstructorCache|))
    (return
      (seq
        (progn
          (|loadFunctor| domainConstructor)
          (setq listOfLocalOps (|getOption| 'local options))
          (when listOfLocalOps (|traceDomainLocalOps|))
          (cond
            ((and listOfLocalOps (null (|getOption| 'ops options))) nil)
            (t
              (do ((t2 (hget |$ConstructorCache| domainConstructor) (cdr t2))
                  (t3 nil))
                ((or (atom t2)
                     (progn (setq t3 (car t2)) nil)
                     (progn
                       (progn
                         (setq argl (car t3))
                         (setq domain (cddr t3)) t3)
                       nil))
                  nil)
              (seq
                (exit
                  (|spadTrace| domain options))))
            (setq /tracenames (cons domainConstructor /tracenames))
            (setq innerDomainConstructor
              (intern (concat domainConstructor ";")))
            (cond
              ((fboundp innerDomainConstructor)
               (setq domainConstructor innerDomainConstructor)))
            (embed domainConstructor
              (cons 'lambda
                (cons
                  (cons '&rest
                    (cons 'args nil))
                  (cons
                    (cons 'prog
                      (cons

```

```

(cons 'domain nil)
(cons
  (cons 'setq
    (cons 'domain
      (cons
        (cons 'apply (cons domainConstructor
          (cons 'args nil))) nil)))
    (cons
      (cons '|spadTrace|
        (cons 'domain
          (cons (mkq options) nil)))
        (cons (cons 'return (cons 'domain nil)) nil))))
    nil)))))))))

```

defun untraceDomainConstructor,keepTraced?

```

[seq p??]
[qcar p??]
[isDomainOrPackage p875]
[boot-equal p??]
[kar p??]
[devaluate p??]
[exit p??]
[/untrace,0 p??]

```

— defun untraceDomainConstructor,keepTraced? —

```

(defun |untraceDomainConstructor,keepTraced?| (df domainConstructor)
  (prog (dc)
    (return
      (seq
        (if (and
          (and
            (and (consp df) (progn (setq dc (qcar df)) t))
            (|isDomainOrPackage| dc))
            (boot-equal (kar (|devaluate| dc)) domainConstructor))
          (exit (seq (|/UNTRACE,0| (cons dc nil)) (exit nil))))
          (exit t))))))

```

defun untraceDomainConstructor

```
[untraceDomainConstructor,keepTraced? p882]
[unembed p??]
[seq p??]
[exit p??]
[concat p1047]
[delete p??]
[/tracenames p??]
```

— defun untraceDomainConstructor —

```
(defun |untraceDomainConstructor| (domainConstructor)
  (prog (innerDomainConstructor)
    (declare (special /tracenames))
    (return
      (seq
        (progn
          (setq /tracenames
            (prog (t0)
              (setq t0 nil)
              (return
                (do ((t1 /tracenames (cdr t1)) (df nil))
                  ((or (atom t1) (progn (setq df (car t1)) nil)) (nreverse0 t0))
                (seq
                  (exit
                    (cond ((|untraceDomainConstructor,keepTraced?|
                          df domainConstructor)
                     (setq t0 (cons df t0))))))))))
          (setq innerDomainConstructor
            (intern (concat domainConstructor ";")))
          (cond
            ((fboundp innerDomainConstructor) (unembed innerDomainConstructor))
            (t (unembed domainConstructor)))
          (setq /tracenames (|delete| domainConstructor /tracenames))))))
```

—————

defun flattenOperationAlist

```
[seq p??]
[exit p??]
```

— defun flattenOperationAlist —

```
(defun |flattenOperationAlist| (|opAlist|)
  (prog (op |mmList| |res|)
```

```

(return
  (seq
    (progn
      (setq |res| nil)
      (do ((t0 |opAlist| (cdr t0)) (t1 nil))
        ((or (atom t0)
              (progn (setq t1 (car t0)) nil)
              (progn
                (progn (setq op (car t1)) (setq |mmList| (cdr t1)) t1)
                nil))
            nil)
          (seq
            (exit
              (setq |res|
                (append |res|
                  (prog (t2)
                    (setq t2 nil)
                    (return
                     (do ((t3 |mmList| (cdr t3)) (mm nil))
                       ((or (atom t3)
                             (progn (setq mm (car t3)) nil)) (nreverse0 t2))
                     (seq
                      (exit
                        (setq t2 (cons (cons op mm) t2))))))))))))
              |res|))))))

```

defun mapLetPrint

[\[getAliasIfTracedMapParameter p889\]](#)
[\[getBpiNameIfTracedMap p890\]](#)
[\[letPrint p885\]](#)

— defun mapLetPrint —

```

(defun |mapLetPrint| (x val currentFunction)
  (setq x (|getAliasIfTracedMapParameter| x currentFunction))
  (setq currentFunction (|getBpiNameIfTracedMap| currentFunction))
  (|letPrint| x val currentFunction))

```

defun letPrint

```
[lassoc p??]
[isgenvar p886]
[isSharpVarWithNum p886]
[gensymp p??]
[sayBrightlyNT p??]
[bright p??]
[shortenForPrinting p891]
[hasPair p891]
[pname p1045]
[break p906]
[$letAssoc p??]
```

— defun letPrint —

```
(defun |letPrint| (x |val| |currentFunction|)
  (prog (y)
    (declare (special |$letAssoc|))
    (return
      (progn
        (cond ((and |$letAssoc|
                     (or
                      (setq y (lassoc |currentFunction| |$letAssoc|))
                      (setq y (lassoc '|all| |$letAssoc|))))
              (cond
                ((and (or (eq y '|all|)
                          (member x y))
                     (null
                      (or (isgenvar x) (|isSharpVarWithNum| x) (gensymp x))))
                  (|sayBrightlyNT| (append (|bright| x) (cons '|:| nil)))
                  (prin1 (|shortenForPrinting| |val|))
                  (terpri)))
                (cond
                  ((and (setq y (|hasPair| 'break y))
                       (or (eq y '|all|)
                           (and (member x y)
                                (null (member (elt (pname x) 0) '($ |#|)))
                                (null (gensymp x))))
                     (|break|
                      (append
                       (|bright| |currentFunction|)
                       (cons "breaks after"
                            (append
                             (|bright| x)
                             (cons " := " (cons (|shortenForPrinting| |val|) nil)))))))
                  (t nil))))
        |val|))))
```

defun Identifier beginning with a sharpsign-number?

This tests if x is an identifier beginning with # followed by a number. [isSharpVar p886]

[pname p1045]
[qcsiz p??]
[digitp p1045]
[dig2fix p??]

— defun isSharpVarWithNum —

```
(defun |isSharpVarWithNum| (x)
  (let (p n d ok c)
    (cond
      ((null (|isSharpVar| x)) nil)
      ((> 2 (setq n (qcsiz (setq p (pname x))))) nil)
      (t
       (setq ok t)
       (setq c 0)
       (do ((t1 (1- n)) (i 1 (1+ i)))
           ((or (> i t1) (null ok)) nil)
          (setq d (elt p i))
          (when (setq ok (digitp d))
            (setq c (+ (* 10 c) (dig2fix d))))))
       (when ok c)))))
```

defun Identifier beginning with a sharpsign?

This tests if x is an identifier beginning with # [identp p1046]

— defun isSharpVar —

```
(defun |isSharpVar| (x)
  (and (identp x) (char= (schar (symbol-name x) 0) #\#)))
```

defun isgenvar

[size p1045]
[digitp p1045]

[identp p1046]

— defun isgenvar —

```
(defun isgenvar (x)
  (and (identp x)
    (let ((y (symbol-name x)))
      (and (char= #\$ (elt y 0)) (> (size y) 1) (digitp (elt y 1))))))
```

—————

defun letPrint2

[letPrint2 p887]
 [lassoc p??]
 [isgenvar p886]
 [isSharpVarWithNum p886]
 [gensymp p??]
 [mathprint p??]
 [print p??]
 [hasPair p891]
 [pname p1045]
 [break p906]
 [bright p??]
 [\$BreakMode p661]
 [\$letAssoc p??]

— defun letPrint2 —

```
(defun |letPrint2| (x |printform| |currentFunction|)
  (prog (|$BreakMode| |flag| y)
    (declare (special |$BreakMode| |$letAssoc|))
    (return
      (progn
        (setq |$BreakMode| nil)
        (cond
          ((and |$letAssoc|
            (or (setq y (lassoc |currentFunction| |$letAssoc|))
              (setq y (lassoc '|all| |$letAssoc|))))
            (cond
              ((and
                (or (eq y '|all|) (member x y))
                (null (or (isgenvar x) (isSharpVarWithNum x) (gensymp x))))
                (setq |$BreakMode| '|letPrint2|)
                (setq |flag| nil)
                (catch '|letPrint2|
```



```

(|mathprint| (cons '= (cons x (cons |printform| nil)))) |flag|)
(cond
  ((eq |flag| '|letPrint2|) (|print| |printform|))
  (t nil))))
(cond
  ((and
    (setq y (|hasPair| 'break y))
    (or (eq y '|all|)
        (and
          (member x y)
          (null (member (elt (pname x) 0) '($ |#|)))
          (null (gensymp x)))))
    (|break|
      (append
        (|bright| |currentFunction|)
        (cons "breaks after"
              (append (|bright| x) (cons '|:=| (cons |printform| nil))))))
    (t nil))))
  x)))

```

defun letPrint3

This is the version for use when we have our hands on a function to convert the data into type "Expression" [letPrint2 p887]

```

[lassoc p??]
[isgenvar p886]
[isSharpVarWithNum p886]
[gensymp p??]
[mathprint p??]
[spadcall p??]
[print p??]
[hasPair p891]
[pname p1045]
[break p906]
[bright p??]
[$BreakMode p661]
[$letAssoc p??]

```

— defun letPrint3 —

```

(defun |letPrint3| (x |xval| |printfn| |currentFunction|)
  (prog (|$BreakMode| |flag| y)
    (declare (special |$BreakMode| |$letAssoc|))
    (return

```

```

(progn
  (setq |$BreakMode| nil)
  (cond
    ((and |$letAssoc|
      (or (setq y (lassoc |currentFunction| |$letAssoc|))
          (setq y (lassoc '|all| |$letAssoc|))))
      (cond
        ((and
          (or (eq y '|all|) (member x y))
          (null (or (isgenvar x) (|isSharpVarWithNum| x) (gensymp x))))
          (setq |$BreakMode| '|letPrint2|)
          (setq |flag| nil)
          (catch '|letPrint2|
            (|mathprint|
              (cons '= (cons x (cons (spadcall |xval| |printfn|) nil))))
            |flag|)
          (cond
            ((eq |flag| '|letPrint2|) (|print| |xval|))
            (t nil))))
        (cond
          ((and
            (setq y (|hasPair| 'break y))
            (or
              (eq y '|all|)
              (and
                (member x y)
                (null (member (elt (pname x) 0) '($ |#|)))
                (null (gensymp x))))
            (|break|
              (append
                (|bright| |currentFunction|)
                (cons "breaks after"
                  (append (|bright| x) (cons " := " (cons |xval| nil)))))))
            (t nil))))
          x))))

```

defun getAliasIfTracedMapParameter

```

[isSharpVarWithNum p886]
[get p??]
[exit p??]
[spaddifference p??]
[string2pint-n p??]
[substring p??]
[pname p1045]

```

```
[seq p??]
[$InteractiveFrame p??]
```

— **defun getAliasIfTracedMapParameter** —

```
(defun |getAliasIfTracedMapParameter| (x |currentFunction|)
  (prog (|aliasList|)
    (declare (special |$InteractiveFrame|))
    (return
      (seq
        (cond
          ((|isSharpVarWithNum| x)
            (cond
              ((setq |aliasList|
                (|get| |currentFunction| 'alias |$InteractiveFrame|))
                (exit
                  (elt |aliasList|
                    (spaddifference
                     (string2pint-n (substring (pname x) 1 nil) 1) 1))))))
            (t x))))))
```

—————

defun getBpiNameIfTracedMap

```
[get p??]
[exit p??]
[seq p??]
[$InteractiveFrame p??]
[/tracenames p??]
```

— **defun getBpiNameIfTracedMap** —

```
(defun |getBpiNameIfTracedMap| (name)
  (prog (lmm bpiName)
    (declare (special |$InteractiveFrame| /tracenames))
    (return
      (seq
        (cond
          ((setq lmm (|get| name '|localModemap| |$InteractiveFrame|))
            (cond
              ((member (setq bpiName (cadar lmm)) /tracenames)
                (exit bpiName))))
          (t name))))))
```

—————

defun hasPair

[qcar p??]
 [qcdr p??]
 [hasPair p⁸⁹¹]

— defun hasPair —

```
(defun |hasPair| (key arg)
  (prog (tmp1 a)
    (return
      (cond
        ((atom arg) nil)
        ((and (consp arg)
              (progn
                (setq tmp1 (qcar arg))
                (and (consp tmp1)
                     (equal (qcar tmp1) key)
                     (progn (setq a (qcdr tmp1)) t))))
          a)
        (t (|hasPair| key (cdr arg)))))))
```

—————

defun shortenForPrinting

[isDomainOrPackage p⁸⁷⁵]
 [devaluate p??]

— defun shortenForPrinting —

```
(defun |shortenForPrinting| (|val|)
  (if (|isDomainOrPackage| |val|)
      (|devaluate| |val|)
      |val|))
```

—————

defun spadTraceAlias

[internl p??]

— defun spadTraceAlias —

```
(defun |spadTraceAlias| (domainid op n)
```

[assoc p??]

[StraceNoisely p846]

```
(defun |reportSpadTrace| (|header| t0)
  (prog (op sig n |t| |msg| |namePart| y |tracePart|)
    (declare (special |$traceNoisely|))
    (return
      (progn
        (setq op (car t0))
        (setq sig (cadr t0))
        (setq n (caddr t0))
        (setq |t| (cddddr t0))
        (cond
          ((null |$traceNoisely|) nil)
          (t
            (setq |msg|
              (cons |header|
                (cons '|%b|
                  (cons op
                    (cons '|:|
                      (cons '|%d|
                        (cons (CDR sig)
                          (cons '| -> |
                            (cons (car sig)
```

```

      (cons '| in slot |
        (cons n nil)))))))))
(setq |namePart| nil)
(setq |tracePart|
  (cond
    ((and (consp |t|) (progn (setq y (qcar |t|)) t) (null (null y)))
      (cond
        ((eq y '|all|)
          (cons '|%b| (cons '|all| (cons '|%d| (cons '|vars| nil))))))
        (t (cons '| vars: | (cons y nil))))))
    (t nil)))
(|sayBrightly| (append |msg| (append |namePart| |tracePart|)))))))))

```

defun orderBySlotNumber

```

[seq p??]
[assocright p??]
[orderList p??]
[exit p??]

```

— defun orderBySlotNumber —

```

(defun |orderBySlotNumber| (arg)
  (prog (n)
    (return
      (seq
        (assocright
          (|orderList|
            (prog (t0)
              (setq t0 nil)
              (return
                (do ((t1 arg (cdr t1)) (x nil))
                  ((or (atom t1)
                      (progn (setq x (car t1)) nil)
                      (progn (progn (setq n (caddr x)) x) nil))
                  (nreverse0 t0))
              (seq
                (exit
                  (setq t0 (cons (cons n x) t0)))))))))))))

```

defun /tracereply

```
[qcar p??]
[isDomainOrPackage p875]
[devaluate p??]
[seq p??]
[exit p??]
[/tracenames p??]
```

— defun /tracereply —

```
(defun /tracereply ()
  (prog (|d| domainlist |functionList|)
    (declare (special /tracenames))
    (return
      (seq
        (cond
          ((null /tracenames) " Nothing is traced.")
          (t
            (do ((t0 /tracenames (cdr t0)) (x nil))
              ((or (atom t0) (progn (setq x (car t0)) nil)) nil)
            (seq
              (exit
                (cond
                  ((and (consp x)
                     (progn (setq |d| (qcar x)) t)
                     (|isDomainOrPackage| |d|))
                   (setq domainlist (cons (|devaluate| |d|) domainlist)))
                (t
                  (setq |functionList| (cons x |functionList|)))))))
            (append |functionList|
              (append domainlist (cons '|traced| nil))))))))))
```

—————

defun spadReply,printName

```
[seq p??]
[qcar p??]
[isDomainOrPackage p875]
[exit p??]
[devaluate p??]
```

— defun spadReply,printName —

```
(defun |spadReply,printName| (x)
```

```
(prog (|d|)
  (return
    (seq
      (if (and (and (consp x) (progn (setq |d| (qcar x)) t))
          (|isDomainOrPackage| |d|))
          (exit (|devaluate| |d|)))
        (exit x))))))
```

defun spadReply

```
[seq p??]
[exit p??]
[spadReply,printName p894]
[/tracenames p??]
```

— defun spadReply —

```
(defun |spadReply| ()
  (prog ()
    (declare (special /tracenames))
    (return
      (seq
        (prog (t0)
          (setq t0 nil)
          (return
            (do ((t1 /tracenames (cdr t1)) (x nil))
              ((or (atom t1) (progn (setq x (car t1)) nil)) (nreverse0 t0))
            (seq
              (exit
                (setq t0 (cons (|spadReply,printName| x) t0)))))))))))
```

defun spadUntrace

```
[isDomainOrPackage p875]
[userError p??]
[getOption p892]
[devaluate p??]
[assoc p??]
[sayMSG p331]
[bright p??]
```



```

[prefix2String p??]
[bpiname p??]
[remover p897]
[setletprintflag p??]
[bpiuntrace p??]
[rplac p??]
[seq p??]
[exit p??]
[delasc p??]
[spadReply p895]
[$letAssoc p??]
[/tracenames p??]

```

— defun `spadUntrace` —

```

(defun |spadUntrace| (domain options)
  (prog (anyiftrue listofoperations domainid |pair| sigslotnumberalist
        op sig n |lv| |bpiPointer| tracename alias |assocPair|
        |newSigSlotNumberAlist|)
    (declare (special |$letAssoc| /tracenames))
    (return
     (seq
      (cond
       ((null (|isDomainOrPackage| domain))
        (|userError| "bad argument to untrace"))
       (t
        (setq anyiftrue (null options))
        (setq listofoperations (|getOption| 'ops:| options))
        (setq domainid (|devaluate| domain))
        (cond
         ((null (setq |pair| (|assoc| domain /tracenames)))
          (|sayMSG|
           (cons "  No functions in"
                (append
                 (|bright| (|prefix2String| domainid))
                 (cons "are now traced." nil))))))
         (t
          (setq sigslotnumberalist (cdr |pair|))
          (do ((t0 sigslotnumberalist (cdr t0)) (|pair| nil))
              ((or (atom t0)
                   (progn (setq |pair| (car t0)) nil)
                   (progn
                    (progn
                     (setq op (car |pair|))
                     (setq sig (cadr |pair|))
                     (setq n (caddr |pair|))
                     (setq |lv| (caddr |pair|))
                     (setq |bpiPointer| (car (cddddr |pair|)))
                     (setq tracename (cadr (cddddr |pair|)))

```

```

        (setq alias (caddr (cddddr |pair|)))
        |pair|)
      nil))
    nil)
  (seq
    (exit
      (cond
        ((or anyiftrue (member op listofoperations))
          (progn
            (bpiuntrace tracename alias)
            (rplac (car (elt domain n)) |bpiPointer|)
            (rplac (caddr |pair|) nil)
            (cond
              ((setq |assocPair|
                (|assoc| (bpiname |bpiPointer|) |$letAssoc|))
                (setq |$letAssoc| (remover |$letAssoc| |assocPair|))
                (cond
                  ((null |$letAssoc|) (setletprintflag nil))
                  (t nil)))
              (t nil))))))
          (t nil))))))
    (setq |newSigSlotNumberAlist|
      (prog (t1)
        (setq t1 nil)
        (return
          (do ((t2 sigslotnumberalist (cdr t2)) (x nil))
            ((or (atom t2) (progn (setq x (car t2)) nil)) (nreverse0 t1))
            (seq
              (exit
                (cond ((caddr x) (setq t1 (cons x t1))))))))))
      (cond
        (|newSigSlotNumberAlist|
          (rplac (cdr |pair|) |newSigSlotNumberAlist|))
        (t
          (setq /tracenames (delasc domain /tracenames))
          (|spadReply|))))))

```

defun remover

[remover p897]

— defun remover —

```

(defun remover (lst item)
  (cond
    ((null (consp lst)) (cond ((equal lst item) nil) (t lst)))
    ((equal (car lst) item) (cdr lst))

```

```
(t
  (rplnode lst (remover (car lst) item) (remover (cdr lst) item))
  (rplaca lst (remover (car lst) item))
  (rplacd lst (remover (cdr lst) item))
  lst)))
```

defun prTraceNames,fn

```
[seq p??]
[qcar p??]
[qcdr p??]
[isDomainOrPackage p875]
[exit p??]
[devaluate p??]
```

— defun prTraceNames,fn —

```
(defun |prTraceNames,fn| (x)
  (prog (|d| |t|)
    (return
      (seq
        (if (and (and (consp x)
                     (progn (setq |d| (qcar x)) (setq |t| (qcdr x)) t))
            (|isDomainOrPackage| |d|))
          (exit (cons (|devaluate| |d|) |t|)))
        (exit x))))))
```

defun prTraceNames

```
[seq p??]
[exit p??]
[prTraceNames,fn p898]
[/tracenames p??]
```

— defun prTraceNames —

```
(defun |prTraceNames| ()
  (declare (special /tracenames))
  (seq
    (progn
```

```
(do ((t0 /tracenames (cdr t0)) (x nil))
    ((or (atom t0) (progn (setq x (car t0)) nil)) nil)
  (seq
   (exit
    (print (|prTraceNames,fn| x)))))) nil)))
```

defvar \$constructors

— initvars —

```
(defvar |$constructors| nil)
```

defun traceReply

```
[sayMessage p??]
[sayBrightly p??]
[qcar p??]
[isDomainOrPackage p875]
[addTraceItem p902]
[isFunctor p??]
[isgenvar p886]
[userError p??]
[seq p??]
[exit p??]
[isSubForRedundantMapName p873]
[rassocSub p871]
[poundsign p??]
[sayMSG p331]
[sayBrightlyLength p??]
[flowSegmentedMsg p??]
[concat p1047]
[prefix2String p??]
[abbreviate p??]
[$domains p??]
[$packages p??]
[$constructors p899]
[$linelength p774]
[/tracenames p??]
```

— defun traceReply —

```
(defun |traceReply| ()
  (prog (|$domains| |$packages| |$constructors| |d| |functionList|
        |displayList|)
    (declare (special |$domains| |$packages| |$constructors| /tracenames
                      $linelength))
    (return
     (seq
      (progn
       (setq |$domains| nil)
       (setq |$packages| nil)
       (setq |$constructors| nil)
       (cond
        ((null /tracenames) (|sayMessage| "   Nothing is traced now."))
        (t
         (|sayBrightly| " ")
         (do ((t0 /tracenames (cdr t0)) (x nil))
              ((or (atom t0) (progn (setq x (car t0)) nil)) nil)
          (seq
           (exit
            (cond
             ((and (consp x)
                  (progn (setq |d| (qcar x)) t) (|isDomainOrPackage| |d|))
              (|addTraceItem| |d|))
             ((atom x)
              (cond
               ((|isFunctor| x) (|addTraceItem| x))
               ((|isgenvar| x) (|addTraceItem| (EVAL x)))
               (t (setq |functionList| (cons x |functionList|))))
              (t (|userError| "bad argument to trace"))))))
           (setq |functionList|
                (prog (t1)
                  (setq t1 nil)
                  (return
                   (do ((t2 |functionList| (cdr t2)) (x nil))
                        ((or (atom t2) (progn (setq x (car t2)) nil)) t1)
                     (seq
                      (exit
                       (cond
                        ((null (|isSubForRedundantMapName| x))
                         (setq t1
                          (append t1
                           (cons (|rassocSub| x |$mapSubNameAlist|)
                            (cons " " nil))))))))))))
                (cond
                 (|functionList|
                  (cond
                   ((eq 2 (|#| |functionList|))
```

```

      (|sayMSG| (cons '| Function traced: | |functionList|)))
    (<= (+ 22 (|sayBrightlyLength| |functionList|)) $linelength)
    (|sayMSG| (cons '| Functions traced: | |functionList|)))
  (t
    (|sayBrightly| " Functions traced:")
    (|sayBrightly|
      (|flowSegmentedMsg| |functionList| $linelength 6))))))
(cond
  (|$domains|
    (setq |displayList|
      (|concat|
        (|prefix2String| (CAR |$domains|))
        (prog (t3)
          (setq t3 nil)
          (return
            (do ((t4 (cdr |$domains|) (cdr t4)) (x nil))
              ((or (atom t4) (progn (setq x (car t4)) nil)) t3)
              (seq
                (exit
                  (setq t3
                    (append t3 (|concat| ", " " " (|prefix2String| x)))))))))))
    (cond
      ((atom |displayList|)
        (setq |displayList| (cons |displayList| nil)))
      (|sayBrightly| " Domains traced: ")
      (|sayBrightly| (|flowSegmentedMsg| |displayList| $linelength 6)))
  (cond
    (|$packages|
      (setq |displayList|
        (|concat|
          (|prefix2String| (CAR |$packages|))
          (prog (t5)
            (setq t5 nil)
            (return
              (do ((t6 (cdr |$packages|) (cdr t6)) (x nil))
                ((or (atom t6) (progn (setq x (car t6)) nil)) t5)
                (seq
                  (exit
                    (setq t5
                      (append t5 (|concat| ', | (|prefix2String| x)))))))))))
      (cond ((atom |displayList|)
        (setq |displayList| (cons |displayList| nil)))
        (|sayBrightly| " Packages traced: ")
        (|sayBrightly| (|flowSegmentedMsg| |displayList| $linelength 6)))
  (cond
    (|$constructors|
      (setq |displayList|
        (|concat|
          (|abbreviate| (CAR |$constructors|))
          (prog (t7)

```

```

      (setq t7 nil)
      (return
        (do ((t8 (cdr |$constructors|) (cdr t8)) (x nil))
            ((or (atom t8) (progn (setq x (car t8)) nil)) t7)
          (seq
            (exit
              (setq t7
                (append t7 (|concat| ' |, | (|abbreviate| x))))))))))
      (cond ((atom |displayList|)
        (setq |displayList| (cons |displayList| nil))))
      (|sayBrightly| "    Parameterized constructors traced:")
      (|sayBrightly| (|flowSegmentedMsg| |displayList| $linelength 6)))
      (t nil)))))))))

```

defun addTraceItem

```

[constructor? p??]
[isDomain p??]
[devaluate p??]
[isDomainOrPackage p875]
[$constructors p899]
[$domains p??]
[$packages p??]

```

— defun addTraceItem —

```

(defun |addTraceItem| (|d|)
  (declare (special |$constructors| |$domains| |$packages|))
  (cond
    ((|constructor?| |d|)
      (setq |$constructors| (cons |d| |$constructors|)))
    ((|isDomain| |d|)
      (setq |$domains| (cons (|devaluate| |d|) |$domains|)))
    ((|isDomainOrPackage| |d|)
      (setq |$packages| (cons (|devaluate| |d|) |$packages|))))

```

defun ?t

```

[isgenvar p886]
[get p??]
[sayMSG p331]

```

```
[bright p??]
[rassocSub p871]
[qcar p??]
[qcdr p??]
[isDomainOrPackage p875]
[isDomain p??]
[reportSpadTrace p892]
[take p??]
[sayBrightly p??]
[devaluate p??]
[$mapSubNameAlist p??]
[$InteractiveFrame p??]
[/tracenames p??]
```

— defun ?t —

```
(defun |?t| ()
  (let (llm d suffix l)
    (declare (special /tracenames |$InteractiveFrame| |$mapSubNameAlist|))
    (if (null /tracenames)
      (|sayMSG| (|bright| "nothing is traced"))
      (progn
        (dolist (x /tracenames)
          (cond
            ((and (atom x) (null (isgenvar x)))
              (progn
                (cond
                  ((setq llm (|get| x '|localModemap| |$InteractiveFrame|))
                    (setq x (list (cadar llm))))
                  (|sayMSG|
                    '("Function" ,@( |bright| (|rassocSub| x |$mapSubNameAlist|)
                      "traced"))))))
            (dolist (x /tracenames)
              (cond
                ((and (consp x)
                      (progn (setq d (qcar x)) (setq l (qcdr x)) t)
                      (|isDomainOrPackage| d))
                  (progn
                    (setq suffix (cond ((|isDomain| d) "domain") (t "package")))
                    (|sayBrightly|
                     '("  Functions traced in " ,suffix |%b| ,(|devaluate| d) |%d| ":"))
                    (dolist (x (|orderBySlotNumber| l))
                      (|reportSpadTrace| '| | (TAKE 4 x)))
                    (terpri))))))))))
```


defun tracelet

```

[gensymp p??]
[stupidIsSpadFunction p906]
[bpname p??]
[lassoc p??]
[union p??]
[setletprintflag p??]
[isgenvar p886]
[compileBoot p907]
[delete p??]
[$traceletflag p??]
[$QuickLet p??]
[$letAssoc p??]
[$traceletFunctions p??]

```

— defun tracelet —

```

(defun |tracelet| (fn |vars|)
  (prog ($traceletflag |$QuickLet| 1)
    (declare (special $traceletflag |$QuickLet| |$letAssoc|
                      |$traceletFunctions|))

    (return
     (progn
      (cond
       ((and (gensymp fn) (|stupidIsSpadFunction| (eval fn)))
        (setq fn (eval fn))
        (cond
         ((compiled-function-p fn) (setq fn (bpname fn)))
         (t nil))))
       (cond
        ((eq fn '|Undef|) nil)
        (t
         (setq |vars|
          (cond
           ((eq |vars| '|all|) '|all|)
           ((setq 1 (lassoc fn |$letAssoc|)) (|union| |vars| 1))
           (t |vars|)))
         (setq |$letAssoc| (cons (cons fn |vars|) |$letAssoc|))
         (cond (|$letAssoc| (setletprintflag t)))
         (setq $traceletflag t)
         (setq |$QuickLet| nil)
         (cond
          ((and (null (member fn |$traceletFunctions|))
                (null (isgenvar fn))
                (compiled-function-p (symbol-function fn))
                (null (|stupidIsSpadFunction| fn))
                (null (gensymp fn)))

```

```
(progn
  (setq |$traceletFunctions| (cons fn |$traceletFunctions|))
  (|compileBoot| fn)
  (setq |$traceletFunctions|
    (|delete| fn |$traceletFunctions|)))))))))
```

defun breaklet

```
[gensymp p??]
[stupidIsSpadFunction p906]
[bpname p??]
[lassoc p??]
[assoc p??]
[union p??]
[setletprintflag p??]
[compileBoot p907]
[delete p??]
[$QuickLet p??]
[$letAssoc p??]
[$traceletFunctions p??]
```

— defun breaklet —

```
(defun |breaklet| (fn |vars|)
  (prog (|$QuickLet| |fnEntry| |pair|)
    (declare (special |$QuickLet| |$letAssoc| |$traceletFunctions|))
    (return
      (progn
        (cond
          ((and (gensymp fn) (|stupidIsSpadFunction| (eval fn)))
            (setq fn (eval fn))
            (cond
              ((compiled-function-p fn) (setq fn (bpname fn)))
              (t nil))))
          (cond
            ((eq fn '|Undef|) nil)
            (t
              (setq |fnEntry| (lassoc fn |$letAssoc|))
              (setq |vars|
                (cond
                  ((setq |pair| (|assoc| 'break |fnEntry|))
                    (|union| |vars| (cdr |pair|)))
                  (t |vars|)))
              (setq |$letAssoc|
                (cond
```

```

((null |fnEntry|)
  (cons (cons fn (list (cons 'break |vars|))) |$letAssoc|))
  (|pair| (rplacd |pair| |vars|) |$letAssoc|)))
(cond (|$letAssoc| (setletprintflag t)))
(setq |$QuickLet| nil)
(cond
  ((and (null (member fn |$traceletFunctions|))
        (null (|stupidIsSpadFunction| fn))
        (null (gensymp fn))))
  (progn
    (setq |$traceletFunctions| (cons fn |$traceletFunctions|))
    (|compileBoot| fn)
    (setq |$traceletFunctions|
      (|delete| fn |$traceletFunctions|)))))))))

```

defun stupidIsSpadFunction

```

[|strpos| p1045]
[|pname| p1045]

```

— defun stupidIsSpadFunction —

```

(defun |stupidIsSpadFunction| (fn)
  (|strpos| "," (pname fn) 0 nil))

```

defun break

```

[|MONITOR,EVALTRAN| p??]
[|enable-backtrace| p??]
[|sayBrightly| p??]
[|interrupt| p??]
[|/breakcondition| p??]

```

— defun break —

```

(defun |break| (msg)
  (prog (condition)
    (declare (special /breakcondition))
    (return
      (progn
        (setq condition (|MONITOR,EVALTRAN| /breakcondition nil))

```

```
(when (eval condition)
  (|sayBrightly| msg)
  (interrupt))))))
```

defun compileBoot

[/D,1 p??]

— defun compileBoot —

```
(defun |compileBoot| (fn)
  (/D,1| (list fn) '(/comp) nil nil))
```

Chapter 53

)undo help page Command

53.1 undo help page man page

— undo.help —

```
=====
A.27. )undo
=====
```

User Level Required: interpreter

Command Syntax:

-)undo
-)undo integer
-)undo integer [option]
-)undo)redo

where option is one of

-)after
-)before

Command Description:

This command is used to restore the state of the user environment to an earlier point in the interactive session. The argument of an)undo is an integer which must designate some step number in the interactive session.

```
)undo n
)undo n )after
```

These commands return the state of the interactive environment to that immediately after step *n*. If *n* is a positive number, then *n* refers to step number *n*. If *n* is a negative number, it refers to the *n*th previous command (that is, undoes the effects of the last *-n* commands).

A `)clear` all resets the `)undo` facility. Otherwise, an `)undo` undoes the effect of `)clear` with options `properties`, `value`, and `mode`, and that of a previous `undo`. If any such system commands are given between steps *n* and *n* + 1 (*n* > 0), their effect is undone for `)undo m` for any $0 < m \leq n$.

The command `)undo` is equivalent to `)undo -1` (it undoes the effect of the previous user expression). The command `)undo 0` undoes any of the above system commands issued since the last user expression.

`)undo n)before`

This command returns the state of the interactive environment to that immediately before step *n*. Any `)undo` or `)clear` system commands given before step *n* will not be undone.

`)undo)redo`

This command reads the file `redo.input`, created by the last `)undo` command. This file consists of all user input lines, excluding those backtracked over due to a previous `)undo`.

The command `)history)write` will eliminate the “undone” command lines of your program.

Also See:

- o `)history`

1

53.2 Evaluation

Some Antique Comments About the Interpreter

EVAL BOOT contains the top level interface to the Scratchhpad-II interpreter. The Entry point into the interpreter from the parser is `processInteractive`.

The type analysis algorithm is contained in the file `BOTMUP BOOT`, and `MODSEL boot`, the map handling routines are in `MAP BOOT` and `NEWMAP BOOT`, and the interactive coerce routines are in `COERCE BOOT` and `COERCEFN BOOT`.

¹ “history” (34.4 p 582)

Conventions: All spad values in the interpreter are passed around in triples. These are lists of three items:

```
[value,mode,environment]
```

The value may be wrapped (this is a pair whose CAR is the atom WRAPPED and whose CDR is the value), which indicates that it is a real value, or unwrapped in which case it needs to be EVALed to produce the proper value. The mode is the type of value, and should always be completely specified (not contain \$EmptyMode). The environment is always empty, and is included for historical reasons.

Modemaps: Modemaps are descriptions of compiled Spad function which the interpreter uses to perform type analysis. They consist of patterns of types for the arguments, and conditions the types must satisfy for the function to apply. For each function name there is a list of modemaps in file modemap DATABASE for each distinct function with that name. The following is the list of the modemaps for “*” (multiplication. The first modemap (the one with the labels) is for module mltiplication which is multiplication of an element of a module by a member of its scalar domain.

This is the signature pattern for the modemap, it is of the form:

```
(DomainOfComputation TargetType <ArgumentType ...>)
|
|                                     This is the predicate that needs to be
|                                     satisfied for the modemap to apply
|                                     |
V                                     |
/-----/                           |
( ( (*1 *1 *2 *1)                   V
  /-----/
  ( (AND (ofCategory *1 (Module *2)) (ofCategory *2 (SimpleRing))) )
    . CATDEF) <-- This is the file where the function was defined
  ( (*1 *1 *2 *1)
    ( (AND (isDomain *2 (Integer)) (ofCategory *1 (AbelianGroup))) )
      . CATDEF)
  ( (*1 *1 *2 *1)
    ( (AND
      (isDomain *2 (NonNegativeInteger))
      (ofCategory *1 (AbelianMonoid))) )
      . CATDEF)
  ((*1 *1 *1 *1) ((ofCategory *1 (SemiGroup)) ) . CATDEF)
  )
```

Environments: Environments associate properties with atoms.

Some common properties are:

- **modeSet:** During interpretation we build a modeSet property for each node in the expression. This is (in theory) a list of all the types possible for the node. In the current implementation these modeSets always contain a single type.

- **value:** Value properties are always triples. This is where the values of variables are stored. We also build value properties for internal nodes during the bottom up phase.
- **mode:** This is the declared type of an identifier.

There are several different environments used in the interpreter:

- **\$InteractiveFrame:** this is the environment where the user values are stored. Any side effects of evaluation of a top-level expression are stored in this environment. It is always used as the starting environment for interpretation.
- **\$e:** This is the name used for **\$InteractiveFrame** while interpreting.
- **\$env:** This is local environment used by the interpreter. Only temporary information (such as types of local variables) is stored in **\$env**. It is thrown away after evaluation of each expression.

Frequently used global variables:

- **\$genValue:** if true then evaluate generated code, otherwise leave code unevaluated. If **\$genValue** is false then we are compiling.
- **\$op:** name of the top level operator (unused except in map printing)
- **\$mapList:** list of maps being type analyzed, used in recursive map type analysis.
- **\$compilingMap:** true when compiling a map, used to detect where to THROW when interpret-only is invoked
- **\$compilingLoop:** true when compiling a loop body, used to control nesting level of interp-only loop CATCH points
- **\$interpOnly:** true when in interpret only mode, used to call alternate forms of COLLECT and REPEAT.
- **\$inCOLLECT:** true when compiling a COLLECT, used only for hacked stream compiler.
- **\$StreamFrame:** used in printing streams, it is the environment where local stream variables are stored
- **\$declaredMode:** Weak type propagation for symbols, set in upCOERCE and upLET. This variable is used to determine the alternate polynomial types of Symbols.
- **\$localVars:** list of local variables in a map body
- **\$MapArgumentTypeList:** hack for stream compilation

defun evalDomain

```
[sayMSG p331]
[concat p1047]
[prefix2String p??]
[startTimingProcess p??]
[eval p??]
[mkEvalable p913]
[stopTimingProcess p??]
[$evalDomain p913]
```

— defun evalDomain —

```
(defun |evalDomain| (form)
  (let (result)
    (declare (special |$evalDomain|))
    (when |$evalDomain|
      (|sayMSG|
        (|concat| "   instantiating" ' |%b| (|prefix2String| form) ' |%d|)))
      (|startTimingProcess| ' |instantiation|)
      (setq result (|eval| (|mkEvalable| form)))
      (|stopTimingProcess| ' |instantiation|)
      result))
```

—————

defun mkEvalable

```
[qcar p??]
[qcdr p??]
[mkEvalable p913]
[devaluate p??]
[mkEvalableRecord p915]
[mkEvalableUnion p915]
[mkEvalableMapping p915]
[loadIfNecessary p??]
[getdatabase p1010]
[mkq p??]
[constructor? p??]
[fbpip p??]
[bpiname p??]
[$Integer p??]
[$EmptyMode p??]
```

— defun mkEvalable —

```

(defun |mkEvalable| (form)
  (let (op argl kind cosig)
    (declare (special |$Integer| |$EmptyMode|))
    (cond
      ((consp form)
       (setq op (qcar form))
       (setq argl (qcdr form))
       (cond
         ((eq op 'quote) form)
         ((eq op 'wrapped) (|mkEvalable| (|devaluate| argl)))
         ((eq op '|Record|) (|mkEvalableRecord| form))
         ((eq op '|Union|) (|mkEvalableUnion| form))
         ((eq op '|Mapping|) (|mkEvalableMapping| form))
         ((eq op '|Enumeration|) form)
       )
      (t
       (|loadIfNecessary| op)
       (setq kind (getdatabase op 'constructorkind))
       (cond
         ((setq cosig (getdatabase op 'cosig))
          (cons op
            (loop for x in argl for typeFlag in (rest cosig)
              collect
                (cond
                  (typeFlag
                   (cond
                     ((eq kind '|category|) (mkq x))
                     ((vecp x) (mkq x))
                     (t
                      (|loadIfNecessary| x)
                      (|mkEvalable| x))))
                  ((and (consp x) (eq (qcar x) 'quote)) x)
                  ((and (consp x) (eq (qcar x) '|#|) (consp (qcdr x))
                     (eq (qcdr (qcdr x)) nil))
                   (list 'size (mkq (qcar (qcdr x)))))
                  (t (mkq x))))))
          (t
           (cons op
             (loop for x in argl
               collect (|mkEvalable| x))))))
         ((equal form |$EmptyMode|) |$Integer|)
         ((and (identp form) (|constructor?| form)) (list form))
         ((fbpip form) (bpiname form))
         (t form))))

```

defun mkEvalableUnion

[mkEvalable p913]

— defun mkEvalableUnion —

```

(defun |mkEvalableUnion| (form)
  (cond
    ((|isTaggedUnion| form)
     (cons
      (car form)
      (loop for item in (rest form)
            collect (list '|:| (second item) (|mkEvalable| (third item))))))
    (t
     (cons (car form)
           (loop for d in (rest form)
                 collect (|mkEvalable| d))))))

```

defun mkEvalableRecord

[mkEvalable p913]

— defun mkEvalableRecord —

```

(defun |mkEvalableRecord| (form)
  (cons
   (car form)
   (loop for item in (rest form)
         collect (list (quote '|:|) (second item) (|mkEvalable| (third item))))))

```

defun mkEvalableMapping

[mkEvalable p913]

— defun mkEvalableMapping —

```

(defun |mkEvalableMapping| (form)
  (cons
   (car form)
   (loop for d in (rest form)
         collect (|mkEvalable| d))))

```

defun evaluateType

Takes a parsed, unabbreviated type and evaluates it, replacing type valued variables with their values, and calling `bottomUp` on non-type valued argumnts to the constructor and finally checking to see whether the type satisfies the conditions of its modemap [`isDomain-ValuedVariable` p959]

```
[qcar p??]
[qcdr p??]
[mkAtree p??]
[bottomUp p??]
[objVal p??]
[getValue p??]
[evaluateSignature p920]
[member p1048]
[evaluateType p916]
[constructor? p??]
[throwEvalTypeMsg p919]
[$EmptyMode p??]
[$expandSegments p??]
```

— defun evaluateType —

```
(defun |evaluateType| (form)
  (let (|$expandSegments| domain form op argl)
    (declare (special |$expandSegments| |$EmptyMode|))
    (cond
      ((setq domain (|isDomainValuedVariable| form)) domain)
      ((equal form |$EmptyMode|) form)
      ((eq form '?) |$EmptyMode|)
      ((stringp form) form)
      ((eq form '$) form)
      (t
       (setq |$expandSegments| nil)
       (cond
         ((and (consp form) (eq (qcar form) '|typeOf|) (consp (qcdr form))
          (eq (qcdr (qcdr form)) nil))
          (setq formp (|mkAtree| form))
          (|bottomUp| formp)
          (|objVal| (|getValue| formp)))
         (consp form)
          (setq op (qcar form))
          (setq argl (qcdr form))
          (cond
            ((eq op 'category)
             (cond
```

```

      ((consp arg1)
       (cons op
              (cons (qcar arg1)
                     (loop for s in (qcdr arg1)
                           collect (|evaluateSignature| s))))))
      (t form)))
    ((|member| op '(|Join| |Mapping|))
     (cons op
            (loop for arg in arg1
                  collect (|evaluateType| arg))))
    ((eq op '|Union|)
     (cond
      ((and arg1 (consp (car arg1)) (consp (qcdr (car arg1)))
              (consp (qcdr (qcdr (car arg1))))
              (eq (qcdr (qcdr (qcdr (car arg1)))) nil)
              (|member| (qcar (car arg1)) '(:| |Declare|)))
       (cons op
              (loop for item in arg1
                    collect
                      (list '(:| (second item) (|evaluateType| (third item))))))
       (t
        (cons op
               (loop for arg in arg1
                     collect (|evaluateType| arg))))))
     ((eq op '|Record|)
      (cons op
             (loop for item in arg1
                   collect
                     (list '(:| (second item) (|evaluateType| (third item))))))
      ((eq op '|Enumeration|) form)
      (t (|evaluateType1| form))))
    ((|constructor?| form)
     (if (atom form)
         (|evaluateType| (list form))
         (|throwEvalTypeMsg| 'S2IE0003 (list form form))))
    (t (|throwEvalTypeMsg| 'S2IE0004 (list form))))))

```

defun Eval args passed to a constructor

Evaluates the arguments passed to a constructor [constructor? p??]

[getConstructorSignature p??]

[throwEvalTypeMsg p919]

[replaceSharps p958]

[categoryForm? p??]

[evaluateType p916]

```

[evalCategory p959]
[getdatabase p1010]
[mkAtree p??]
[putTarget p??]
[bottumUp p??]
[qcar p??]
[qcdr p??]
[getAndEvalConstructorArgument p958]
[coerceOrRetract p??]
[objValUnwrap p??]
[throwKeyedMsgCannotCoerceWithValue p??]
[makeOrdinal p920]
[$quadSymbol p??]
[$EmptyMode p??]

```

— defun evaluateType1 —

```

(defun |evaluateType1| (form)
  (let (op arg1 sig ml xp tree tmp1 m1 z1 zt zv v typeList (argnum 0))
    (declare (special |$quadSymbol| |$EmptyMode|))
    (setq op (car form))
    (setq arg1 (cdr form))
    (cond
      ((|constructor?| op)
       (cond
         ((null (setq sig (|getConstructorSignature| form)))
          (|throwEvalTypeMsg| 'S2IE0005 (list form)))
         (t
          (setq ml (cdr sig))
          (setq ml (|replaceSharps| ml form))
          (cond
            ((not (eq1 (|#| arg1) (|#| ml)))
             (|throwEvalTypeMsg| 'S2IE0003 (list form form)))
            (t
             (loop for x in arg1 for m in ml
                   do
                     (setq typeList
                           (cons
                            (cond
                              ((|categoryForm?| m)
                               (setq m (|evaluateType| (subst x '$ m)))
                               (if (|evalCategory| (setq xp (|evaluateType| x)) m)
                                   xp
                                   (|throwEvalTypeMsg| 'S2IE0004 (list form))))
                             (t
                              (setq m (|evaluateType| m))
                              (cond
                                ((and (eq (getdatabase (|opOf| m) 'constructorkind) '|domain|)

```

```

      (setq tree (|mkAtree| x))
      (|putTarget| tree m)
      (progn
        (setq tmp1 (|bottomUp| tree))
        (and (consp tmp1)
              (eq (qcdr tmp1) nil))))
      (setq m1 (qcar tmp1))
      (setq z1 (|getAndEvalConstructorArgument| tree))
      (setq zt (car z1))
      (setq zv (cdr z1))
      (if (setq v (|coerceOrRetract| z1 m))
          (|objValUnwrap| v)
          (|throwKeyedMsgCannotCoerceWithValue| zv zt m)))
      (t
       (when (equal x |$EmptyMode|) (setq x |$quadSymbol|))
       (|throwEvalTypeMsg| 'S2IE0006
        (list (|makeOrdinal| (incf argnum)) m form))))))
      typeList)))
      (cons op (nreverse typeList))))))
      (t (|throwEvalTypeMsg| 'S2IE0007 (list op))))))

```

defvar \$noEvalTypeMsg

— initvars —

```
(defvar |$noEvalTypeMsg| nil)
```

defun throwEvalTypeMsg

```

[spadThrow p??]
[throwKeyedMsg p??]
|$noEvalTypeMsg p919]

```

— defun throwEvalTypeMsg —

```

(defun |throwEvalTypeMsg| (msg args)
  (declare (special |$noEvalTypeMsg|))
  (if |$noEvalTypeMsg|
      (|spadThrow|)
      (|throwKeyedMsg| msg args)))

```

defun makeOrdinal

— defun makeOrdinal —

```
(defun |makeOrdinal| (i)
  (elt '(|first| |second| |third| |fourth| |fifth| |sixth| |seventh|
        |eighth| |ninth| |tenth|)
    (1- i)))
```

defun evaluateSignature

Calls evaluateType on a signature [evaluateType p916]

— defun evaluateSignature —

```
(defun |evaluateSignature| (sig)
  (cond
    ((and (consp sig) (eq (qcar sig) 'signature) (consp (qcdr sig))
      (consp (qcdr (qcdr sig))) (eq (qcdr (qcdr (qcdr sig))) nil))
      (cons 'signature (cons (qcar (qcdr sig))
        (list
          (loop for z in (qcar (qcdr (qcdr sig)))
            collect (if (eq z '$) z (|evaluateType| z)))))))
    (t sig)))
```

53.3 Data Structures

`$frameRecord = [delta1, delta2, ...]` where `delta(i)` contains changes in the “backwards” direction. Each `delta(i)` has the form `((var . proplist)...)` where `proplist` denotes an ordinary proplist. For example, an entry of the form `((x (value) (mode (Integer))))...` indicates that to undo 1 step, `x`’s value is cleared and its mode should be set to `(Integer)`.

A `delta(i)` of the form `(systemCommand . delta)` is a special delta indicating changes due to system commands executed between the last command and the current command. By recording these deltas separately, it is possible to undo to either BEFORE or AFTER the command. These special `delta(i)`s are given ONLY when a a system command is given which alters the environment.

recordFrame('system) is called before a command is executed, and recordFrame('normal) is called after (see processInteractive1). If no changes are found for former, no special entry is given.

The \$previousBindings is a copy of the CAAR \$InteractiveFrame. This is used to compute the delta(i)s stored in \$frameRecord.

53.4 Functions

Initial Undo Variables

```
$undoFlag := true      --Default setting for undo is "on"
$frameRecord := nil    --Initial setting for frame record
$previousBindings := nil
```

defvar \$undoFlag

— initvars —

```
(defvar |$undoFlag| t "t means we record undo information")
```

—————

defvar \$frameRecord

— initvars —

```
(defvar |$frameRecord| nil "a list of value changes")
```

—————

defvar \$previousBindings

— initvars —

```
(defvar |$previousBindings| nil "a copy of Interactive Frame info for undo")
```

—————

defvar \$reportundo

— initvars —

```
(defvar |$reportundo| nil "t means we report the steps undo takes")
```

—————

defun undo

```
[stringPrefix? p??]
[pname p1045]
[read p642]
[userError p??]
[qcdr p??]
[qcar p??]
[spaddifference p??]
[identp p1046]
[undoSteps p930]
[undoCount p929]
[$options p??]
[$InteractiveFrame p??]
```

— defun undo —

```
(defun |undo| (l)
  (let (tmp1 key s undoWhen n)
    (declare (special |$options| |$InteractiveFrame|))
    (setq undoWhen '|after|)
    (when
      (and (consp |$options|)
           (eq (qcdr |$options|) nil)
           (progn
             (setq tmp1 (qcar |$options|))
             (and (consp tmp1)
                  (eq (qcdr tmp1) nil)
                  (progn (setq key (qcar tmp1)) t))))
      (cond
        ((|stringPrefix?| (setq s (pname key)) "redo")
         (setq |$options| nil)
         (|read| '(|redo.input|)))
        ((null (|stringPrefix?| s "before"))
         (|userError| "only option to undo is \"redo\""))
        (t
         (setq undoWhen '|before|))))))
```

```

(if (null l)
  (setq n (spaddifference 1))
  (setq n (car l)))
(when (identp n)
  (setq n (parse-integer (pname n)))
  (unless (integerp n)
    (userError| "undo argument must be an integer")))
(setq |$InteractiveFrame| (|undoSteps| (|undoCount| n) undoWhen))
nil))

```

defun recordFrame

```

[kar p??]
[diffAlist p924]
[seq p??]
[exit p??]
[$undoFlag p921]
[$frameRecord p921]
[$InteractiveFrame p??]
[$previousBindings p921]

```

— defun recordFrame —

```

(defun |recordFrame| (systemNormal)
  (prog (currentAlist delta)
    (declare (special |$undoFlag| |$frameRecord| |$InteractiveFrame|
      |$previousBindings|))
    (return
      (seq
        (cond
          ((null |$undoFlag|) nil)
          (t
            (setq currentAlist (kar |$frameRecord|))
            (setq delta
              (|diffAlist| (caar |$InteractiveFrame|) |$previousBindings|))
            (cond
              ((eq systemNormal '|system|)
                (cond
                  ((null delta)
                    (return nil)))
                (t
                  (setq delta (cons '|systemCommand| delta))))))
            (setq |$frameRecord| (cons delta |$frameRecord|))
            (setq |$previousBindings|
              (prog (tmp0)

```

```

(setq tmp0 nil)
(return
  (do ((tmp1 (caar |$InteractiveFrame|) (cdr tmp1)) (x nil))
      ((or (atom tmp1)
            (progn (setq x (car tmp1)) nil))
       (nreverse0 tmp0))
    (seq
      (exit
        (setq tmp0
          (cons
            (cons
              (car x)
              (prog (tmp2)
                    (setq tmp2 nil)
                    (return
                      (do ((tmp3 (cdr x) (cdr tmp3)) (y nil))
                          ((or (atom tmp3)
                                (progn (setq y (car tmp3)) nil))
                           (nreverse0 tmp2))
                        (seq
                          (exit
                            (setq tmp2 (cons (cons (car y) (cdr y)) tmp2))))))))
                    tmp0))))))
      (car |$frameRecord|))))))

```

defun diffAlist

```

diffAlist(new,old) ==
--record only those properties which are different
for (pair := [name,:proplist]) in new repeat
  -- name has an entry both in new and old world
  -- (1) if the old world had no proplist for that variable, then
  --   record NIL as the value of each new property
  -- (2) if the old world does have a proplist for that variable, then
  --   a) for each property with a value: give the old value
  --   b) for each property missing:      give NIL as the old value
oldPair := ASSQ(name,old) =>
null (oldProplist := CDR oldPair) =>
--record old values of new properties as NIL
acc := [ [name,:[ [prop] for [prop,.] in proplist] ],:acc]
deltas := nil
for (propval := [prop,:val]) in proplist repeat
  null (oldPropval := ASSOC(prop,oldProplist)) => --missing property
    deltas := [ [prop],:deltas]
    EQ(CDR oldPropval,val) => 'skip
    deltas := [oldPropval,:deltas]

```

```

    deltas => acc := [ [name,:NREVERSE deltas],:acc]
    acc := [ [name,:[ [prop] for [prop,:.] in proplist] ],:acc]
--record properties absent on new list (say, from a )cl all)
for (oldPair := [name,:r]) in old repeat
  r and null LASSQ(name,new) =>
    acc := [oldPair,:acc]
  -- name has an entry both in new and old world
  -- (1) if the new world has no proplist for that variable
  --   (a) if the old world does, record the old proplist
  --   (b) if the old world does not, record nothing
  -- (2) if the new world has a proplist for that variable, it has
  --   been handled by the first loop.
res := NREVERSE acc
if BOUNDP '$reportundo and $reportundo then reportUndo res
res

```

```

[assq p1050]
[tmp1 p??]
[seq p??]
[exit p??]
[assoc p??]
[lassq p??]
[reportUndo p927]

```

— defun diffAlist —

```

(defun |diffAlist| (new old)
  (prog (proplist oldPair oldProplist val oldPropval deltas prop name r acc res)
    (return
      (seq
        (progn
          (do ((tmp0 new (cdr tmp0)) (pair nil))
            ((or (atom tmp0)
                 (progn (setq pair (car tmp0)) nil)
                 (progn
                     (progn
                       (setq name (car pair))
                       (setq proplist (cdr pair))
                       pair)
                     nil))
              nil)
          (seq
            (exit
              (cond
                ((setq oldPair (assq name old))
                 (cond
                   ((null (setq oldProplist (cdr oldPair)))
                    (setq acc
                      (cons

```

```

(cons
  name
  (prog (tmp1)
    (setq tmp1 nil)
    (return
      (do ((tmp2 proplist (cdr tmp2)) (tmp3 nil))
        ((or (atom tmp2)
              (progn (setq tmp3 (car tmp2)) nil)
              (progn
                (progn (setq prop (car tmp3)) tmp3)
                nil))
              (nreverse0 tmp1)))
        (seq
          (exit
            (setq tmp1 (cons (cons prop nil) tmp1)))))))
    acc)))
(t
  (setq deltas nil)
  (do ((tmp4 proplist (cdr tmp4)) (|propval| nil))
    ((or (atom tmp4)
          (progn (setq |propval| (car tmp4)) nil)
          (progn
            (progn
              (setq prop (car |propval|))
              (setq val (cdr |propval|))
              |propval|)
            nil))
          nil))
    nil)
  (seq
    (exit
      (cond
        ((null (setq oldPropval (|assoc| prop oldProplist)))
          (setq deltas (cons (cons prop nil) deltas)))
        ((eq (cdr oldPropval) val) '|skip|)
        (t (setq deltas (cons oldPropval deltas))))))
    (when deltas
      (setq acc
        (cons (cons name (nreverse deltas)) acc))))))
(t
  (setq acc
    (cons
      (cons
        name
        (prog (tmp5)
          (setq tmp5 nil)
          (return
            (do ((tmp6 proplist (cdr tmp6)) (tmp7 nil))
              ((or (atom tmp6)
                    (progn (setq tmp7 (CAR tmp6)) nil)
                    (progn

```

```

                (progn (setq prop (CAR tmp7)) tmp7)
                nil))
            (nreverse0 tmp5))
        (seq
         (exit
          (setq tmp5 (cons (cons prop nil) tmp5)))))))))
    acc))))))
(seq
 (do ((tmp8 old (cdr tmp8)) (oldPair nil))
      ((or (atom tmp8)
           (progn (setq oldPair (car tmp8)) nil)
                 (progn
                  (setq name (car oldPair))
                  (setq r (cdr oldPair))
                  oldPair)
              nil))
       nil)
      nil)
  (seq
   (exit
    (cond
     ((and r (null (lassq name new)))
      (exit
       (setq acc (cons oldPair acc)))))))))
  (setq res (nreverse acc))
  (cond
   ((and (boundp '$reportundo) |$reportundo|)
    (|reportUndo| res)))
  (exit res))))))

```

defun reportUndo

This function is enabled by setting `$reportundo` to a non-nil value. An example of the output generated is:

```
r := binary(22/7)
```

```

---
(1)  11.001

```

Type: BinaryExpansion

Properties of % ::

value was: NIL

value is: ((|BinaryExpansion|) WRAPPED . #(1 (1 1) NIL (0 0 1)))

Properties of r ::

value was: NIL


```
[seq p??]
[exit p??]
[sayBrightly p??]
[concat p1047]
[pname p1045]
[lassoc p??]
[sayBrightlyNT p??]
[pp p??]
[$InteractiveFrame p??]
```

```
(defun |reportUndo| (acc)
  (prog (name proplist curproplist prop value)
    (declare (special |$InteractiveFrame|))
    (return
      (seq
        (do ((tmp0 acc (cdr tmp0)) (tmp1 nil))
          ((or (atom tmp0)
              (progn (setq tmp1 (car tmp0)) nil)
              (progn
                (progn
                  (setq name (car tmp1))
                  (setq proplist (cdr tmp1))
                  tmp1)
                nil))
            nil))
          nil)
        (seq
          (exit
            (progn
              (|sayBrightly|
                (concat ' |Properties of | (pname name) " ::"))
              (setq curproplist (lassoc name (caar |$InteractiveFrame|)))
              (do ((tmp2 proplist (cdr tmp2)) (tmp3 nil))
                ((or (atom tmp2)
                    (progn (setq tmp3 (car tmp2)) nil)
                    (progn
                      (progn
                        (setq prop (car tmp3))
                        (setq value (cdr tmp3))
                        tmp3)
                      nil))
                  nil)
                nil)
              (seq
                (exit
                  (progn
```

```
(|sayBrightlyNT|
  (cons " " (cons prop (cons " was: " nil))))
(|pp| value)
(|sayBrightlyNT|
  (cons " " (cons prop (cons " is: " nil))))
(|pp| (lassoc prop curproplist)))))))))
```

defun clearFrame

```
[clearCmdAll p503]
[$frameRecord p921]
[$previousBindings p921]
```

— defun clearFrame —

```
(defun |clearFrame| ()
  (declare (special |$frameRecord| |$previousBindings|))
  (|clearCmdAll|)
  (setq |$frameRecord| nil)
  (setq |$previousBindings| nil))
```

Undo previous n commands

```
[spaddifference p??]
[userError p??]
[concat p1047]
[$IOindex p10]
```

— defun undoCount —

```
(defun |undoCount| (n)
  "Undo previous n commands"
  (prog (m)
    (declare (special |$IOindex|))
    (return
      (progn
        (setq m
          (cond
            ((>= n 0) (spaddifference (spaddifference |$IOindex| n) 1))
            (t (spaddifference n))))
        (cond
```

```

((>= m |$IOindex|)
 (|userError|
  (concat "Magnitude of undo argument must be less than step number ("
    (princ-to-string |$IOindex|) ")."))))
(t m))))))

```

defun undoSteps

```

-- undoes m previous commands; if )before option, then undo one extra at end
--Example: if $IOindex now is 6 and m = 2 then general layout of $frameRecord,
-- after the call to recordFrame below will be:
-- (<change for systemcommands>
-- (<change for #5> <change for system commands>
-- (<change for #4> <change for system commands>
-- (<change for #3> <change for system commands>
-- <change for #2> <change for system commands>
-- <change for #1> <change for system commands>) where system
-- command entries are optional and identified by (systemCommand . change).
-- For a ")undo 3 )after", m = 2 and undoStep swill restore the environment
-- up to, but not including <change for #3>.
-- An "undo 3 )before" will additionally restore <change for #3>.
-- Thus, the later requires one extra undo at the end.

```

```

[writeInputLines p587]
[spaddifference p??]
[recordFrame p923]
[copy p??]
[undoSingleStep p931]
[qcdr p??]
[qcar p??]
[$IOindex p10]
[$InteractiveFrame p??]
[$frameRecord p921]

```

— defun undoSteps —

```

(defun |undoSteps| (m beforeOrAfter)
  (let (tmp1 tmp2 systemDelta lastTailSeen env)
    (declare (special |$IOindex| |$InteractiveFrame| |$frameRecord|))
    (|writeInputLines| '|redo| (spaddifference |$IOindex| m))
    (|recordFrame| '|normal|)
    (setq env (copy (caar |$InteractiveFrame|)))
    (do ((i 0 (1+ i)) (framelist |$frameRecord| (cdr framelist)))
      ((or (> i m) (atom framelist)) nil)

```

```

(setq env (|undoSingleStep| (CAR framelist) env))
(if (and (consp framelist)
        (progn
          (setq tmp1 (qcdr framelist))
          (and (consp tmp1)
                (progn
                  (setq tmp2 (qcar tmp1))
                  (and (consp tmp2)
                        (eq (qcar tmp2) '|systemCommand|)
                        (progn
                          (setq systemDelta (qcdr tmp2))
                          t)))))))
    (progn
      (setq framelist (cdr framelist))
      (setq env (|undoSingleStep| systemDelta env)))
    (setq lastTailSeen framelist)))
(cond
 ((eq beforeOrAfter '|before|)
  (setq env (|undoSingleStep| (car (cdr lastTailSeen)) env))))
(setq |$frameRecord| (cdr |$frameRecord|))
(setq |$InteractiveFrame| (list (list env))))

```

defun undoSingleStep

```

undoSingleStep(changes,env) ==
--Each change is a name-proplist pair. For each change:
-- (1) if there exists a proplist in env, then for each prop-value change:
--     (a) if the prop exists in env, RPLAC in the change value
--     (b) otherwise, CONS it onto the front of prop-values for that name
-- (2) add change to the front of env
-- pp '"----Undoing 1 step-----"
-- pp changes

```

```

[assq p1050]
[seq p??]
[exit p??]
[lassoc p??]
[undoLocalModemapHack p933]

```

— defun undoSingleStep —

```

(defun |undoSingleStep| (changes env)
  (prog (name changeList pairlist proplist prop value node)
    (return
      (seq

```

```

(progn
  (do ((tmp0 changes (cdr tmp0)) (|change| nil))
      ((or (atom tmp0)
            (progn (setq |change| (car tmp0)) nil)
            (progn
              (progn
                (setq name (car |change|))
                (setq changeList (cdr |change|))
                |change|)
              nil))
        nil)
    (seq
      (exit
        (progn
          (when (lassoc '|localModemap| changeList)
            (setq changeList (|undoLocalModemapHack| changeList)))
          (cond
            ((setq pairlist (assq name env))
              (cond
                ((setq proplist (cdr pairlist))
                  (do ((tmp1 changeList (cdr tmp1)) (pair nil))
                      ((or (atom tmp1)
                            (progn (setq pair (car tmp1)) nil)
                            (progn
                              (progn
                                (setq prop (car pair))
                                (setq value (cdr pair))
                                pair)
                              nil))
                      nil)
                  (seq
                    (exit
                      (cond
                        ((setq node (assq prop proplist))
                          (rplacd node value))
                        (t
                          (rplacd proplist
                                (cons (car proplist) (cdr proplist)))
                          (rplaca proplist pair))))))
                    (t (rplacd pairlist changeList))))
                  (t
                    (setq env (cons |change| env))))))))
      env))))

```

defun undoLocalModemapHack

```
[seq p??]
[exit p??]
```

— defun undoLocalModemapHack —

```
(defun |undoLocalModemapHack| (changeList)
  (prog (name value)
    (return
      (seq
        (prog (tmp0)
          (setq tmp0 nil)
          (return
            (do ((tmp1 changeList (cdr tmp1)) (pair nil))
              ((or (atom tmp1)
                  (progn (setq pair (car tmp1)) nil)
                  (progn
                     (setq name (car pair))
                     (setq value (cdr pair))
                     pair)
                  nil)))
              (nreverse0 tmp0)))
          (seq
            (exit
              (cond
                ((cond
                  ((eq name '|localModemap|) (cons name nil))
                  (t pair))
                 (setq tmp0
                   (cons
                     (cond
                       ((eq name '|localModemap|) (cons name nil))
                       (t pair)) tmp0))))))))))))))
```

—————

Remove undo lines from history write

Removing undo lines from)hist)write linelist [stringPrefix? p??]

```
[seq p??]
[exit p??]
[trimString p??]
[substring p??]
[charPosition p??]
[maxindex p??]
```

```
[undoCount p929]
[spaddifference p??]
[concat p1047]
[$currentLine p??]
[$IOindex p10]
```

— defun removeUndoLines —

```
(defun |removeUndoLines| (u)
  "Remove undo lines from history write"
  (prog (xtra savedIOindex s s1 m s2 x code c n acc)
    (declare (special |$currentLine| |$IOindex|))
    (return
      (seq
        (progn
          (setq xtra
            (cond
              ((stringp |$currentLine|) (cons |$currentLine| nil))
              (t (reverse |$currentLine|))))
          (setq xtra
            (prog (tmp0)
              (setq tmp0 nil)
              (return
                (do ((tmp1 xtra (cdr tmp1)) (x nil))
                  ((or (atom tmp1)
                      (progn (setq x (car tmp1)) nil))
                   (nreverse0 tmp0)))
                (seq
                  (exit
                    (cond
                      ((null (|stringPrefix?| ")history" x))
                      (setq tmp0 (cons x tmp0))))))))
              (setq u (append u xtra))
              (cond
                ((null
                  (prog (tmp2)
                    (setq tmp2 nil)
                    (return
                      (do ((tmp3 nil tmp2) (tmp4 u (cdr tmp4)) (x nil))
                        ((or tmp3 (atom tmp4) (progn (setq x (car tmp4)) nil)) tmp2)
                      (seq
                        (exit
                          (setq tmp2
                            (or tmp2 (|stringPrefix?| ")undo" x))))))))) u)
                  (t
                    (setq savedIOindex |$IOindex|)
                    (setq |$IOindex| 1)
                    (do ((y u (cdr y)))
                      ((atom y) nil))
```

```

(seq
  (exit
    (cond
      ((eql (elt (setq x (car y)) 0) #\ )
        (cond
          ((|stringPrefix?| ")undo"
            (setq s (|trimString| x)))
          (setq s1 (|trimString| (substring s 5 nil)))
          (cond
            ((not (string= s1 ")redo"))
              (setq m (|charPosition| #\ ) s1 0))
              (setq code
                (cond
                  ((> (maxindex s1) m) (elt s1 (1+ m)))
                  (t #\a)))
                (setq s2 (|trimString| (substring s1 0 m))))))
            (setq n
              (cond
                ((string= s1 ")redo")
                  0)
                ((not (string= s2 ""))
                  (|undoCount| (parse-integer s2)))
                (t -1)))
              (rplaca y
                (concat ">" code (princ-to-string n))))
            (t nil)))
          (t (setq |$IOindex| (1+ |$IOindex|))))))
    (setq acc nil)
    (do ((y (nreverse u) (cdr y)))
      ((atom y) nil)
      (seq
        (exit
          (cond
            ((eql (elt (setq x (car y)) 0) #\>)
              (setq code (elt x 1))
              (setq n (parse-integer (substring x 2 nil)))
              (setq y (cdr y))
              (do ()
                ((null y) nil)
                (seq
                  (exit
                    (progn
                      (setq c (car y))
                      (cond
                        ((or (eql (elt c 0) #\))
                          (eql (elt c 0) #\>))
                        (setq y (cdr y)))
                      ((eql n 0)
                        (return nil))
                      (t

```



```
(setq n (spaddifference n 1))
(setq y (cdr y))))))
(cond
  ((and y (not (eql code #\b)))
    (setq acc (cons c acc))))
  (t (setq acc (cons x acc))))))
(setq |$IOindex| savedIOindex)
acc))))))
```

—————→

Chapter 54

)what help page Command

54.1 what help page man page

— what.help —

```
=====
A.28. )what
=====
```

User Level Required: interpreter

Command Syntax:

```
- )what categories pattern1 [pattern2 ...]
- )what commands  pattern1 [pattern2 ...]
- )what domains   pattern1 [pattern2 ...]
- )what operations pattern1 [pattern2 ...]
- )what packages  pattern1 [pattern2 ...]
- )what synonym   pattern1 [pattern2 ...]
- )what things    pattern1 [pattern2 ...]
- )apropos        pattern1 [pattern2 ...]
```

Command Description:

This command is used to display lists of things in the system. The patterns are all strings and, if present, restrict the contents of the lists. Only those items that contain one or more of the strings as substrings are displayed. For example,

```
)what synonym
```

displays all command synonyms,

)what synonym ver

displays all command synonyms containing the substring ‘ver’,

)what synonym ver pr

displays all command synonyms containing the substring ‘ver’ or the substring ‘pr’. Output similar to the following will be displayed

----- System Command Synonyms -----

user-defined synonyms satisfying patterns:

ver pr

```
)apr ..... )what things
)apropos ..... )what things
)prompt ..... )set message prompt
)version ..... )lisp *yearweek*
```

Several other things can be listed with the)what command:

categories displays a list of category constructors.

commands displays a list of system commands available at your user-level. Your user-level is set via the)set userlevel command. To get a description of a particular command, such as ‘)what’, issue)help what.

domains displays a list of domain constructors.

operations displays a list of operations in the system library.

It is recommended that you qualify this command with one or more patterns, as there are thousands of operations available. For example, say you are looking for functions that involve computation of eigenvalues. To find their names, try)what operations eig. A rather large list of operations is loaded into the workspace when this command is first issued. This list will be deleted when you clear the workspace via)clear all or)clear completely. It will be re-created if it is needed again.

packages displays a list of package constructors.

synonym lists system command synonyms.

things displays all of the above types for items containing the pattern strings as substrings. The command synonym)apropos is equivalent to)what things.

Also See:

- o)display
- o)set
- o)show

1

defvar \$whatOptions

— **initvars** —

```
(defvar |$whatOptions| '(|operations| |categories| |domains| |packages|
                        |commands| |synonyms| |things|))
```

defun what

[whatSpad2Cmd p940]

— **defun what** —

```
(defun |what| (l)
  (|whatSpad2Cmd| l))
```

defun whatSpad2Cmd,fixpat

[qcar p??]
[downcase p??]

— **defun whatSpad2Cmd,fixpat** —

```
(defun |whatSpad2Cmd,fixpat| (x)
  (let (xp)
    (if (and (consp x) (progn (setq xp (qcar x)) t))
        (downcase xp)
        (downcase x))))
```

¹ “display” (29.2 p 535) “set” (45.36 p 808) “show” (46.1 p 814)

defun whatSpad2Cmd

```

[reportWhatOptions p941]
[selectOptionLC p479]
[sayKeyedMsg p329]
[seq p??]
[exit p??]
[whatSpad2Cmd,fixpat p939]
[whatSpad2Cmd p940]
[filterAndFormatConstructors p944]
[whatCommands p941]
[apropos p945]
[printSynonyms p474]
[$e p??]
[$whatOptions p939]

```

— defun whatSpad2Cmd —

```

(defun |whatSpad2Cmd| (arg)
  (prog (|$e| |key0| key args)
    (declare (special |$e| |$whatOptions|))
    (return
      (seq
        (progn
          (setq |$e| |$EmptyEnvironment|)
          (cond
            ((null arg) (|reportWhatOptions|))
            (t
              (setq |key0| (car arg))
              (setq args (cdr arg))
              (setq key (|selectOptionLC| |key0| |$whatOptions| nil))
              (cond
                ((null key) (|sayKeyedMsg| 's2iz0043 nil))
                (t
                  (setq args
                    (prog (t0)
                      (setq t0 nil)
                      (return
                        (do ((t1 args (cdr t1)) (p nil))
                          ((or (atom t1)
                              (progn (setq p (car t1)) nil))
                           (nreverse0 t0))
                        (seq
                          (exit
                            (setq t0 (cons (|whatSpad2Cmd,fixpat| p) t0))))))))
                    (seq
                      (exit
                        (setq t0 (cons (|whatSpad2Cmd,fixpat| p) t0))))))))
              (cond
                ((eq key '|things|)

```

```

      (do ((t2 |$whatOptions| (cdr t2)) (opt nil))
          ((or (atom t2) (progn (setq opt (CAR t2)) nil)) nil)
          (seq
            (exit
              (cond
                ((null (member opt '(|things|)))
                 (exit (|whatSpad2Cmd| (cons opt args)))))))))
      ((eq key '|categories|)
       (|filterAndFormatConstructors| '|category| "Categories" args))
      ((eq key '|commands|) (|whatCommands| args))
      ((eq key '|domains|)
       (|filterAndFormatConstructors| '|domain| "Domains" args))
      ((eq key '|operations|)
       (|apropos| args))
      ((eq key '|packages|)
       (|filterAndFormatConstructors| '|package| "Packages" args))
      (t
       (cond ((eq key '|synonyms|)
              (|printSynonyms| args)))))))))

```

defun Show keywords for)what command

```

[|sayBrightly| p??]
[|$whatOptions| p939]

```

— defun reportWhatOptions —

```

(defun |reportWhatOptions| ()
  (let (optlist)
    (declare (special |$whatOptions|))
    (setq optlist
      (reduce #'append
        (mapcar #'(lambda (x) '(|%l| " " ,x)) |$whatOptions|)))
    (|sayBrightly|
      '(|%b| " )what" |%d| "argument keywords are" |%b| ,@optlist |%d|
        |%l| " or abbreviations thereof." |%l| |%l| " Issue" |%b| ")what ?"
        |%d| "for more information."))))

```

defun The)what commands implementation

```

[|centerAndHighlight| p??]
[|strconc| p??]

```

[\[specialChar p980\]](#)
[\[filterListOfStrings p942\]](#)
[\[commandsForUserLevel p448\]](#)
[\[sayMessage p??\]](#)
[\[blankList p??\]](#)
[\[sayAsManyPerLineAsPossible p??\]](#)
[\[say p??\]](#)
[\[sayKeyedMsg p329\]](#)
[\[\\$systemCommands p443\]](#)
[\[\\$linelength p774\]](#)
[\[\\$UserLevel p807\]](#)

— defun whatCommands —

```

(defun |whatCommands| (patterns)
  (let (label ell)
    (declare (special |$systemCommands| $linelength |$UserLevel|))
    (setq label
      (strconc ' |System Commands for User Level: |
        (princ-to-string |$UserLevel|)))
    (|centerAndHighlight| label $linelength (|specialChar| ' |hbar|))
    (setq ell
      (|filterListOfStrings| patterns
        (mapcar #'princ-to-string (|commandsForUserLevel| |$systemCommands|))))
    (when patterns
      (if ell
        (|sayMessage|
          ("System commands at this level matching patterns:" |%l| " " |%b|
            ,@(append (|blankList| patterns) (list ' |%d|))))
        (|sayMessage|
          ("No system commands at this level matching patterns:" |%l| " " |%b|
            ,@(append (|blankList| patterns) (list ' |%d|))))))
    (when ell
      (|sayAsManyPerLineAsPossible| ell)
      (say " "))
    (unless patterns (|sayKeyedMsg| 's2iz0046 nil))))

```

defun Find all names contained in a pattern

Names and patterns are lists of strings. This returns a list of strings in names that contains any of the strings in the patterns [\[satisfiesRegularExpressions p943\]](#)

— defun filterListOfStrings —

```

(defun |filterListOfStrings| (patterns names)

```

```
(let (result)
  (if (or (null patterns) (null names))
      names
      (dolist (name (reverse names) result)
        (when (|satisfiesRegularExpressions| name patterns)
          (push name result))))))
```

defun Find function of names contained in pattern

The argument names and patterns are lists of strings. The argument fn is something like CAR or CADR This returns a list of strings in names that contains any of the strings in patterns [satisfiesRegularExpressions p943]

— defun filterListOfStringsWithFn —

```
(defun |filterListOfStringsWithFn| (patterns names fn)
  (let (result)
    (if (or (null patterns) (null names))
        names
        (dolist (name (reverse names) result)
          (when (|satisfiesRegularExpressions| (funcall fn name) patterns)
            (push name result))))))
```

defun satisfiesRegularExpressions

[strpos p1045]

— defun satisfiesRegularExpressions —

```
(defun |satisfiesRegularExpressions| (name patterns)
  (let ((dname (downcase (copy name))))
    (dolist (pattern patterns)
      (when (strpos pattern dname 0 "@")
        (return-from nil t)))))
```

defun filterAndFormatConstructors

[\[sayMessage p??\]](#)
[\[blankList p??\]](#)
[\[pp2Cols p??\]](#)
[\[centerAndHighlight p??\]](#)
[\[specialChar p980\]](#)
[\[filterListOfStringsWithFn p943\]](#)
[\[whatConstructors p945\]](#)
[\[function p??\]](#)
[\[\\$linelength p774\]](#)

— **defun filterAndFormatConstructors** —

```

(defun |filterAndFormatConstructors| (constrType label patterns)
  (prog (1)
    (declare (special $linelength))
    (return
      (progn (|centerAndHighlight| label $linelength (|specialChar| '|hbar|))
        (setq 1
          (|filterListOfStringsWithFn| patterns
            (|whatConstructors| constrType)
            (|function| cdr)))
        (cond (patterns)
          (cond
            ((null 1)
              (|sayMessage|
                (cons "  No "
                  (cons label
                    (cons " with names matching patterns:"
                      (cons '|%l|
                        (cons "  "
                          (cons '|%b|
                            (append (|blankList| patterns)
                              (cons '|%d| nil))))))))))
              (t
                (|sayMessage|
                  (cons label
                    (cons " with names matching patterns:"
                      (cons '|%l|
                        (cons "  "
                          (cons '|%b|
                            (append (|blankList| patterns)
                              (cons '|%d| nil))))))))))
                (cond (1 (|pp2Cols| 1)))))))

```

defun whatConstructors

```

[boot-equal p??]
[getdatabase p1010]
[seq p??]
[msort p??]
[exit p??]

— defun whatConstructors —

(defun |whatConstructors| (constrType)
  (prog nil
    (return
      (seq
        (msort
          (prog (t0)
            (setq t0 nil)
            (return
              (do ((t1 (|allConstructors|) (cdr t1)) (|con| nil))
                ((or (atom t1) (progn (setq |con| (car t1)) nil)) (nreverse0 t0))
              (seq
                (exit
                  (cond
                    ((equal (getdatabase |con| 'constructorkind) constrType)
                     (setq t0
                       (cons
                        (cons
                          (getdatabase |con| 'abbreviation)
                          (string |con|))
                        t0))))))))))))))

```

Display all operation names containing the fragment

Argument *l* is a list of operation name fragments. This displays all operation names containing these fragments [allOperations p1033]

```

[filterListOfStrings p942]
[seq p??]
[exit p??]
[downcase p??]
[sayMessage p??]
[sayAsManyPerLineAsPossible p??]
[msort p??]
[sayKeyedMsg p329]

```

— defun apropos —

```
(defun |apropos| (arg)
  "Display all operation names containing the fragment"
  (prog (ops)
    (return
      (seq
        (progn
          (setq ops
            (cond
              ((null arg) (|allOperations|))
              (t
               (|filterListOfStrings|
                (prog (t0)
                  (setq t0 nil)
                  (return
                    (do ((t1 arg (cdr t1)) (p nil))
                      ((or (atom t1) (progn (setq p (car t1)) nil))
                       (nreverse0 t0))
                    (seq (exit (setq t0 (cons (downcase (princ-to-string p)) t0))))))
                (|allOperations|))))))
          (cond
            (ops
             (|sayMessage| "Operations whose names satisfy the above pattern(s):")
             (|sayAsManyPerLineAsPossible| (msort ops))
             (|sayKeyedMsg| 's2if0011 (cons (car ops) nil)))
            (t
             (|sayMessage| "  There are no operations containing those patterns"
              nil))))))
```

—————

Chapter 55

)with help page Command

55.1 with help page man page

— with.help —

This command is obsolete.
This has been renamed)library.

See also:
o)library

1

defun with

[library p1013]

— defun with —

```
(defun |with| (args)
  (|library| args))
```

¹ “library” (66.1 p 1013)

Chapter 56

)workfiles help page Command

56.1 workfiles help page man page

defun workfiles

[workfilesSpad2Cmd p949]

— defun workfiles —

```
(defun |workfiles| (l)
  (|workfilesSpad2Cmd| l))
```

—————

defun workfilesSpad2Cmd

```
[throwKeyedMsg p??]
[selectOptionLC p479]
[pathname p1042]
[delete p??]
[makeInputFilename p983]
[sayKeyedMsg p329]
[namestring p1040]
[updateSourceFiles p546]
[say p??]
[centerAndHighlight p??]
[specialChar p980]
[sortby p??]
[sayBrightly p??]
```

[Options p??]
 [SourceFiles p??]
 [linelength p774]

— defun workfilesSpad2Cmd —

```
(defun |workfilesSpad2Cmd| (args)
  (let (deleteflag type flist type1 fl)
    (declare (special |Options| |SourceFiles| $linelength))
    (cond
      (args (|throwKeyedMsg| 's2iz0047 nil))
      (t
        (setq deleteflag nil)
        (do ((t0 |Options| (cdr t0)) (t1 nil))
          ((or (atom t0)
              (progn (setq t1 (car t0)) nil)
              (progn (progn (setq type (car t1)) t1) nil))
          nil)
          (setq type1
            (|selectOptionLC| type '(|boot| |lisp| |meta| |delete|) nil))
          (cond
            ((null type1) (|throwKeyedMsg| 's2iz0048 (cons type nil)))
            ((eq type1 '|delete|) (setq deleteflag t)))
          (do ((t2 |Options| (cdr t2)) (t3 nil))
            ((or (atom t2)
                (progn (setq t3 (CAR t2)) nil)
                (progn
                  (progn
                    (setq type (car t3))
                    (setq flist (cdr t3)) t3)
                  nil))
            nil)
            (setq type1 (|selectOptionLC| type '(|boot| |lisp| |meta| |delete|) nil))
            (unless (eq type1 '|delete|)
              (dolist (file flist)
                (setq fl (|pathname| (list file type1 "*")))
                (cond
                  (deleteflag
                    (setq |SourceFiles| (|delete| fl |SourceFiles|)))
                  ((null (makeInputFilename fl))
                    (|sayKeyedMsg| 's2iz0035 (list (|namestring| fl))))
                  (t (|updateSourceFiles| fl))))))
            (say " ")
            (|centerAndHighlight|
              '| User-specified work files |
              $linelength
              (|specialChar| '|hbar|))
            (say " ")
            (if (null |SourceFiles|)
```

```
(say "  no files specified")
(progn
  (setq |$sourceFiles| (sortby '|pathnameType| |$sourceFiles|))
  (do ((t5 |$sourceFiles| (cdr t5)) (f1 nil))
      ((or (atom t5) (progn (setq f1 (car t5)) nil)) nil)
      (|sayBrightly| (list "  " (|namestring| f1))))))
```

Chapter 57

)zsystemdevelopment help page Command

57.1 zsystemdevelopment help page man page

defun zsystemdevelopment

[zsystemDevelopmentSpad2Cmd p953]

— defun zsystemdevelopment —

```
(defun |zsystemdevelopment| (arg)
  (|zsystemDevelopmentSpad2Cmd| arg))
```

—————

defun zsystemDevelopmentSpad2Cmd

[zsystemdevelopment1 p954]

[\$InteractiveMode p22]

— defun zsystemDevelopmentSpad2Cmd —

```
(defun |zsystemDevelopmentSpad2Cmd| (arg)
  (declare (special |$InteractiveMode|))
  (|zsystemdevelopment1| arg |$InteractiveMode|))
```

—————

```
[filenam p??]  
[selectOptionLC p479]  
[/D,1 p??]  
[/comp p??]  
[version p??]  
[defiostream p982]  
[next p36]  
[shut p982]  
[kar p??]  
[kadr p??]  
[kaddr p??]  
[sayMessage p??]  
[sayBrightly p??]  
[bright p??]  
[$InteractiveMode p22]  
[$options p??]  
[/wsname p??]  
[/version p??]
```

```
(defun |zsystemdevelopment1| (arg im)
  (let (|$InteractiveMode| fromopt opt optarg newopt opt1 constream upf fun)
    (declare (special |$InteractiveMode| /wsname /version |$options|))
    (setq |$InteractiveMode| im)
    (setq fromopt nil)
    (do ((t0 |$options| (cdr t0)) (t1 nil))
        ((or (atom t0)
              (progn (setq t1 (car t0)) nil)
                    (progn
                     (progn
                      (setq opt (CAR t1))
                      (setq optarg (CDR t1))
                      t1)
                     nil)))
         nil)
      (setq opt1 (|selectOptionLC| opt '(|from|) nil))
      (when (eq opt1 '|from|) (setq fromopt (cons (cons 'from optarg) nil))))
    (do ((t2 |$options| (cdr t2)) (t3 nil))
        ((or (atom t2)
              (progn (setq t3 (car t2)) nil)
                    (progn
                     (progn
                      (setq opt (car t3))
                      (setq optarg (cdr t3))
                      t3)
                     nil)))
```

```

        nil))
    nil)
  (unless optargs (setq optargs arg))
  (setq newopt (append optargs fromopt))
  (setq opt1 (|selectOptionLC| opt '(|from|) nil))
  (cond
   ((eq opt1 '|from|) nil)
   ((eq opt '|c|) (|/D,1| newopt (/COMP) nil nil))
   ((eq opt '|d|) (|/D,1| newopt 'define nil nil))
   ((eq opt '|dt|) (|/D,1| newopt 'define nil t))
   ((eq opt '|ct|) (|/D,1| newopt (/COMP) nil t))
   ((eq opt '|ctl|) (|/D,1| newopt (/COMP) nil 'tracelet))
   ((eq opt '|ec|) (|/D,1| newopt (/COMP) t nil))
   ((eq opt '|ect|) (|/D,1| newopt (/COMP) t t))
   ((eq opt '|el|) (|/D,1| newopt nil t nil))
   ((eq opt '|version|) (|version|))
   ((eq opt '|pause|)
    (setq constream
      (defiostream '((device . console) (qual . v)) 120 0))
    (next constream)
    (shut constream))
   ((or
    (eq opt '|update|)
    (eq opt '|patch|))
    (setq |$InteractiveMode| nil)
    (setq upf
      (cons
       (or (kar optargs) /version)
       (cons
        (or (kadr optargs) /wsname)
        (cons (or (kaddr optargs) '*) nil))))))
    (setq fun
      (cond
       ((eq opt '|patch|) '/update-lib-1)
       (t '/update-1)))
    (catch 'filenam (funcall fun upf))
    (|sayMessage| " Update/patch is completed.))
  ((null optargs)
   (|sayBrightly| '(" An argument is required for" ,@(|bright| opt))))
  (t
   (|sayMessage|
    '(" Unknown option:" ,@(|bright| opt)
      |%l| " Available options are"
      ,@(|bright|
        "c ct e ec ect cls pause update patch compare record"))))))))

```

Chapter 58

Handlers for Special Forms

This file contains the functions which do type analysis and evaluation of special functions in the interpreter. Special functions are ones which are not defined in the algebra code, such as assignment, construct, COLLECT and declaration.

Operators which require special handlers all have a LISP “up” property which is the name of the special handler, which is always the word “up” followed by the operator name. If an operator has this “up” property the handler is called automatically from bottomUp instead of general modemap selection.

The up handlers are usually split into two pieces, the first is the up function itself, which performs the type analysis, and an “eval” function, which generates (and executes, if required) the code for the function.

The up functions always take a single argument, which is the entire attributed tree for the operation, and return the modeSet of the node, which is a singleton list containing the type computed for the node.

The eval functions can take any arguments deemed necessary. Actual evaluation is done if `$genValue` is true, otherwise code is generated.

(See the function analyzeMap for other things that may affect what is generated in these functions.)

These functions are required to do two things:

1. do a putValue on the operator vector with the computed value of the node, which is a triple. This is usually done in the eval functions.
2. do a putModeSet on the operator vector with a list of the computed type of the node. This is usually done in the up functions.

There are several special modes used in these functions:

1. Void is the mode that should be used for all statements that do not otherwise return values, such as declarations, loops, IF-THEN's without ELSE's, etc..

2. `$NoValueMode` and `$ThrowAwayMode` used to be used in situations where `Void` is now used, and are being phased out completely.

defun getAndEvalConstructorArgument

```
[getValue p??]
[objMode p??]
[isWrapped p??]
[objVal p??]
[isLocalVar p??]
[compFailure p??]
[objNewWrap p??]
[timedEVALFUN p??]
```

— defun getAndEvalConstructorArgument —

```
(defun |getAndEvalConstructorArgument| (tree)
  (let (triple)
    (setq triple (|getValue| tree))
    (cond
      ((eq (|objMode| triple) '(|Domain|)) triple)
      ((|isWrapped| (|objVal| triple)) triple)
      ((|isLocalVar| (|objVal| triple))
        (|compFailure| " Local variable or parameter used in type"))
      (t
        (|objNewWrap| (|timedEVALFUN| (|objVal| triple)) (|objMode| triple))))))
```

defun replaceSharps

Replaces all sharps in `x` by the arguments of domain `d`. Replaces all replaces the triangle variables

```
[subCopy p??]
[$TriangleVariableList p??]
[$FormalMapVariableList p??]
```

— defun replaceSharps —

```
(defun |replaceSharps| (x d)
  (let (sl)
    (declare (special |$TriangleVariableList| |$FormalMapVariableList|))
    (loop for e in (rest d) for var in |$FormalMapVariableList|
      do (setq sl (cons (cons var e) sl)))
    (setq x (|subCopy| x sl))
    (setq sl nil))
```

```
(loop for e in (rest d) for var in |$TriangleVariableList|
  do (setq sl (cons (cons var e) sl)))
(|subCopy| x sl)))
```

defun isDomainValuedVariable

Returns the value of form if form is a variable with a type value [identp p1046]

```
[get p??]
[member p1048]
[objMode p??]
[objValUnwrap p??]
[$e p??]
[$env p??]
[$InteractiveFrame p??]
```

— defun isDomainValuedVariable —

```
(defun |isDomainValuedVariable| (form)
  (let (val)
    (declare (special |$e| |$env| |$InteractiveFrame|))
    (when (and (identp form)
                (setq val
                      (or (|get| form '|value| |$InteractiveFrame|)
                          (and (consp |$env|) (|get| form '|value| |$env|))
                          (and (consp |$e|) (|get| form '|value| |$e|))))
          (|member| (|objMode| val) '((|Domain|) (|SubDomain| (|Domain|)))))
      (|objValUnwrap| val))))
```

defun evalCategory

```
[ofCategory p419]
[isPartialMode p420]
```

— defun evalCategory —

```
(defun |evalCategory| (d c)
  (or (|isPartialMode| d) (|ofCategory| d c)))
```

Chapter 59

Handling input files

defun Handle .axiom.input file

[/editfile p515]

— defun readSpadProfileIfThere —

```
(defun |readSpadProfileIfThere| ()  
  (let ((file (list '|.axiom| '|input|)))  
    (declare (special /editfile))  
    (when (makeInputFilename file) (setq /editfile file) (/rq))))
```

—————

defvar \$boot-line-stack

— initvars —

```
(defvar boot-line-stack nil "List of lines returned from preparse")
```

—————

defvar \$in-stream

— initvars —

```
(defvar in-stream t "Current input stream.")
```

defvar \$out-stream

— initvars —

(defvar out-stream t "Current output stream.")

defvar \$file-closed

— initvars —

(defvar file-closed nil "Way to stop EOF tests for console input.")

defvar \$echo-meta

— initvars —

(defvar echo-meta nil "T if you want a listing of what has been read.")

defvar \$noSubsumption

— initvars —

(defvar |\$noSubsumption| t)

defvar \$envHashTable

The `$envHashTable` variable is a hashtable that optimizes lookups in the environment, which normally involve search. This gets populated in the `addBinding` function.

— **initvars** —

```
(defvar |$envHashTable| nil)
```

defun Dynamically add bindings to the environment

[getProplist p964]

[addBindingInteractive p967]

[hput p1044]

[\$InteractiveMode p22]

[\$envHashTable p963]

— **defun addBinding** —

```
(defun |addBinding| (var proplist e)
  (let (tailContour tailEnv tmp1 curContour lx)
    (declare (special |$InteractiveMode| |$envHashTable|))
    (setq curContour (caar e))
    (setq tailContour (cdar e))
    (setq tailEnv (cdr e))
    (cond
      ((eq proplist (|getProplist| var e)) e)
      (t
       (when |$envHashTable|
         (do ((prop proplist (cdr prop)) (u nil))
             ((or (atom prop)
                  (progn (setq u (car prop)) nil))
              nil)
          (hput |$envHashTable| (list var (car u)) t)))
        (cond
          (|$InteractiveMode| (|addBindingInteractive| var proplist e))
          (t
           (when (and (consp curContour)
                      (progn
                        (setq tmp1 (qcar curContour))
                        (and (consp tmp1) (equal (qcar tmp1) var))))
             (setq curContour (cdr curContour)))
           (setq lx (cons var proplist))
           (cons (cons (cons lx curContour) tailContour) tailEnv)))))))
```

defun Fetch a property list for a symbol from CategoryFrame

```
[getProplist p964]
[search p964]
[$CategoryFrame p??]

— defun getProplist —

(defun |getProplist| (x e)
  (let (u pl)
    (declare (special |$CategoryFrame|))
    (cond
      ((null (atom x)) (|getProplist| (car x) e))
      ((setq u (|search| x e)) u)
      ((setq pl (|search| x |$CategoryFrame|)) pl))))
```

defun Search for a binding in the environment list

```
[searchCurrentEnv p964]
[searchTailEnv p965]

— defun search —

(defun |search| (x e)
  (let ((curEnv (car e)) (tailEnv (cdr e)))
    (or (|searchCurrentEnv| x curEnv) (|searchTailEnv| x tailEnv))))
```

defun Search for a binding in the current environment

```
searchCurrentEnv(x,currentEnv) ==
  for contour in currentEnv repeat
    if u:= ASSQ(x,contour) then return (signal:= u)
  KDR signal
```

```
[assq p1050]
[kdr p??]
```

— defun searchCurrentEnv —

```
(defun |searchCurrentEnv| (x currentEnv)
```

```

(prog (u signal)
  (return
    (seq
      (progn
        (do ((thisenv currentEnv (cdr thisenv)) (contour nil))
          ((or (atom thisenv) (progn (setq contour (car thisenv)) nil)) nil)
        (seq
          (exit
            (cond
              ((setq u (assq x contour)) (return (setq signal u)))
              (t nil))))))
      (kdr signal))))))

```

defun searchTailEnv

```

;searchTailEnv(x,e) ==
; for env in e repeat
;   signal:=
;   for contour in env repeat
;     if (u:= ASSQ(x,contour)) and ASSQ("FLUID",u) then return (signal:= u)
;   if signal then return signal
; KDR signal

```

```

[assq p1050]
[kdr p??]

```

— defun searchTailEnv —

```

(defun |searchTailEnv| (x e)
  (prog (u signal)
    (return
      (seq
        (progn
          (do ((thise e (cdr thise)) (env nil))
            ((or (atom thise) (progn (setq env (car thise)) nil)) nil)
          (seq
            (exit
              (setq signal
                (progn
                  (do ((cone env (cdr cone)) (contour nil))
                    ((or (atom cone) (progn (setq contour (car cone)) nil)) nil)
                  (seq
                    (exit
                      (cond
                        ((and (setq u (assq x contour)) (assq 'fluid u))

```

```
        (return (setq signal u)))
      (t nil))))
  (cond
    (signal (return signal))
    (t nil))))))
(kdr signal))))))
```

Chapter 60

File Parsing

defun Bind a variable in the interactive environment

[assq p1050]

— defun addBindingInteractive —

```
(defun |addBindingInteractive| (var proplist e)
  (let ((curContour (caar e)) u)
    (cond
      ((setq u (assq var curContour)) (rplacd u proplist) e)
      (t (rplac (caar e) (cons (cons var proplist) curContour)) e))))
```

—————

defvar \$line-handler

— initvars —

```
(defparameter line-handler 'next-META-line "Who grabs lines for us.")
```

—————

defvar \$spad-errors

— initvars —


```
(defvar $spad_errors (vector 0 0 0))
```

defvar \$xtokenreader

— initvars —

```
(defvar xtokenreader 'spadtok)
```

defun Initialize the spad reader

```
[next-lines-clear p972]
[ioclear p972]
[$spad-errors p967]
[spaderrorstream p??]
[*standard-output* p??]
[xtokenreader p968]
[line-handler p967]
[meta-error-handler p??]
[file-closed p962]
[boot-line-stack p961]
```

— defun init-boot/spad-reader —

```
(defun init-boot/spad-reader ()
  (declare (special $spad_errors spaderrorstream *standard-output*
                  xtokenreader line-handler meta-error-handler file-closed
                  boot-line-stack))
  (setq $spad_errors (vector 0 0 0))
  (setq spaderrorstream *standard-output*)
  (setq xtokenreader 'get-BOOT-token)
  (setq line-Handler 'next-BOOT-line)
  (setq meta-error-handler 'spad-syntax-error)
  (setq file-closed nil)
  (next-lines-clear)
  (ioclear))
```

defun spad-syntax-error

```
[bumperrorcount p??]
[consoleinputp p??]
[spad-long-error p969]
[spad-short-error p970]
[ioclear p972]
[debugmode p??]
[spad-reader p??]
```

— defun spad-syntax-error —

```
(defun spad-syntax-error (&rest byebye)
  "Print syntax error indication, underline character, scrub line."
  (declare (special debugmode))
  (bumperrorcount '|syntax|)
  (cond ((and (eq debugmode 'yes) (not(consoleinputp in-stream)))
    (spad-long-error))
    ((spad-short-error)))
  (ioclear)
  (throw 'spad_reader nil))
```

—————

defun spad-long-error

```
[spad-error-loc p970]
[iostat p970]
[out-stream p962]
[spaderrorstream p??]
```

— defun spad-long-error —

```
(defun spad-long-error ()
  (declare (special spaderrorstream))
  (spad-error-loc spaderrorstream)
  (iostat)
  (unless (equal out-stream spaderrorstream)
    (spad-error-loc out-stream)
    (terpri out-stream)))
```

—————

defun spad-short-error

```
[line-past-end-p p??]
[line-print p??]
[$current-line p??]
```

— defun spad-short-error —

```
(defun spad-short-error ()
  (if (line-past-end-p Current-Line)
      (format t "~&The current line is empty.~%")
      (progn
        (format t "~&The current line is:~%~%")
        (line-print current-line))))
```

—————

defun spad-error-loc

— defun spad-error-loc —

```
(defun spad-error-loc (str)
  (format str "***** Boot Syntax Error detected *****"))
```

—————

defun iostat

```
[line-past-end-p p??]
[line-print p??]
[token-stack-show p971]
[next-lines-show p971]
[$boot p23]
[$spad p18]
[$current-line p??]
```

— defun iostat —

```
(defun iostat ()
  "Tell me what the current state of the parsing world is."
  (declare (special $boot $spad))
  (if (line-past-end-p Current-Line)
      (format t "~&The current line is empty.~%")
```

```

(progn
  (format t "~&The current line is:~%~%")
  (line-print current-line)))
(if (or $boot $spad) (next-lines-show))
(token-stack-show)
nil)

```

defun next-lines-show

[boot-line-stack p961]

— defun next-lines-show —

```

(defun next-lines-show ()
  (declare (special boot-line-stack))
  (and boot-line-stack (format t "Currently prepared lines are:~%~%")
    (mapcar #'(lambda (line)
      (format t "~&~5D> ~A~%" (car line) (cdr line)))
      boot-line-stack))

```

defun token-stack-show

[token-type p??]
 [valid-tokens p??]
 [current-token p??]
 [next-token p??]
 [prior-token p??]

— defun token-stack-show —

```

(defun token-stack-show ()
  (if (= valid-tokens 0)
    (format t "~%There are no valid tokens.~%")
    (format t "~%The number of valid tokens is ~S.~%" valid-tokens))
  (when (> valid-tokens 0)
    (format t "The current token is~%")
    (describe current-token))
  (when (> valid-tokens 1)
    (format t "The next token is~%")
    (describe next-token))
  (when (token-type prior-token)

```

```
(format t "The prior token was~%")
(describe prior-token))
```

defun ioclear

The IO state manipulation routines assume that

- one I/O stream pair is in effect at any moment
- there is a current line
- there is a current token and a next token
- there is a reduction stack

```
[line-clear p??]
[reduce-stack-clear p??]
[current-fragment p??]
[current-line p??]
[$boot p23]
[$spad p18]
```

— defun ioclear —

```
(defun ioclear (&optional (in t) (out t))
  (declare (special current-fragment current-line $boot $spad)
    (ignore in out))
  (setq current-fragment nil)
  (line-clear current-line)
  (token-install nil nil current-token nil)
  (token-install nil nil next-token nil)
  (token-install nil nil prior-token nil)
  (reduce-stack-clear)
  (if (or $boot $spad) (next-lines-clear))
  nil)
```

defun Set boot-line-stack to nil

```
[boot-line-stack p961]
```

— defun next-lines-clear —

```
(defun next-lines-clear ()  
  (setq boot-line-stack nil))
```

Chapter 61

Handling output

61.1 Special Character Tables

`defvar $defaultSpecialCharacters`

— initvars —

```
(defvar |$defaultSpecialCharacters| (list
  (int-char 28)    ; upper left corner
  (int-char 27)    ; upper right corner
  (int-char 30)    ; lower left corner
  (int-char 31)    ; lower right corner
  (int-char 79)    ; vertical bar
  (int-char 45)    ; horizontal bar
  (int-char 144)   ; APL quad
  (int-char 173)   ; left bracket
  (int-char 189)   ; right bracket
  (int-char 192)   ; left brace
  (int-char 208)   ; right brace
  (int-char 59)    ; top    box tee
  (int-char 62)    ; bottom box tee
  (int-char 63)    ; right  box tee
  (int-char 61)    ; left   box tee
  (int-char 44)    ; center box tee
  (int-char 224))) ; back slash
```

defvar \$plainSpecialCharacters0

— initvars —

```
(defvar |$plainSpecialCharacters0| (list
  (int-char 78)      ; upper left corner  (+)
  (int-char 78)      ; upper right corner (+)
  (int-char 78)      ; lower left corner  (+)
  (int-char 78)      ; lower right corner (+)
  (int-char 79)      ; vertical bar
  (int-char 96)      ; horizontal bar      (-)
  (int-char 111)     ; APL quad            (?)
  (int-char 173)     ; left bracket
  (int-char 189)     ; right bracket
  (int-char 192)     ; left brace
  (int-char 208)     ; right brace
  (int-char 78)      ; top    box tee      (+)
  (int-char 78)      ; bottom box tee      (+)
  (int-char 78)      ; right  box tee      (+)
  (int-char 78)      ; left   box tee      (+)
  (int-char 78)      ; center box tee      (+)
  (int-char 224))) ; back slash
```

—————

defvar \$plainSpecialCharacters1

— initvars —

```
(defvar |$plainSpecialCharacters1| (list
  (int-char 107)     ; upper left corner  (,)
  (int-char 107)     ; upper right corner (,)
  (int-char 125)     ; lower left corner  (')
  (int-char 125)     ; lower right corner (')
  (int-char 79)      ; vertical bar
  (int-char 96)      ; horizontal bar      (-)
  (int-char 111)     ; APL quad            (?)
  (int-char 173)     ; left bracket
  (int-char 189)     ; right bracket
  (int-char 192)     ; left brace
  (int-char 208)     ; right brace
  (int-char 78)      ; top    box tee      (+)
  (int-char 78)      ; bottom box tee      (+)
  (int-char 78)      ; right  box tee      (+)
  (int-char 78)      ; left   box tee      (+)
```

```
(int-char 78)      ; center box tee      (+)
(int-char 224)))   ; back slash
```

defvar \$plainSpecialCharacters2

— initvars —

```
(defvar |$plainSpecialCharacters2| (list
  (int-char 79)      ; upper left corner  (|)
  (int-char 79)      ; upper right corner (|)
  (int-char 79)      ; lower left corner  (|)
  (int-char 79)      ; lower right corner (|)
  (int-char 79)      ; vertical bar
  (int-char 96)      ; horizontal bar      (-)
  (int-char 111)     ; APL quad           (?)
  (int-char 173)     ; left bracket
  (int-char 189)     ; right bracket
  (int-char 192)     ; left brace
  (int-char 208)     ; right brace
  (int-char 78)      ; top    box tee      (+)
  (int-char 78)      ; bottom box tee      (+)
  (int-char 78)      ; right  box tee      (+)
  (int-char 78)      ; left   box tee      (+)
  (int-char 78)      ; center box tee      (+)
  (int-char 224)))   ; back slash
```

defvar \$plainSpecialCharacters3

— initvars —

```
(defvar |$plainSpecialCharacters3| (list
  (int-char 96)      ; upper left corner  (-)
  (int-char 96)      ; upper right corner (-)
  (int-char 96)      ; lower left corner  (-)
  (int-char 96)      ; lower right corner (-)
  (int-char 79)      ; vertical bar
  (int-char 96)      ; horizontal bar      (-)
  (int-char 111)     ; APL quad           (?)
  (int-char 173)     ; left bracket
```

```

(int-char 189)    ; right bracket
(int-char 192)    ; left brace
(int-char 208)    ; right brace
(int-char 78)     ; top    box tee      (+)
(int-char 78)     ; bottom box tee      (+)
(int-char 78)     ; right  box tee      (+)
(int-char 78)     ; left   box tee      (+)
(int-char 78)     ; center box tee      (+)
(int-char 224)))  ; back slash

```

defvar \$plainRTspecialCharacters

— initvars —

```

(defvar |$plainRTspecialCharacters| (list
  (QUOTE +)      ; upper left corner  (+)
  (QUOTE +)      ; upper right corner (+)
  (QUOTE +)      ; lower left corner  (+)
  (QUOTE +)      ; lower right corner (+)
  (QUOTE |\|))   ; vertical bar
  (QUOTE -)      ; horizontal bar      (-)
  (QUOTE ?)      ; APL quad            (?)
  (QUOTE [)      ; left bracket
  (QUOTE ])      ; right bracket
  (QUOTE {)      ; left brace
  (QUOTE })      ; right brace
  (QUOTE +)      ; top    box tee      (+)
  (QUOTE +)      ; bottom box tee      (+)
  (QUOTE +)      ; right  box tee      (+)
  (QUOTE +)      ; left   box tee      (+)
  (QUOTE +)      ; center box tee      (+)
  (QUOTE |\|)))  ; back slash

```

defvar \$RTspecialCharacters

— initvars —

```

(defvar |$RTspecialCharacters| (list
  (intern (string (code-char 218))) ;-- upper left corner  (+)

```

```

(intern (string (code-char 191))) ;-- upper right corner (+)
(intern (string (code-char 192))) ;-- lower left corner (+)
(intern (string (code-char 217))) ;-- lower right corner (+)
(intern (string (code-char 179))) ;-- vertical bar
(intern (string (code-char 196))) ;-- horizontal bar      (-)
(list (code-char #x1d) (code-char #xe2))
                                ;-- APL quad             (?)
(QUOTE [])                     ;-- left bracket
(QUOTE ])                     ;-- right bracket
(QUOTE {)                     ;-- left brace
(QUOTE })                     ;-- right brace
(intern (string (code-char 194))) ;-- top box tee        (+)
(intern (string (code-char 193))) ;-- bottom box tee     (+)
(intern (string (code-char 180))) ;-- right box tee      (+)
(intern (string (code-char 195))) ;-- left box tee       (+)
(intern (string (code-char 197))) ;-- center box tee     (+)
(QUOTE \\|))                  ;-- back slash

```

defvar \$specialCharacters

— initvars —

```
(defvar |$specialCharacters| |$RTspecialCharacters|)
```

defvar \$specialCharacterAlist

— initvars —

```

(defvar |$specialCharacterAlist|
  '([|ulc| . 0)
    (|urc| . 1)
    (|llc| . 2)
    (|lrc| . 3)
    (|vbar| . 4)
    (|hbar| . 5)
    (|quad| . 6)
    (|lbrk| . 7)
    (|rbrk| . 8)
    (|lbrc| . 9)

```

```
(|rbrcl| . 10)
(|ttee| . 11)
(|btee| . 12)
(|rtee| . 13)
(|ltee| . 14)
(|ctee| . 15)
(|bslash| . 16)))
```

defun Look up a special character code for a symbol

This function looks up a symbol in `$specialCharacterAlist`, gets the index into the EBCDIC table, and returns the appropriate character. **TPDHERE: Make this more international, not EBCDIC** [ifcdr p??]

```
[assq p1050]
[$specialCharacters p979]
[$specialCharacterAlist p979]
```

— defun specialChar —

```
(defun |specialChar| (symbol)
  (let (code)
    (declare (special |$specialCharacters| |$specialCharacterAlist|))
    (if (setq code (ifcdr (assq symbol |$specialCharacterAlist|)))
        (elt |$specialCharacters| code)
        "?")))
```

Chapter 62

Stream and File Handling

defun make-instream

[makeInputFilename p983]

— defun make-instream —

```
(defun make-instream (filespec &optional (recnum 0))
  (declare (ignore recnum))
  (cond ((numberp filespec) (make-synonym-stream '*terminal-io*))
        ((null filespec) (error "not handled yet"))
        (t (open (makeInputFilename filespec)
                  :direction :input :if-does-not-exist nil))))
```

—————

defun make-outstream

[make-filename p??]

— defun make-outstream —

```
(defun make-outstream (filespec &optional (width nil) (recnum 0))
  (declare (ignore width) (ignore recnum))
  (cond ((numberp filespec) (make-synonym-stream '*terminal-io*))
        ((null filespec) (error "not handled yet"))
        (t (open (make-filename filespec) :direction :output))))
```

—————

defun make-appendstream

[make-filename p??]

— defun make-appendstream —

```

(defun make-appendstream (filespec &optional (width nil) (recnum 0))
  "fortran support"
  (declare (ignore width) (ignore recnum))
  (cond
    ((numberp filespec) (make-synonym-stream '*terminal-io*))
    ((null filespec) (error "make-appendstream: not handled yet"))
    ('else (open (make-filename filespec) :direction :output
                  :if-exists :append :if-does-not-exist :create))))

```

defun defiostream

— defun defiostream —

```

(defun defiostream (stream-alist buffer-size char-position)
  (declare (ignore buffer-size))
  (let ((mode (or (cdr (assoc 'mode stream-alist)) 'input))
        (filename (cdr (assoc 'file stream-alist)))
        (dev (cdr (assoc 'device stream-alist))))
    (if (eq dev 'console) (make-synonym-stream '*terminal-io*)
        (let ((strm (case mode
                      ((output o) (open (make-filename filename)
                                           :direction :output))
                      ((input i) (open (makeInputFilename filename)
                                           :direction :input)))))
          (if (and (numberp char-position) (> char-position 0))
              (file-position strm char-position)
              strm))))

```

defun shut

[shut is-console (vol9)]

— defun shut —

```
(defun shut (st)
  (if (is-console st)
      st
      (if (streamp st) (close st) -1)))
```

defun eofp

— defun eofp —

```
(defun eofp (stream) (null (peek-char nil stream nil nil)))
```

defun makeStream

[make-appendstream p982]
[make-outstream p981]

— defun makeStream —

```
(defun |makeStream| (append filename i j)
  (if append
      (make-appendstream filename i j)
      (make-outstream filename i j)))
```

defun Construct a new input file name

— defun makeInputFilename —

```
(defun makeInputFilename (filearg &optional (filetype nil))
  (let*
    ((filename (make-filename filearg filetype))
     (dirname (pathname-directory filename))
     (ft (pathname-type filename))
     (dirs (getDirectoryList ft))
     (newfn nil))
    (if (or (null dirname) (eqcar dirname :relative))
```



```
(dolist (dir dirs (probeName filename))
  (when (probe-file (setq newfn (concatenate 'string dir filename)))
    (return newfn)))
(probeName filename))))
```

defun getDirectoryList

[[\\$current-directory](#) p5]
 [[\\$UserLevel](#) p807]
 [[\\$library-directory-list](#) p7]
 [[\\$directory-list](#) p6]

— defun getDirectoryList —

```
(defun getDirectoryList (ft &aux (cd (namestring $current-directory)))
  (declare (special $current-directory |$UserLevel| $library-directory-list
    $directory-list))
  (if (member ft '("nrlib" "daase" "exposed")) :test #'string=)
  (if (eq |$UserLevel| '|development|)
    (cons cd $library-directory-list)
    $library-directory-list)
  (adjoin cd
    (adjoin (namestring (user-homedir-pathname)) $directory-list
      :test #'string=)
    :test #'string=)))
```

defun probeName

Sometimes we are given a file and sometimes we are given the name of an Axiom KAF (Keyed-Access File). KAF files are actually directories with a single file called “index.kaf”. We check for the latter case and return the directory name as the filename, per Axiom convention.

— defun probeName —

```
(defun probeName (file)
  (when (or (probe-file file)
    (probe-file (concatenate 'string (namestring file) "/index.kaf")))
    (namestring file)))
```

defun makeFullNamestring

— defun makeFullNamestring —

```
(defun makeFullNamestring (filearg &optional (filetype nil))
  (namestring (merge-pathnames (make-filename filearg filetype))))
```

—————

defun Replace a file by erase and rename

[makeFullNamestring [p985](#)]

— defun replaceFile —

```
(defun replaceFile (filespec1 filespec2)
  ($erase (setq filespec1 (makeFullNamestring filespec1)))
  (rename-file (makeFullNamestring filespec2) filespec1))
```

—————

Chapter 63

The Spad Server Mechanism

defun openserver

This is a cover function for the C code used for communication interface.

— **defun** openserver —

```
(defun openserver (name)
  (open_server name))
```

—————

Chapter 64

Axiom Build-time Functions

defun spad-save

The **spad-save** function is just a cover function for more lisp system specific save functions. There is no standard name for saving a lisp image so we make one and conditionalize it at compile time.

This function is passed the name of an image that will be saved. The saved image contains all of the loaded functions.

This is used in the src/interp/Makefile.pamphlet in three places:

- creating depsys, an image for compiling axiom.

Some of the Common Lisp code we compile uses macros which are assumed to be available at compile time. The **DEPSYS** image is created to contain the compile time environment and saved. We pipe compile commands into this environment to compile from Common Lisp to machine dependent code.

```
DEPSYS=${OBJ}/${SYS}/bin/depsys
```

- creating savesys, an image for running axiom.

Once we've compile all of the Common Lisp files we fire up a clean lisp image called **LOADSYS**, load all of the final executable code and save it out as **SAVESYS**. The **SAVESYS** image is copied to the `${MNT}/${SYS}/bin` subdirectory and becomes the axiom executable image.

```
LOADSYS= ${OBJ}/${SYS}/bin/lisp
SAVESYS= ${OBJ}/${SYS}/bin/interpsys
AXIOMSYS= ${MNT}/${SYS}/bin/AXIOMsys
```

- creating debugsys, an image with all interpreted functions loaded.

Occasionally we need to really get into the system internals. The best way to do this is to run almost all of the lisp code interpreted rather than compiled (note that `cfuncs.lisp` and `sockio.lisp` still need to be loaded in compiled form as they depend on the loader to link with lisp internals). This image is nothing more than a load of the file `src/interp/debugsys.lisp.pamphlet`. If you need to make test modifications you can add code to that file and it will show up here.

```
DEBUGSYS=${OBJ}/${SYS}/bin/debugsys
```

```
[save-system p??]  
[$SpadServer p10]  
[$openServerIfTrue p8]
```

— defun spad-save —

```
(defun user::spad-save (save-file)
  (declare (special |$SpadServer| $openServerIfTrue))
  (setq |$SpadServer| nil)
  (setq $openServerIfTrue t)
  #+:AKCL
  (system::save-system save-file)
  #+:allegro
  (if (fboundp 'boot::restart)
      (excl::dumplisp :name save-file :restart-function #'boot::restart)
      (excl::dumplisp :name save-file))
  #+:Lucid
  (if (fboundp 'boot::restart)
      (sys::disksave save-file :restart-function #'boot::restart)
      (sys::disksave save-file))
  #+:CCL
  (preserve)
)
```

Chapter 65

Exposure Groups

Exposure groups are a way of controlling the namespace available to the user. Certain algebra files are only useful for internal purposes but they contain functions have common names (like “map”. In order to separate the user visible functions from the internal functions the algebra files are collected into “exposure groups”. These large groups are grouped into sets in the variable `$globalExposureGroupAlist`.

Exposure group information is kept in the local frame. For more information “The Frame Mechanism” [32.3](#) on page [552](#).

Chapter 66

Databases

66.1 Database structure

In order to understand this program you need to understand some details of the structure of the databases it reads. Axiom has 5 databases, the `interp.daase`, `operation.daase`, `category.daase`, and `browse.daase`.

kaf File Format

This documentation refers to kaf files which are random access files. `nrllib` files are kaf files (look for `nrllib/index.kaf`) The format of a random access file is

```
byte-offset-of-key-table
first-entry
second-entry
...
last-entry
((key1 . first-entry-byte-address)
 (key2 . second-entry-byte-address)
 ...
 (keyN . last-entry-byte-address))
```

The key table is a standard lisp alist.

To open a database you fetch the first number, seek to that location, and `(read)` which returns the key-data alist. To look up data you index into the key-data alist, find the `ith-entry-byte-address`, seek to that address, and `(read)`.

For instance, see `src/share/algebra/users.daase/index.kaf`

One existing optimization is that if the data is a simple thing like a symbol then the `nth-entry-byte-address` is replaced by immediate data.

Another existing one is a compression algorithm applied to the data so that the very long names don't take up so much space. We could probably remove the compression algorithm as 64k is no longer considered 'huge'. The database-abbreviation routine handles this on read and write-compress handles this on write.

Indeed, a faster optimization is to simply read the whole database into the image before it is saved. The system would be easier to understand and the interpreter would be faster.

The fastest optimization is to fix the time stamp mechanism which is currently broken. Making this work requires a small bit of coordination at 'make' time which I forgot to implement.

Database Files

Database files are very similar to kaf files except that there is an optimization (currently broken) which makes the first item a pair of two numbers. The first number in the pair is the offset of the key-value table, the second is a time stamp. If the time stamp in the database matches the time stamp in the image the database is not needed (since the internal hash tables already contain all of the information). When the database is built the time stamp is saved in both the gcl image and the database.

Regarding the 'ancestors field in a category: At database build time there exists a `*ancestors-hash*` hash table that gets filled with CATEGORY (not domain) ancestor information. This later provides the information that goes into `interp.daase`. This `*ancestors-hash*` does not exist at normal runtime (it can be made by a call to `genCategoryTable`). Note that the ancestor information in `*ancestors-hash*` (and hence `interp.daase`) involves #1, #2, etc instead of R, Coef, etc. The latter thingies appear in all `.nrlib/index.kaf` files. So we need to be careful when we `)lib` categories and update the ancestor info.

This file contains the code to build, open and access the `.daase` files. This file contains the code to `)library` `nrlibs` and `asy` files

There is a major issue about the data that resides in these databases. the fundamental problem is that the system requires more information to build the databases than it needs to run the interpreter. in particular, `modemap.daase` is constructed using properties like "modemaps" but the interpreter will never ask for this information.

So, the design is as follows:

- the `modemap.daase` needs to be built. this is done by doing a `)library` on ALL of the `nrlib` files that are going into the system. this will bring in "modemap" information and add it to the `*modemaps-hash*` hashtable.
- database build proceeds, accessing the "modemap" property from the hashtables. once this completes this information is never used again.
- the `interp.daase` database is built. this contains only the information necessary to run the interpreter. note that during the running of the interpreter users can extend the system by do a `)library` on a new `nrlib` file. this will cause fields such as "modemap" to be read and hashed.

Each constructor (e.g. LIST) had one library directory (e.g. LIST.nrlib). This directory contained a random access file called the index.kaf file. These files contain runtime information such as the operationAlist and the ConstructorModemap. At system build time we merge all of these .nrlib/index.kaf files into one database, INTERP.daase. Requests to get information from this database are cached so that multiple references do not cause additional disk i/o.

This database is left open at all times as it is used frequently by the interpreter. one minor complication is that newly compiled files need to override information that exists in this database.

The design calls for constructing a random read (kaf format) file that is accessed by functions that cache their results. when the database is opened the list of constructor-index pairs is hashed by constructor name. a request for information about a constructor causes the information to replace the index in the hash table. since the index is a number and the data is a non-numeric sexpr there is no source of confusion about when the data needs to be read.

The format of this new database is as follows:

```
first entry:
  an integer giving the byte offset to the constructor alist
  at the bottom of the file
second and subsequent entries (one per constructor)
  (operationAlist)
  (constructorModemap)
  ....
last entry: (pointed at by the first entry)
  an alist of (constructor . index) e.g.
  ( (PI offset-of-operationAlist offset-of-constructorModemap)
    (NNI offset-of-operationAlist offset-of-constructorModemap)
    ....)
This list is read at open time and hashed by the car of each item.
```

The system has been changed to use the property list of the symbols rather than hash tables. since we already hashed once to get the symbol we need only an offset to get the property list. this also has the advantage that eq hash tables no longer need to be moved during garbage collection.

There are 3 potential speedups that could be done.

- the best would be to use the value cell of the symbol rather than the property list but i'm unable to determine all uses of the value cell at the present time.
- a second speedup is to guarantee that the property list is a single item, namely the database structure. this removes an assoc but leaves one open to breaking the system if someone adds something to the property list. this was not done because of the danger mentioned.
- a third speedup is to make the getdatabase call go away, either by making it a macro or eliding it entirely. this was not done because we want to keep the flexibility of changing the database forms.

The new design does not use hash tables. the database structure contains an entry for each item that used to be in a hash table. initially the structure contains file-position pointers and these are replaced by real data when they are first looked up. the database structure is kept on the property list of the constructor, thus, (get '—DenavitHartenbergMatrix— 'database) will return the database structure object.

Each operation has a property on its symbol name called 'operation which is a list of all of the signatures of operations with that name.

defstruct \$database

— initvars —

```
(defstruct database
  abbreviation          ; interp.
  ancestors             ; interp.
  constructor           ; interp.
  constructorcategory   ; interp.
  constructorkind       ; interp.
  constructormodemap    ; interp.
  cosig                ; interp.
  defaultdomain        ; interp.
  modemaps             ; interp.
  niladic              ; interp.
  object               ; interp.
  operationalist        ; interp.
  documentation        ; browse.
  constructorform       ; browse.
  attributes           ; browse.
  predicates           ; browse.
  sourcefile           ; browse.
  parents              ; browse.
  users                ; browse.
  dependents           ; browse.
  spare                ; superstition
) ; database structure
```

—————

defvar \$*defaultdomain-list*

There are only a small number of domains that have default domains. rather than keep this slot in every domain we maintain a list here.

— initvars —

```
(defvar *defaultdomain-list* '(
```

```
(|MultisetAggregate| |Multiset|)
(|FunctionSpace| |Expression|)
(|AlgebraicallyClosedFunctionSpace| |Expression|)
(|ThreeSpaceCategory| |ThreeSpace|)
(|DequeueAggregate| |Dequeue|)
(|ComplexCategory| |Complex|)
(|LazyStreamAggregate| |Stream|)
(|AssociationListAggregate| |AssociationList|)
(|QuaternionCategory| |Quaternion|)
(|PriorityQueueAggregate| |Heap|)
(|PointCategory| |Point|)
(|PlottableSpaceCurveCategory| |Plot3D|)
(|PermutationCategory| |Permutation|)
(|StringCategory| |String|)
(|FileNameCategory| |FileName|)
(|OctonionCategory| |Octonion|)))
```

defvar \$*operation-hash*

— **initvars** —

```
(defvar *operation-hash* nil "given an operation name, what are its modemaps?")
```

defvar \$*hasCategory-hash*

This hash table is used to answer the question “does domain x have category y?”. this is answered by constructing a pair of (x . y) and doing an equal hash into this table.

— **initvars** —

```
(defvar *hasCategory-hash* nil "answers x has y category questions")
```

defvar \$*miss*

This variable is used for debugging. If a hash table lookup fails and this variable is non-nil then a message is printed.

— **initvars** —

```
(defvar *miss* nil "print out cache misses on getdatabase calls")
```

Note that constructorcategory information need only be kept for items of type category. this will be fixed in the next iteration when the need for the various caches are reviewed

Note that the *modemaps-hash* information does not need to be kept for system files. these are precomputed and kept in modemap.daase however, for user-defined files these are needed. Currently these are added to the database for 2 reasons; there is a still-unresolved issue of user database extensions and this information is used during database build time

Database streams

This are the streams for the databases. They are always open. There is an optimization for speeding up system startup. If the database is opened and the `..stream-stamp*` variable matches the position information in the database then the database is NOT read in and is assumed to match the in-core version

```
defvar $*interp-stream*
```

— initvars —

```
(defvar *interp-stream* nil "an open stream to the interpreter database")
```

```
defvar $*interp-stream-stamp*
```

— initvars —

```
(defvar *interp-stream-stamp* 0 "*interp-stream* (position . time)")
```

```
defvar $*operation-stream*
```

This is indexed by operation, not constructor

— initvars —

```
(defvar *operation-stream* nil "the stream to operation.daase")
```

defvar \$*operation-stream-stamp*

— initvars —

```
(defvar *operation-stream-stamp* 0 "*operation-stream* (position . time)")
```

defvar \$*browse-stream*

— initvars —

```
(defvar *browse-stream* nil "an open stream to the browser database")
```

defvar \$*browse-stream-stamp*

— initvars —

```
(defvar *browse-stream-stamp* 0 "*browse-stream* (position . time)")
```

defvar \$*category-stream*

This is indexed by (domain . category)

— initvars —

```
(defvar *category-stream* nil "an open stream to the category table")
```

```
defvar $*category-stream-stamp*
```

```
— initvars —
```

```
(defvar *category-stream-stamp* 0 "category-stream* (position . time)")
```

```
—————
```

```
defvar $*allconstructors*
```

```
— initvars —
```

```
(defvar *allconstructors* nil "a list of all the constructors in the system")
```

```
—————
```

```
defvar $*allOperations*
```

```
— initvars —
```

```
(defvar *allOperations* nil "a list of all the operations in the system")
```

```
—————
```

```
defun Reset all hash tables before saving system
```

```
[interpopen p??]  
[operationopen p??]  
[browseopen p??]  
[categoryopen p??]  
[initial-getdatabase p1001]  
[*sourcefiles* p??]  
[*interp-stream* p998]  
[*operation-stream* p998]  
[*category-stream* p999]  
[*browse-stream* p999]  
[*category-stream-stamp* p1000]  
[*operation-stream-stamp* p999]  
[*interp-stream-stamp* p998]
```

```
[*allconstructors* p1000]
[*operation-hash* p997]
[*hascategory-hash* p??]
```

— defun resethashtables —

```
(defun resethashtables ()
  "set all -hash* to clean values. used to clean up core before saving system"
  (declare (special *sourcefiles* *interp-stream* *operation-stream*
                    *category-stream* *browse-stream* *category-stream-stamp*
                    *operation-stream-stamp* *interp-stream-stamp*
                    *allconstructors* *operation-hash* *hascategory-hash*))
  (setq *hascategory-hash* (make-hash-table :test #'equal))
  (setq *operation-hash* (make-hash-table))
  (setq *allconstructors* nil)
  (setq *sourcefiles* nil)
  (setq *interp-stream-stamp* '(0 . 0))
  (interpopen)
  (setq *operation-stream-stamp* '(0 . 0))
  (operationopen)
  (setq *browse-stream-stamp* '(0 . 0))
  (browseopen)
  (setq *category-stream-stamp* '(0 . 0))
  (categoryopen) ;note: this depends on constructorform in browse.daase
  (initial-getdatabase)
  (close *interp-stream*)
  (close *operation-stream*)
  (close *category-stream*)
  (close *browse-stream*)
  (gbc t))
```

defun Preload algebra into saved system

```
[getdatabase p1010]
[getEnv p??]
```

— defun initial-getdatabase —

```
(defun initial-getdatabase ()
  "fetch data we want in the saved system"
  (let (hascategory constructormodemapAndoperationalist operation constr)
    (format t "Initial getdatabase~%")
    (setq hascategory '(
      (|Equation| . |Ring|)
      (|Expression| . |CoercibleTo|) (|Expression| . |CommutativeRing|)
```

```

(|Expression| . |IntegralDomain|) (|Expression| . |Ring|)
(|Float| . |RetractableTo|)
(|Fraction| . |Algebra|) (|Fraction| . |CoercibleTo|)
(|Fraction| . |OrderedSet|) (|Fraction| . |RetractableTo|)
(|Integer| . |Algebra|) (|Integer| . |CoercibleTo|)
(|Integer| . |ConvertibleTo|) (|Integer| . |LinearlyExplicitRingOver|)
(|Integer| . |RetractableTo|)
(|List| . |CoercibleTo|) (|List| . |FiniteLinearAggregate|)
(|List| . |OrderedSet|)
(|Polynomial| . |CoercibleTo|) (|Polynomial| . |CommutativeRing|)
(|Polynomial| . |ConvertibleTo|) (|Polynomial| . |OrderedSet|)
(|Polynomial| . |RetractableTo|)
(|Symbol| . |CoercibleTo|) (|Symbol| . |ConvertibleTo|)
(|Variable| . |CoercibleTo|)))
(dolist (pair hascategory) (getdatabase pair 'hascategory))
(setq constructormodemapAndoperationalist '(
|BasicOperator| |Boolean|
|CardinalNumber| |Color| |Complex|
|Database|
|Equation| |EquationFunctions2| |Expression|
|Float| |Fraction| |FractionFunctions2|
|Integer| |IntegralDomain|
|Kernel|
|List|
|Matrix| |MappingPackage1|
|Operator| |OutputForm|
|NonNegativeInteger|
|ParametricPlaneCurve| |ParametricSpaceCurve| |Point| |Polynomial|
|PolynomialFunctions2| |PositiveInteger|
|Ring|
|SetCategory| |SegmentBinding| |SegmentBindingFunctions2| |DoubleFloat|
|SparseMultivariatePolynomial| |SparseUnivariatePolynomial| |Segment|
|String| |Symbol|
|UniversalSegment|
|Variable| |Vector|))
(dolist (con constructormodemapAndoperationalist)
  (getdatabase con 'constructormodemap)
  (getdatabase con 'operationalist))
(setq operation '(
|+| |-| |*| | / | |**| |coerce| |convert| |elt| |equation|
|float| |sin| |cos| |map| |SEGMENT|))
(dolist (op operation) (getdatabase op 'operation))
(setq constr '( ;these are sorted least-to-most freq. delete early ones first
|Factored| |SparseUnivariatePolynomialFunctions2| |TableAggregate&| | |
|RetractableTo&| |RecursiveAggregate&| |UserDefinedPartialOrdering|
|None| |UnivariatePolynomialCategoryFunctions2| |IntegerPrimesPackage|
|SetCategory&| |IndexedExponents| |QuotientFieldCategory&| |Polynomial|
|EltableAggregate&| |PartialDifferentialRing&| |Set|
|UnivariatePolynomialCategory&| |FlexibleArray|
|SparseMultivariatePolynomial| |PolynomialCategory&|

```

```

|DifferentialExtension&| |IndexedFlexibleArray| |AbelianMonoidRing&| | | | |
|FiniteAbelianMonoidRing&| |DivisionRing&| |FullyLinearlyExplicitRingOver&|
|IndexedVector| |IndexedOneDimensionalArray| |LocalAlgebra| |Localize|
|Boolean| |Field&| |Vector| |IndexedDirectProductObject| |Aggregate&|
|PolynomialRing| |FreeModule| |IndexedDirectProductAbelianGroup|
|IndexedDirectProductAbelianMonoid| |SingletonAsOrderedSet|
|SparseUnivariatePolynomial| |Fraction| |Collection&| |HomogeneousAggregate&|
|RepeatedSquaring| |IntegerNumberSystem&| |AbelianSemiGroup&|
|AssociationList| |OrderedRing&| |SemiGroup&| |Symbol|
|UniqueFactorizationDomain&| |EuclideanDomain&| |IndexedAggregate&|
|GcdDomain&| |IntegralDomain&| |DifferentialRing&| |Monoid&| |Reference|
|UnaryRecursiveAggregate&| |OrderedSet&| |AbelianGroup&| |Algebra&|
|Module&| |Ring&| |StringAggregate&| |AbelianMonoid&|
|ExtensibleLinearAggregate&| |PositiveInteger| |StreamAggregate&|
|IndexedString| |IndexedList| |ListAggregate&| |LinearAggregate&|
|Character| |String| |NonNegativeInteger| |SingleInteger|
|OneDimensionalArrayAggregate&| |FiniteLinearAggregate&| |PrimitiveArray|
|Integer| |List| |OutputForm|))
(dolist (con constr)
  (let ((c (concatenate 'string
                        (|getEnv| "AXIOM") "/algebra/"
                        (string (getdatabase con 'abbreviation)) ".o"))))
    (format t "  preloading ~a.." c)
    (if (probe-file c)
        (progn
          (put con 'loaded c)
          (load c)
          (format t "loaded.~%")
          (format t "skipped.~%"))))
    (format t "~%"))))

```

defun Open the interp database

Format of an entry in interp.daase:

```

(constructor-name
 operationalist
 constructormodemap
 modemaps          -- this should not be needed. eliminate it.
 object            -- the name of the object file to load for this con.
 constructorcategory -- note that this info is the cadar of the
                    constructormodemap for domains and packages so it is stored
                    as NIL for them. it is valid for categories.
 niladic           -- t or nil directly
 unused
 cosig             -- kept directly

```

```

    constructorkind      -- kept directly
    defaultdomain       -- a short list, for %i
    ancestors           -- used to compute new category updates
  )

[make-database p??]
[DaaseName p1023]
[$spadroot p9]
[*allconstructors* p1000]
[*interp-stream* p998]
[*interp-stream-stamp* p998]

— defun interpOpen —

(defun interpOpen ()
  "open the interpreter database and hash the keys"
  (declare (special $spadroot *allconstructors* *interp-stream*
                    *interp-stream-stamp*))
  (let (constructors pos stamp dbstruct)
    (setq *interp-stream* (open (DaaseName "interp.daase" nil)))
    (setq stamp (read *interp-stream*))
    (unless (equal stamp *interp-stream-stamp*)
      (format t "  Re-reading interp.daase")
      (setq *interp-stream-stamp* stamp)
      (setq pos (car stamp))
      (file-position *interp-stream* pos)
      (setq constructors (read *interp-stream*))
      (dolist (item constructors)
        (setq *allconstructors* (adjoin (first item) *allconstructors*))
        (setq dbstruct (make-database))
        (setf (get (car item) 'database) dbstruct)
        (setf (database-operationalist dbstruct) (second item))
        (setf (database-constructormodemap dbstruct) (third item))
        (setf (database-modemaps dbstruct) (fourth item))
        (setf (database-object dbstruct) (fifth item))
        (setf (database-constructorcategory dbstruct) (sixth item))
        (setf (database-niladic dbstruct) (seventh item))
        (setf (database-abbreviation dbstruct) (eighth item))
        (setf (get (eighth item) 'abbreviationfor) (first item)) ;invert
        (setf (database-cosig dbstruct) (ninth item))
        (setf (database-constructorkind dbstruct) (tenth item))
        (setf (database-ancestors dbstruct) (nth 11 item))))
    (format t "~&")))
```

This is an initialization function for the constructor database it sets up 2 hash tables, opens the database and hashes the index values.

There is a slight asymmetry in this code. The sourcefile information for system files is only the filename and extension. For user files it contains the full pathname. when the database is first opened the sourcefile slot contains system names. The lookup function has to prefix the "\$spadroot" information if the directory-namestring is null (we don't know the real root at database build time).

An object-hash table is set up to look up nrlib and ao information. this slot is empty until a user does a)library call. We remember the location of the nrlib or ao file for the users local library at that time. A NIL result from this probe means that the library is in the system-specified place. When we get into multiple library locations this will also contain system files.

defun Open the browse database

Format of an entry in browse.daase:

```
( constructorname
  sourcefile
  constructorform
  documentation
  attributes
  predicates
)
```

[\$spadroot p9]
[*allconstructors* p1000]
[*browse-stream* p999]
[*browse-stream-stamp* p999]

— defun browseOpen —

```
(defun browseOpen ()
  "open the constructor database and hash the keys"
  (declare (special $spadroot *allconstructors* *browse-stream*
                    *browse-stream-stamp*))
  (let (constructors pos stamp dbstruct)
    (setq *browse-stream* (open (DaaseName "browse.daase" nil)))
    (setq stamp (read *browse-stream*))
    (unless (equal stamp *browse-stream-stamp*)
      (format t "  Re-reading browse.daase")
      (setq *browse-stream-stamp* stamp)
      (setq pos (car stamp))
      (file-position *browse-stream* pos)
      (setq constructors (read *browse-stream*))
      (dolist (item constructors)
        (unless (setq dbstruct (get (car item) 'database))
          (format t "browseOpen:~%")
          (format t "the browse database contains a constructor ~a~%" item))
```

```

(format t "that is not in the interp.daase file. we cannot~%")
(format t "get the database structure for this constructor and~%")
(warn "will create a new one~%")
(setf (get (car item) 'database) (setq dbstruct (make-database)))
(setq *allconstructors* (adjoin item *allconstructors*))
(setf (database-sourcefile dbstruct) (second item))
(setf (database-constructorform dbstruct) (third item))
(setf (database-documentation dbstruct) (fourth item))
(setf (database-attributes dbstruct) (fifth item))
(setf (database-predicates dbstruct) (sixth item))
(setf (database-parents dbstruct) (seventh item)))
(format t "~&"))

```

defun Open the category database

```

[$spadroot p9]
[*hasCategory-hash* p997]
[*category-stream* p999]
[*category-stream-stamp* p1000]

```

— defun categoryOpen —

```

(defun categoryOpen ()
  "open category.daase and hash the keys"
  (declare (special $spadroot *hasCategory-hash* *category-stream*
                    *category-stream-stamp*))
  (let (pos keys stamp)
    (setq *category-stream* (open (DaaseName "category.daase" nil)))
    (setq stamp (read *category-stream*))
    (unless (equal stamp *category-stream-stamp*)
      (format t "  Re-reading category.daase")
      (setq *category-stream-stamp* stamp)
      (setq pos (car stamp))
      (file-position *category-stream* pos)
      (setq keys (read *category-stream*))
      (setq *hasCategory-hash* (make-hash-table :test #'equal))
      (dolist (item keys)
        (setf (gethash (first item) *hasCategory-hash*) (second item))))
    (format t "~&"))

```

defun Open the operations database

```
[$spadroot p9]
[*operation-hash* p997]
[*operation-stream* p998]
[*operation-stream-stamp* p999]
```

— defun operationOpen —

```
(defun operationOpen ()
  "read operation database and hash the keys"
  (declare (special $spadroot *operation-hash* *operation-stream*
                    *operation-stream-stamp*))
  (let (operations pos stamp)
    (setq *operation-stream* (open (DaaseName "operation.daase" nil)))
    (setq stamp (read *operation-stream*))
    (unless (equal stamp *operation-stream-stamp*)
      (format t " Re-reading operation.daase")
      (setq *operation-stream-stamp* stamp)
      (setq pos (car stamp))
      (file-position *operation-stream* pos)
      (setq operations (read *operation-stream*))
      (dolist (item operations)
        (setf (gethash (car item) *operation-hash*) (cdr item))))
    (format t "~&")))
```

—

defun Add operations from newly compiled code

```
[getdatabase p1010]
[*operation-hash* p997]
```

— defun addoperations —

```
(defun addoperations (constructor oldmaps)
  "add ops from a )library domain to *operation-hash*"
  (declare (special *operation-hash*))
  (dolist (map oldmaps) ; out with the old
    (let (oldop op)
      (setq op (car map))
      (setq oldop (getdatabase op 'operation))
      (setq oldop (lisp::delete (cdr map) oldop :test #'equal))
      (setf (gethash op *operation-hash*) oldop)))
  (dolist (map (getdatabase constructor 'modemaps)) ; in with the new
    (let (op newmap)
      (setq op (car map))
```



```
(setq newmap (getdatabase op 'operation))
(setf (gethash op *operation-hash*) (cons (cdr map) newmap))))
```

defun Show all database attributes of a constructor

[getdatabase p1010]

— defun showdatabase —

```
(defun showdatabase (constructor)
  (format t "~&~a: ~a~%" 'constructorkind
    (getdatabase constructor 'constructorkind))
  (format t "~&~a: ~a~%" 'cosig
    (getdatabase constructor 'cosig))
  (format t "~&~a: ~a~%" 'operation
    (getdatabase constructor 'operation))
  (format t "~&~a: ~%" 'constructormodemap)
  (pprint (getdatabase constructor 'constructormodemap))
  (format t "~&~a: ~%" 'constructorcategory)
  (pprint (getdatabase constructor 'constructorcategory))
  (format t "~&~a: ~%" 'operationalist)
  (pprint (getdatabase constructor 'operationalist))
  (format t "~&~a: ~%" 'modemaps)
  (pprint (getdatabase constructor 'modemaps))
  (format t "~&~a: ~a~%" 'hascategory
    (getdatabase constructor 'hascategory))
  (format t "~&~a: ~a~%" 'object
    (getdatabase constructor 'object))
  (format t "~&~a: ~a~%" 'niladic
    (getdatabase constructor 'niladic))
  (format t "~&~a: ~a~%" 'abbreviation
    (getdatabase constructor 'abbreviation))
  (format t "~&~a: ~a~%" 'constructor?
    (getdatabase constructor 'constructor?))
  (format t "~&~a: ~a~%" 'constructor
    (getdatabase constructor 'constructor))
  (format t "~&~a: ~a~%" 'defaultdomain
    (getdatabase constructor 'defaultdomain))
  (format t "~&~a: ~a~%" 'ancestors
    (getdatabase constructor 'ancestors))
  (format t "~&~a: ~a~%" 'sourcefile
    (getdatabase constructor 'sourcefile))
  (format t "~&~a: ~a~%" 'constructorform
    (getdatabase constructor 'constructorform))
  (format t "~&~a: ~a~%" 'constructorargs
    (getdatabase constructor 'constructorargs)))
```

```
(format t "~&~a: ~a~%" 'attributes
  (getdatabase constructor 'attributes))
(format t "~&~a: ~%" 'predicates)
  (pprint (getdatabase constructor 'predicates))
(format t "~&~a: ~a~%" 'documentation
  (getdatabase constructor 'documentation))
(format t "~&~a: ~a~%" 'parents
  (getdatabase constructor 'parents)))
```

defun Set a value for a constructor key in the database

[make-database p??]

— defun setdatabase —

```
(defun setdatabase (constructor key value)
  (let (struct)
    (when (symbolp constructor)
      (unless (setq struct (get constructor 'database))
        (setq struct (make-database))
        (setf (get constructor 'database) struct))
      (case key
        (abbreviation
          (setf (database-abbreviation struct) value)
          (when (symbolp value)
            (setf (get value 'abbreviationfor) constructor))))
        (constructorkind
          (setf (database-constructorkind struct) value))))))
```

defun Delete a value for a constructor key in the database

— defun deldatabase —

```
(defun deldatabase (constructor key)
  (when (symbolp constructor)
    (case key
      (abbreviation
        (setf (get constructor 'abbreviationfor) nil))))))
```

defun Get constructor information for a database key

```

[warn p??]
[$spadroot p9]
[*miss* p997]
[*hascategory-hash* p??]
[*operation-hash* p997]
[*browse-stream* p999]
[*defaultdomain-list* p996]
[*interp-stream* p998]
[*category-stream* p999]
[*hasCategory-hash* p997]
[*operation-stream* p998]

```

— **defun** getdatabase —

```

(defun getdatabase (constructor key)
  (declare (special $spadroot) (special *miss*))
  (when (eq *miss* t) (format t "getdatabase call: ~20a ~a~%" constructor key))
  (let (data table stream ignore struct)
    (declare (ignore ignore)
      (special *hascategory-hash* *operation-hash*
        *browse-stream* *defaultdomain-list* *interp-stream*
        *category-stream* *hasCategory-hash* *operation-stream*))
    (when (or (symbolp constructor)
      (and (eq key 'hascategory) (consp constructor))))
    (case key
      ; note that abbreviation, constructorkind and cosig are heavy hitters
      ; thus they occur first in the list of things to check
      (abbreviation
        (setq stream *interp-stream*)
        (when (setq struct (get constructor 'database))
          (setq data (database-abbreviation struct)))))
      (constructorkind
        (setq stream *interp-stream*)
        (when (setq struct (get constructor 'database))
          (setq data (database-constructorkind struct)))))
      (cosig
        (setq stream *interp-stream*)
        (when (setq struct (get constructor 'database))
          (setq data (database-cosig struct)))))
      (operation
        (setq stream *operation-stream*)
        (setq data (gethash constructor *operation-hash*)))
      (constructormodemap
        (setq stream *interp-stream*)
        (when (setq struct (get constructor 'database))
          (setq data (database-constructormodemap struct)))))
      (constructorcategory

```

```

(setq stream *interp-stream*)
(when (setq struct (get constructor 'database))
  (setq data (database-constructcategory struct))
  (when (null data) ;domain or package then subfield of constructormodemap
    (setq data (cadar (getdatabase constructor 'constructormodemap))))))
(operationalist
  (setq stream *interp-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-operationalist struct))))
(modemaps
  (setq stream *interp-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-modemaps struct))))
(hascategory
  (setq table *hasCategory-hash*)
  (setq stream *category-stream*)
  (setq data (gethash constructor table)))
(object
  (setq stream *interp-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-object struct))))
(asharp?
  (setq stream *interp-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-object struct))))
(niladic
  (setq stream *interp-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-niladic struct))))
(constructor?
  (when (setq struct (get constructor 'database))
    (setq data (when (database-operationalist struct) t))))
(superdomain ; only 2 superdomains in the world
  (case constructor
    (|NonNegativeInteger|
      (setq data '((|Integer|) (IF (<|#1| 0) |false| |true|))))
    (|PositiveInteger|
      (setq data '((|NonNegativeInteger|) (< 0|#1|))))))
(constructor
  (when (setq data (get constructor 'abbreviationfor))))
(defaultdomain
  (setq data (cadr (assoc constructor *defaultdomain-list*))))
(ancestors
  (setq stream *interp-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-ancestors struct))))
(sourcefile
  (setq stream *browse-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-sourcefile struct))))

```

```

(constructorform
  (setq stream *browse-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-constructorform struct))))
(constructorargs
  (setq data (cdr (getdatabase constructor 'constructorform))))
(attributes
  (setq stream *browse-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-attributes struct))))
(predicates
  (setq stream *browse-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-predicates struct))))
(documentation
  (setq stream *browse-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-documentation struct))))
(parents
  (setq stream *browse-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-parents struct))))
(users
  (setq stream *browse-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-users struct))))
(dependents
  (setq stream *browse-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-dependents struct))))
(otherwise (warn "~%(GETDATABASE ~a ~a) failed~%" constructor key)))
(when (numberp data) ;fetch the real data
  (when *miss* (format t "getdatabase miss: ~20a ~a~%" constructor key))
  (file-position stream data)
  (setq data (read stream)))
(case key ; cache the result of the database read
  (operation      (setf (gethash constructor *operation-hash*) data))
  (hascategory    (setf (gethash constructor *hascategory-hash*) data))
  (constructorkind (setf (database-constructorkind struct) data))
  (cosig          (setf (database-cosig struct) data))
  (constructormodemap (setf (database-constructormodemap struct) data))
  (constructorcategory (setf (database-constructorcategory struct) data))
  (operationalist  (setf (database-operationalist struct) data))
  (modemaps       (setf (database-modemaps struct) data))
  (object         (setf (database-object struct) data))
  (niladic        (setf (database-niladic struct) data))
  (abbreviation   (setf (database-abbreviation struct) data))
  (constructor     (setf (database-constructor struct) data))
  (ancestors      (setf (database-ancestors struct) data))
  (constructorform (setf (database-constructorform struct) data))

```

```

(attributes      (setf (database-attributes struct) data))
(predicates      (setf (database-predicates struct) data))
(documentation    (setf (database-documentation struct) data))
(parents         (setf (database-parents struct) data))
(users           (setf (database-users struct) data))
(dependents      (setf (database-dependents struct) data))
(sourcefile       (setf (database-sourcefile struct) data))))
(case key ; fixup the special cases
  (sourcefile
    (when (and data (string= (directory-namestring data) ""))
      (string= (pathname-type data) "spad"))
    (setq data
      (concatenate 'string $spadroot "../src/algebra/" data))))
  (asharp? ; is this asharp code?
    (if (consp data)
      (setq data (cdr data))
      (setq data nil)))
  (object ; fix up system object pathname
    (if (consp data)
      (setq data
        (if (string= (directory-namestring (car data)) "")
          (concatenate 'string $spadroot "/algebra/" (car data) ".o")
          (car data)))
      (when (and data (string= (directory-namestring data) ""))
        (setq data (concatenate 'string $spadroot "/algebra/" data ".o"))))))
  data))

```

defun The)library top level command

[\[localdatabase p1014\]](#)
[\[extendLocalLibdb p??\]](#)
[\[tersyscommand p452\]](#)
[\[\\$newConlist p??\]](#)
[\[\\$options p??\]](#)

— defun library —

```

(defun |library| (args)
  (let (original-directory)
    (declare (special |$options| |$newConlist|))
    (setq original-directory (get-current-directory))
    (setq |$newConlist| nil)
    (localdatabase args |$options|)
    (|extendLocalLibdb| |$newConlist|)
    (system::chdir original-directory)
  )

```

```
(tersyscommand)))
```

defun Read a local filename and update the hash tables

The localdatabase function tries to find files in the order of:

- nrlib/index.kaf
- .asy
- .ao,
- asharp to .asy

```
[sayKeyedMsg p329]
[localnrlib p1015]
[$forceDatabaseUpdate p??]
[$ConstructorCache p??]
[*index-filename* p??]
```

— defun localdatabase —

```
(defun localdatabase (filelist options &optional (make-database? nil))
  "read a local filename and update the hash tables"
  (labels (
    (processOptions (options)
      (let (only dir noexpose)
        (when (setq only (assoc '|only| options))
          (setq options (lisp::delete only options :test #'equal))
          (setq only (cdr only)))
        (when (setq dir (assoc '|dir| options))
          (setq options (lisp::delete dir options :test #'equal))
          (setq dir (second dir))
          (when (null dir)
            (|sayKeyedMsg| 'S2IU0002 nil) ))
        (when (setq noexpose (assoc '|noexpose| options))
          (setq options (lisp::delete noexpose options :test #'equal))
          (setq noexpose 't) )
        (when options
          (format t " Ignoring unknown )library option: ~a~%" options))
        (values only dir noexpose)))
    (processDir (dirarg thisdir)
      (let (allfiles)
        (declare (special vmlisp::*index-filename*))
        (system:chdir (string dirarg))
```

```

(setq allfiles (directory "*"))
(system:chdir thisdir)
(mapcan #'(lambda (f)
  (when (string-equal (pathname-type f) "nrlib")
    (list (concatenate 'string (namestring f) "/"
      vmlisp::*index-filename*)))) allfiles))))
(let (thisdir nrlibs object only dir key (|$forceDatabaseUpdate| t) noexpose)
  (declare (special |$forceDatabaseUpdate| vmlisp::*index-filename*
    |$ConstructorCache|))
  (setq thisdir (namestring (truename ".")))
  (setq noexpose nil)
  (multiple-value-setq (only dir noexpose) (processOptions options))
  ;don't force exposure during database build
  (if make-database? (setq noexpose t))
  (when dir (setq nrlibs (processDir dir thisdir)))
  (dolist (file filelist)
    (let ((filename (pathname-name file))
      (namedir (directory-namestring file)))
      (unless namedir (setq thisdir (concatenate 'string thisdir "/")))
      (cond
        ((setq file (probe-file
          (concatenate 'string namedir filename ".nrlib/"
            vmlisp::*index-filename*)))
          (push (namestring file) nrlibs))
        ('else (format t "library cannot find the file ~a.~%" filename))))))
  (dolist (file (nreverse nrlibs))
    (setq key (pathname-name (first (last (pathname-directory file)))))
    (setq object (concatenate 'string (directory-namestring file) "code"))
    (localnrlib key file object make-database? noexpose))
  (clrhash |$ConstructorCache|))))

```

defun Update the database from an nrlib index.kaf file

```

[getdatabase p1010]
[make-database p??]
[addoperations p1007]
[sublislis p??]
[updateDatabase p1017]
[installConstructor p??]
[updateCategoryTable p??]
[categoryForm? p??]
[setExposeAddConstr p700]
[startTimingProcess p??]
[loadLibNoUpdate p1037]
[sayKeyedMsg p329]

```



```
[$FormalMapVariableList p??]
[*allOperations* p1000]
[*allconstructors* p1000]
```

— defun localnrlib —

```
(defun localnrlib (key nrlib object make-database? noexpose)
  "given a string pathname of an index.kaf and the object update the database"
  (labels (
    (fetchdata (alist in index)
      (let (pos)
        (setq pos (third (assoc index alist :test #'string=)))
        (when pos
          (file-position in pos)
          (read in))))))
    (let (alist kind (systemdir? nil) pos constructorform oldmaps abbrev dbstruct)
      (declare (special *allOperations* *allconstructors*
                        |$FormalMapVariableList|))
      (with-open-file (in nrlib)
        (file-position in (read in))
        (setq alist (read in))
        (setq pos (third (assoc "constructorForm" alist :test #'string=)))
        (file-position in pos)
        (setq constructorform (read in))
        (setq key (car constructorform))
        (setq oldmaps (getdatabase key 'modemaps))
        (setq dbstruct (make-database))
        (setq *allconstructors* (adjoin key *allconstructors*))
        (setf (get key 'database) dbstruct) ; store the struct, side-effect it...
        (setf (database-constructorform dbstruct) constructorform)
        (setq *allOperations* nil) ; force this to recompute
        (setf (database-object dbstruct) object)
        (setq abbrev
          (intern (pathname-name (first (last (pathname-directory object))))))
        (setf (database-abbreviation dbstruct) abbrev)
        (setf (get abbrev 'abbreviationfor) key)
        (setf (database-operationalist dbstruct) nil)
        (setf (database-operationalist dbstruct)
          (fetchdata alist in "operationAlist"))
        (setf (database-constructormodemap dbstruct)
          (fetchdata alist in "constructorModemap"))
        (setf (database-modemaps dbstruct) (fetchdata alist in "modemaps"))
        (setf (database-sourcefile dbstruct) (fetchdata alist in "sourceFile"))
        (when make-database?
          (setf (database-sourcefile dbstruct)
            (file-namestring (database-sourcefile dbstruct)))
          (setf (database-constructorkind dbstruct)
            (setq kind (fetchdata alist in "constructorKind")))
          (setf (database-constructorcategor dbstruct)
```

```

(fetchdata alist in "constructorCategory"))
(setf (database-documentation dbstruct)
  (fetchdata alist in "documentation"))
(setf (database-attributes dbstruct)
  (fetchdata alist in "attributes"))
(setf (database-predicates dbstruct)
  (fetchdata alist in "predicates"))
(setf (database-niladic dbstruct)
  (when (fetchdata alist in "NILADIC") t))
(addoperations key oldmaps)
(unless make-database?
  (if (eq kind '|category|)
    (setf (database-ancestors dbstruct)
      (sublislis |$FormalMapVariableList|
        (cdr constructorform) (fetchdata alist in "ancestors"))))
  (|updateDatabase| key key systemdir?) ;makes many hashtables???
  (|installConstructor| key kind) ;used to be key cname ...
  (|updateCategoryTable| key kind)
  (if |$InteractiveModel| (setq |$CategoryFrame| |$EmptyEnvironment|)))
(setf (database-cosig dbstruct)
  (cons nil (mapcar #'|categoryForm?|
    (cddar (database-constructormodemap dbstruct))))))
(remprop key 'loaded)
(if (null noexpose) (|setExposeAddConstr| (cons key nil)))
(setf (symbol-function key) ; sets the autoload property for cname
  #'(lambda (&rest args)
    (unless (get key 'loaded)
      (|startTimingProcess| '|load|)
      (|loadLibNoUpdate| key key object)) ; used to be cname key
    (apply key args)))
(|sayKeyedMsg| 'S2IU0001 (list key object))))

```

defun updateDatabase

For now in NRUNTIME do database update only if forced [constructor? p??]

```

[clearClams p??]
[clearAllSlams p??]
[$forceDatabaseUpdate p??]

```

— defun updateDatabase —

```

(defun |updateDatabase| (fname cname systemdirp)
  (declare (ignore fname))
  (declare (special |$forceDatabaseUpdate|))
  (when |$forceDatabaseUpdate|

```

```
(when (|constructor?| cname)
  (|clearClams|)
  (|clearAllSlams| nil)
  (when (get1 cname 'loaded) (|clearConstructorCaches|)))
(when (or |$forceDatabaseUpdate| (null systemdirp))
  (|clearClams|)
  (|clearAllSlams| nil)))
```

defun Make new databases

Making new databases consists of:

1. reset all of the system hash tables
2. set up Union, Record and Mapping
3. map)library across all of the system files (fills the databases)
4. loading some normally autoloaded files
5. making some database entries that are computed (like ancestors)
6. writing out the databases
7. write out 'warm' data to be loaded into the image at build time

Note that this process should be done in a clean image followed by a rebuild of the system image to include the new index pointers (e.g. *interp-stream-stamp*)

The system will work without a rebuild but it needs to re-read the databases on startup. Rebuilding the system will cache the information into the image and the databases are opened but not read, saving considerable startup time. Also note that the order the databases are written out is critical. The interp.daase depends on prior computations and has to be written out last.

The build-name-to-pamphlet-hash builds a hash table whose key-*λ*value is:

- abbreviation -*λ* pamphlet file name
- abbreviation-line -*λ* pamphlet file position
- constructor -*λ* pamphlet file name
- constructor-line -*λ* pamphlet file position

is the symbol of the constructor name and whose value is the name of the source file without any path information. We hash the constructor abbreviation to pamphlet file name. [local-database p1014]

```
[getEnv p??]
[browserAutoloadOnceTrigger p??]
[mkTopicHashTable p??]
[buildLibdb p??]
[dbSplitLibdb p??]
[mkUsersHashTable p??]
[saveUsersHashTable p1022]
[mkDependentsHashTable p??]
[saveDependentsHashTable p1022]
[write-browsedb p1029]
[write-operationdb p1031]
[write-categorydb p1030]
[allConstructors p1032]
[categoryForm? p??]
[domainsOf p??]
[getConstructorForm p??]
[write-interpdb p1027]
[write-warmdata p1032]
[$constructorList p??]
[*sourcefiles* p??]
[*allconstructors* p1000]
[*operation-hash* p997]
```

— defun make-databases —

```
(defun make-databases (ext dirlist)
  (labels (
    (build-name-to-pamphlet-hash (dir)
      (let ((ht (make-hash-table)) (eof '(done)) point mark abbrev name file ns)
        (dolist (fn (directory dir))
          (with-open-file (f fn)
            (do ((ln (read-line f nil eof) (read-line f nil eof))
                (line 0 (incf line)))
              ((eq ln eof))
              (when (and (setq mark (search ")abb" ln)) (= mark 0))
                (setq mark (position #\space ln :from-end t))
                (setq name (intern (string-trim '(#\space) (subseq ln mark))))
                (cond
                  ((setq mark (search "domain" ln)) (setq mark (+ mark 7)))
                  ((setq mark (search "package" ln)) (setq mark (+ mark 8)))
                  ((setq mark (search "category" ln)) (setq mark (+ mark 9)))
                (setq point (position #\space ln :start (+ mark 1)))
                (setq abbrev
                  (intern (string-trim '(#\space) (subseq ln mark point))))
```

```

    (setq ns (namestring fn))
    (setq mark (position #\ / ns :from-end t))
    (setq file (subseq ns (+ mark 1)))
    (setf (gethash abbrev ht) file)
    (setf (gethash (format nil "~a-line" abbrev) ht) line)
    (setf (gethash name ht) file)
    (setf (gethash (format nil "~a-line" name) ht) line))))
  ht))
;; these are types which have no library object associated with them.
;; we store some constructed data to make them perform like library
;; objects, the *operationalist-hash* key entry is used by allConstructors
(withSpecialConstructors ()
  (declare (special *allconstructors*))
  ; note: if item is not in *operationalist-hash* it will not be written
  ; Category
  (setf (get '|Category| 'database)
    (make-database :operationalist nil :niladic t))
  (push '|Category| *allconstructors*)
  ; UNION
  (setf (get '|Union| 'database)
    (make-database :operationalist nil :constructorkind '|domain|))
  (push '|Union| *allconstructors*)
  ; RECORD
  (setf (get '|Record| 'database)
    (make-database :operationalist nil :constructorkind '|domain|))
  (push '|Record| *allconstructors*)
  ; MAPPING
  (setf (get '|Mapping| 'database)
    (make-database :operationalist nil :constructorkind '|domain|))
  (push '|Mapping| *allconstructors*)
  ; ENUMERATION
  (setf (get '|Enumeration| 'database)
    (make-database :operationalist nil :constructorkind '|domain|))
  (push '|Enumeration| *allconstructors*)
  )
  (final-name (root)
    (format nil "~a.daase~a" root ext))
  )
)
(let (d)
  (declare (special |$constructorList| *sourcefiles*
    *allconstructors* *operation-hash*))
  (do-symbols (symbol)
    (when (get symbol 'database)
      (setf (get symbol 'database) nil)))
  (setq *hascategory-hash* (make-hash-table :test #'equal))
  (setq *operation-hash* (make-hash-table))
  (setq *allconstructors* nil)
  (withSpecialConstructors)
  (localdatabase nil
    (list (list '|dir| (namestring (truename ". /")))) ))

```

```

    'make-database)
  (dolist (dir dirlist)
    (localdatabase nil
      (list (list 'dir| (namestring (truename (format nil "~a" dir))))))
    'make-database))
;browse.daase
  (load (concatenate 'string (|getEnv| "AXIOM") "/autoload/topics")) ;; hack
  (|browserAutoLoadOnceTrigger|)
  (|mkTopicHashTable|)
  (setq |$constructorList| nil) ;; affects buildLibdb
  (setq *sourcefiles* (build-name-to-pamphlet-hash
    (concatenate 'string (|getEnv| "AXIOM")
      "/../../src/algebra/*.pamphlet")))
  (|buildLibdb|)
  (|dbSplitLibdb|)
; (|dbAugmentConstructorDataTable|)
  (|mkUsersHashTable|)
  (|saveUsersHashTable|)
  (|mkDependentsHashTable|)
  (|saveDependentsHashTable|)
; (|buildGloss|)
  (write-browsedb)
  (write-operationdb)
; note: genCategoryTable creates a new *hascategory-hash* table
; this smashes the existing table and regenerates it.
; write-categorydb does getdatabase calls to write the new information
  (write-categorydb)
  (dolist (con (|allConstructors|))
    (let (dbstruct)
      (when (setq dbstruct (get con 'database))
        (setf (database-cosig dbstruct)
          (cons nil (mapcar #'|categoryForm?|
            (cddar (database-constructormodemap dbstruct))))))
      (when (and (|categoryForm?| con)
        (= (length (setq d (|domainsOf| (list con) NIL NIL))) 1))
        (setq d (caar d))
        (when (= (length d) (length (|getConstructorForm| con)))
          (format t " ~a has a default domain of ~a~%" con (car d))
          (setf (database-defaultdomain dbstruct) (car d))))))
    ; note: genCategoryTable creates *ancestors-hash*. write-interpdb
    ; does gethash calls into it rather than doing a getdatabase call.
  (write-interpdb)
  (write-warmdata)
  (when (probe-file (final-name "interp"))
    (delete-file (final-name "interp")))
  (rename-file "interp.build" (final-name "interp"))
  (when (probe-file (final-name "operation"))
    (delete-file (final-name "operation")))
  (rename-file "operation.build" (final-name "operation"))
  (when (probe-file (final-name "browse"))

```

```

      (delete-file (final-name "browse")))
(rename-file "browse.build"
  (final-name "browse"))
(when (probe-file (final-name "category"))
  (delete-file (final-name "category")))
(rename-file "category.build"
  (final-name "category"))))

```

defun saveDependentsHashTable

```

[erase p??]
[writeLib1 p??]
[msort p??]
[hkeys p1044]
[rwrite p604]
[hget p1044]
[rshut p??]
[$depTb p??]
[$erase p??]

```

— defun saveDependentsHashTable —

```

(defun |saveDependentsHashTable| ()
  (let (stream)
    (declare (special |$depTb| $erase))
    ($erase '|dependents| 'database '|a|)
    (setq stream (|writeLib1| '|dependents| 'database '|a|))
    (dolist (k (msort (hkeys |$depTb|)))
      (|rwrite| k (hget |$depTb| k) stream))
    (rshut stream)))

```

defun saveUsersHashTable

```

[erase p??]
[writeLib1 p??]
[msort p??]
[hkeys p1044]
[rwrite p604]
[hget p1044]
[rshut p??]

```

```
[$erase p??]
[$usersTb p??]
```

— defun saveUsersHashTable —

```
(defun |saveUsersHashTable| ()
  (let (stream)
    (declare (special |$usersTb| $erase))
    ($erase '|users| 'database '|a|)
    (setq stream (|writeLib1| '|users| 'database '|a|))
    (dolist (k (msort (hkeys |$usersTb|)))
      (|rwrite| k (HGET |$usersTb| k) stream))
    (rshut stream)))
```

—————

defun Construct the proper database full pathname

```
[getEnv p??]
[$spadroot p9]
```

— defun DaaseName —

```
(defun DaaseName (name erase?)
  (let (daase filename)
    (declare (special $spadroot))
    (if (setq daase (|getEnv| "DAASE"))
      (progn
        (setq filename (concatenate 'string daase "/algebra/" name))
        (format t " Using local database ~a." filename))
      (setq filename (concatenate 'string $spadroot "/algebra/" name)))
    (when erase? (system::system (concatenate 'string "rm -f " filename)))
    filename))
```

—————

Building the interp.daase from hash tables

```
format of an entry in interp.daase:
(constructor-name
  operationalist
  constructormodemap
  modemaps          -- this should not be needed. eliminate it.
  object            -- the name of the object file to load for this con.
  constructorcategory -- note that this info is the cadar of the
```



```

        constructormodemap for domains and packages so it is stored
        as NIL for them. it is valid for categories.
    niladic          -- t or nil directly
    unused
    cosig            -- kept directly
    constructorkind  -- kept directly
    defaultdomain   -- a short list, for %i
    ancestors        -- used to compute new category updates
)

```

Here I'll try to outline the interp database write procedure

```

(defun write-interpdb ()
  "build interp.daase from hash tables"
  (declare (special $spadroot *ancestors-hash*))
  (let (opalistpos modemapspos cmodemappos master masterpos obj *print-pretty*
        concategory categorypos kind niladic cosig abbrev defaultdomain
        ancestors ancestorspos out)
    (declare (special *print-pretty*))
    (print "building interp.daase")

; 1. We open the file we're going to create

    (setq out (open "interp.build" :direction :output))

; 2. We reserve some space at the top of the file for the key-time pair
;    We will overwrite these spaces just before we close the file.

    (princ "                                " out)

; 3. Make sure we write it out
    (finish-output out)

; 4. For every constructor in the system we write the parts:

    (dolist (constructor (|allConstructors|))
      (let (struct)

; 4a. Each constructor has a property list. A property list is a list
;     of (key . value) pairs. The property we want is called 'database
;     so there is a ('database . something) in the property list

        (setq struct (get constructor 'database))

; 5 We write the "operationsalist"
; 5a. We remember the current file position before we write
;     We need this information so we can seek to this position on read

        (setq opalistpos (file-position out))

```

```

; 5b. We get the "operationalist" and write it out

(print (database-operationalist struct) out)

; 5c. We make sure it was written

(finish-output out)

; 6 We write the "constructormodemap"
; 6a. We remember the current file position before we write

(setq cmodemappos (file-position out))

; 6b. We get the "constructormodemap" and write it out

(print (database-constructormodemap struct) out)

; 6c. We make sure it was written

(finish-output out)

; 7. We write the "modemaps"
; 7a. We remember the current file position before we write

(setq modemapspos (file-position out))

; 7b. We get the "modemaps" and write it out

(print (database-modemaps struct) out)

; 7c. We make sure it was written

(finish-output out)

; 8. We remember source file pathnames in the obj variable

(if (consp (database-object struct)) ; if asharp code ...
    (setq obj
      (cons (pathname-name (car (database-object struct)))
            (cdr (database-object struct))))
    (setq obj
      (pathname-name
        (first (last (pathname-directory (database-object struct)))))))

; 9. We write the "constructorcategory", if it is a category, else nil
; 9a. Get the constructorcategory

(setq concategory (database-constructorcategory struct))

; 9b. If we have any data we write it out, else we don't write it

```

```

;      Note that if there is no data then the byte index for the
;      constructorcategory will not be a number but will be nil.

(if concategory ; if category then write data else write nil
  (progn
    (setq categorypos (file-position out))
    (print concategory out)
    (finish-output out))
  (setq categorypos nil))

; 10. We get a set of properties which are kept as "immediate" data
;      This means that the key table will hold this data directly
;      rather than as a byte index into the file.
; 10a. niladic data

      (setq niladic (database-niladic struct))

; 10b. abbreviation data (e.g. POLY for polynomial)

      (setq abbrev (database-abbreviation struct))

; 10c. cosig data

      (setq cosig (database-cosig struct))

; 10d. kind data

      (setq kind (database-constructorkind struct))

; 10e. defaultdomain data

      (setq defaultdomain (database-defaultdomain struct))

; 11. The ancestor data might exist. If it does we fetch it
;      and write it out. If it does not we place
;      and immediate value of nil in the key-value table

      (setq ancestors (gethash constructor *ancestors-hash*)) ;cattable.boot
      (if ancestors
        (progn
          (setq ancestorspos (file-position out))
          (print ancestors out)
          (finish-output out))
        (setq ancestorspos nil))

; 12. "master" is an alist. Each element of the alist has the name of
;      the constructor and all of the above attributes. When the loop
;      finishes we will have constructed all of the data for the key-value
;      table

```

```

(push (list constructor opalistpos cmodemappos modemapspos
  obj categorypos niladic abbrev cosig kind defaultdomain
  ancestorspos) master)))

; 13. The loop is done, we make sure all of the data is written

(finish-output out)

; 14. We remember where the key-value table will be written in the file

(setq masterpos (file-position out))

; 15. We print the key-value table

(print master out)

; 16. We make sure we write the table

(finish-output out)

; 17. We go to the top of the file

(file-position out 0)

; 18. We write out the (master-byte-position . universal-time) pair
;   Note that if the universal-time value matches the value of
;   *interp-stream-stamp* then there is no reason to read the
;   interp database because all of the data is already cached in
;   the image. This happens if you build a database and immediatly
;   save the image. The saved image already has the data since we
;   just wrote it out. If the *interp-stream-stamp* and the database
;   time stamp differ we "reread" the database on startup. Actually
;   we just open the database and fetch as needed. You can see fetches
;   by setting the *miss* variable non-nil.

(print (cons masterpos (get-universal-time)) out)

; 19. We make sure we write it.

(finish-output out)

; 20 And we are done

(close out)))

```

defun Write the interp database

```

[$spadroot p9]
[*ancestors-hash* p??]

```

```
[*print-pretty* p??]
```

— defun write-interpdb —

```
(defun write-interpdb ()
  "build interp.daase from hash tables"
  (declare (special $spadroot *ancestors-hash*))
  (let (opalistpos modemapspos cmodemappos master masterpos obj *print-pretty*
        concategory categorypos kind niladic cosig abbrev defaultdomain
        ancestors ancestorspos out)
    (declare (special *print-pretty*))
    (print "building interp.daase")
    (setq out (open "interp.build" :direction :output))
    (princ " " out)
    (finish-output out)
    (dolist (constructor (|allConstructors|))
      (let (struct)
        (setq struct (get constructor 'database))
        (setq opalistpos (file-position out))
        (print (database-operationalist struct) out)
        (finish-output out)
        (setq cmodemappos (file-position out))
        (print (database-constructormodemap struct) out)
        (finish-output out)
        (setq modemapspos (file-position out))
        (print (database-modemaps struct) out)
        (finish-output out)
        (if (consp (database-object struct)) ; if asharp code ...
            (setq obj
              (cons (pathname-name (car (database-object struct)))
                    (cdr (database-object struct))))
            (setq obj
              (pathname-name
               (first (last (pathname-directory (database-object struct)))))))
        (setq concategory (database-constructcategory struct))
        (if concategory ; if category then write data else write nil
            (progn
              (setq categorypos (file-position out))
              (print concategory out)
              (finish-output out)
              (setq categorypos nil))
            (setq niladic (database-niladic struct))
            (setq abbrev (database-abbreviation struct))
            (setq cosig (database-cosig struct))
            (setq kind (database-constructorkind struct))
            (setq defaultdomain (database-defaultdomain struct))
            (setq ancestors (gethash constructor *ancestors-hash*)) ;cattable.boot
            (if ancestors
                (progn
                  (setq ancestorspos (file-position out))
```

```

      (print ancestors out)
      (finish-output out))
    (setq ancestorspos nil))
  (push (list constructor opalistpos cmodemappos modemapspos
    obj categorypos niladic abbrev cosig kind defaultdomain
    ancestorspos) master)))
(finish-output out)
(setq masterpos (file-position out))
(print master out)
(finish-output out)
(file-position out 0)
(print (cons masterpos (get-universal-time)) out)
(finish-output out)
(close out)))

```

Building the browse.daase from hash tables

```

format of an entry in browse.daase:
( constructorname
  sourcefile
  constructorform
  documentation
  attributes
  predicates
)

```

This is essentially the same overall process as write-interpdb.

We reserve some space for the (key-table-byte-position . timestamp)

We loop across the list of constructors dumping the data and remembering the byte positions in a key-value pair table.

We dump the final key-value pair table, write the byte position and time stamp at the top of the file and close the file.

defun Write the browse database

```

[allConstructors p1032]
[$spadroot p9]
[*sourcefiles* p??]
[*print-pretty* p??]

```

— defun write-browsedb —

```

(defun write-browsedb ()

```

```

"make browse.daase from hash tables"
(declare (special $spadroot *sourcefiles*))
(let (master masterpos src formpos docpos attpos predpos *print-pretty* out)
  (declare (special *print-pretty*))
  (print "building browse.daase")
  (setq out (open "browse.build" :direction :output))
  (princ " " out)
  (finish-output out)
  (dolist (constructor (|allConstructors|))
    (let (struct)
      (setq struct (get constructor 'database))
      ; sourcefile is small. store the string directly
      (setq src (gethash constructor *sourcefiles*))
      (setq formpos (file-position out))
      (print (database-constructorform struct) out)
      (finish-output out)
      (setq docpos (file-position out))
      (print (database-documentation struct) out)
      (finish-output out)
      (setq attpos (file-position out))
      (print (database-attributes struct) out)
      (finish-output out)
      (setq predpos (file-position out))
      (print (database-predicates struct) out)
      (finish-output out)
      (push (list constructor src formpos docpos attpos predpos) master)))
    (finish-output out)
  (setq masterpos (file-position out))
  (print master out)
  (finish-output out)
  (file-position out 0)
  (print (cons masterpos (get-universal-time)) out)
  (finish-output out)
  (close out)))

```

Building the category.daase from hash tables

This is a single table of category hash table information, dumped in the database format.

defun Write the category database

```

[genCategoryTable p??]
[*print-pretty* p??]
[*hasCategory-hash* p997]

```

— defun write-categorydb —

```
(defun write-categorydb ()
  "make category.daase from scratch. contains the *hasCategory-hash* table"
  (let (out master pos *print-pretty*)
    (declare (special *print-pretty* *hasCategory-hash*))
    (print "building category.daase")
    (|genCategoryTable|)
    (setq out (open "category.build" :direction :output))
    (princ " " out)
    (finish-output out)
    (maphash #'(lambda (key value)
      (if (or (null value) (eq value t))
        (setq pos value)
        (progn
          (setq pos (file-position out))
          (print value out)
          (finish-output out))))
      (push (list key pos) master))
      *hasCategory-hash*)
    (setq pos (file-position out))
    (print master out)
    (finish-output out)
    (file-position out 0)
    (print (cons pos (get-universal-time)) out)
    (finish-output out)
    (close out)))
```

—————

Building the operation.daase from hash tables

This is a single table of operations hash table information, dumped in the database format.

defun Write the operations database

[*operation-hash* [p997](#)]

— defun write-operationdb —

```
(defun write-operationdb ()
  (let (pos master out)
    (declare (special leaves *operation-hash*))
    (setq out (open "operation.build" :direction :output))
    (princ " " out)
```



```

(finish-output out)
(maphash #'(lambda (key value)
  (setq pos (file-position out))
  (print value out)
  (finish-output out)
  (push (cons key pos) master))
  *operation-hash*)
(finish-output out)
(setq pos (file-position out))
(print master out)
(file-position out 0)
(print (cons pos (get-universal-time)) out)
(finish-output out)
(close out)))

```

Database support operations

defun Data preloaded into the image at build time

`[$topicHash p??]`

— defun write-warmdata —

```

(defun write-warmdata ()
  "write out information to be loaded into the image at build time"
  (declare (special |$topicHash|))
  (with-open-file (out "warm.data" :direction :output)
    (format out "(in-package \"BOOT\")~%" )
    (format out "(setq |$topicHash| (make-hash-table))~%" )
    (maphash #'(lambda (k v)
      (format out "(setf (gethash '|~a| |$topicHash|) ~a)~%" k v)) |$topicHash|)))

```

defun Return all constructors

`[*allconstructors* p1000]`

— defun allConstructors —

```

(defun |allConstructors| ()
  (declare (special *allconstructors*))
  *allconstructors*)

```

defun Return all operations

[*allOperations* p1000]
[*operation-hash* p997]

— **defun allOperations** —

```
(defun |allOperations| ()  
  (declare (special *allOperations* *operation-hash*))  
  (unless *allOperations*  
    (maphash #'(lambda (k v) (declare (ignore v)) (push k *allOperations*))  
              *operation-hash*))  
  *allOperations*)
```

Chapter 67

System Statistics

defun statisticsInitialization

[gbc-time p??]

— defun statisticsInitialization —

```
(defun |statisticsInitialization| ()  
  "initialize the garbage collection timer"  
  #+:akcl (system:gbc-time 0)  
  nil)
```

—————

67.1 Lisp Library Handling

defun loadLib

```
[startTimingProcess p??]  
[getdatabase p1010]  
[isSystemDirectory p1037]  
[pathnameDirectory p1041]  
[loadLibNoUpdate p1037]  
[sayKeyedMsg p329]  
[namestring p1040]  
[clearConstructorCache p??]  
[updateDatabase p1017]  
[installConstructor p??]  
[updateCategoryTable p??]
```

```

[categoryForm? p??]
[remprop p??]
[stopTimingProcess p??]
[$InteractiveMode p22]
[$printLoadMsgs p736]
[$forceDatabaseUpdate p??]
[$CategoryFrame p??]

```

— defun loadLib —

```

(defun |loadLib| (cname)
  (let (fullLibName systemdir? update? kind u sig coSig)
    (declare (special |$CategoryFrame| |$InteractiveMode| |$printLoadMsgs|
                      |$forceDatabaseUpdate|))
    (|startTimingProcess| '|load|)
    (when (setq fullLibName (getdatabase cname 'object))
      (setq systemdir? (|isSystemDirectory| (|pathnameDirectory| fullLibName)))
      (setq update? (or |$forceDatabaseUpdate| (null systemdir?)))
      (cond
        ((null update?) (|loadLibNoUpdate| cname cname fullLibName))
        (t
         (setq kind (getdatabase cname 'constructorkind))
         (when |$printLoadMsgs|
           (|sayKeyedMsg| 'S2IL0002 (list (|namestring| fullLibName) kind cname)))
         (load fullLibName)
         (|clearConstructorCache| cname)
         (|updateDatabase| cname cname systemdir?)
         (|installConstructor| cname kind)
         (setq u (getdatabase cname 'constructormodemap))
         (|updateCategoryTable| cname kind)
         (setq coSig
          (when u
           (setq sig (cdar u))
           (cons nil (loop for x in (cdr sig) collect (|categoryForm?| x))))))
        (if (null (cdr (getdatabase cname 'constructorform)))
          (setf (get cname 'niladic) t)
          (remprop cname 'niladic))
        (setf (get cname 'loaded) fullLibName)
        (when |$InteractiveMode| (setq |$CategoryFrame| (list (list nil))))
        (|stopTimingProcess| '|load|)
        t))))))

```

defun isSystemDirectory

```
[function p??]
[$spadroot p9]
```

— defun isSystemDirectory —

```
(defun |isSystemDirectory| (dir)
  (declare (special $spadroot))
  (every (|function| char=) $spadroot dir))
```

—————

defun loadLibNoUpdate

```
[getdatabase p1010]
[sayKeyedMsg p329]
[toplevel p??]
[clearConstructorCache p??]
[installConstructor p??]
[stopTimingProcess p??]
[$printLoadMsgs p736]
[$InteractiveMode p22]
[$CategoryFrame p??]
```

— defun loadLibNoUpdate —

```
(defun |loadLibNoUpdate| (cname libName fullLibName)
  (declare (ignore libName))
  (let (kind)
    (declare (special |$CategoryFrame| |$InteractiveMode| |$printLoadMsgs|))
    (setq kind (getdatabase cname 'constructorkind))
    (when |$printLoadMsgs|
      (|sayKeyedMsg| 'S2IL0002 (list (|namestring| fullLibName) kind cname)))
    (cond
      ((equal (catch 'versioncheck (load fullLibName)) (- 1))
        (princ "    wrong library version...recompile ")
        (princ fullLibName)
        (terpri)
        (toplevel))
      (t
        (|clearConstructorCache| cname)
        (|installConstructor| cname kind)
        (setf (get cname 'loaded) fullLibName)
        (when |$InteractiveMode| (setq |$CategoryFrame| (list (list nil))))
        (|stopTimingProcess| '|load|)))
```

```
t))
```

defun loadFunctor

```
[loadFunctor p1038]  
[loadLibIfNotLoaded p??]
```

— **defun loadFunctor** —

```
(defun |loadFunctor| (u)  
  (cond  
    ((null (atom u)) (|loadFunctor| (car u)))  
    (t  
     (|loadLibIfNotLoaded| u)  
     u)))
```

Chapter 68

Special Lisp Functions

68.1 Axiom control structure macros

Axiom used various control structures in the boot code which are not available in Common Lisp. We write some macros here to make the boot to lisp translations easier to read.

defun put

— **defun put** —

```
(defun put (sym ind val) (setf (get sym ind) val))
```

—————

defmacro while

While the condition is true, repeat the body. When the condition is false, return t.

— **defmacro while** —

```
(defmacro while (condition &rest body)
  '(loop (if (not ,condition) (return t)) ,@body))
```

—————

defmacro whileWithResult

While the condition is true, repeat the body. When the condition is false, return the result form's value.

— **defmacro whileWithResult** —

```
(defmacro whileWithResult (condition result &rest body)
  '(loop (if (not ,condition) ,@result) ,@body))
```

—————

68.2 Filename Handling

This code implements the Common Lisp pathname functions for Lisp/VM. On VM, a filename is 3-list consisting of the filename, filetype and filemode. We also UPCASE everything.

defun namestring

[pathname p1042]

— **defun namestring** —

```
(defun |namestring| (arg)
  (namestring (|pathname| arg)))
```

—————

defun pathnameName

[pathname p1042]

— **defun pathnameName** —

```
(defun |pathnameName| (arg)
  (pathname-name (|pathname| arg)))
```

—————

defun pathnameType

[pathname p1042]

— **defun** `pathnameType` —

```
(defun |pathnameType| (arg)
  (pathname-type (|pathname| arg)))
```

—————

defun `pathnameTypeId`

```
[upcase p??]
[object2Identifier p??]
[pathnameType p1040]
```

— **defun** `pathnameTypeId` —

```
(defun |pathnameTypeId| (arg)
  (upcase (|object2Identifier| (|pathnameType| arg))))
```

—————

defun `mergePathnames`

```
[pathnameName p1040]
[pathnameType p1040]
[pathnameDirectory p1041]
```

— **defun** `mergePathnames` —

```
(defun |mergePathnames| (a b)
  (let (fn ft fm)
    (cond
      ((string= (setq fn (|pathnameName| a)) "*") b)
      ((not (equal fn (|pathnameName| b))) a)
      ((string= (setq ft (|pathnameType| a)) "*") b)
      ((not (equal ft (|pathnameType| b))) a)
      ((equal (setq fm (|pathnameDirectory| a)) (list "*" )) b)
      (t a))))
```

—————

defun `pathnameDirectory`

```
[pathname p1042]
```

— defun pathnameDirectory —

```
(defun |pathnameDirectory| (arg)
  (namestring (make-pathname :directory (pathname-directory (|pathname| arg)))))
```

—————

defun Axiom pathnames

[pathname p¹⁰⁴²]
[make-filename p??]

— defun pathname —

```
(defun |pathname| (p)
  (cond
    ((null p) p)
    ((pathnamep p) p)
    ((null (consp p)) (pathname p))
    (t
     (when (> (|#| p) 2) (setq p (cons (elt p 0) (cons (elt p 1) nil))))
     (pathname (apply #'make-filename p)))))
```

—————

defun makePathname

[pathname p¹⁰⁴²]
[object2String p??]

— defun makePathname —

```
(defun |makePathname| (name type dir)
  (declare (ignore dir))
  (|pathname| (list (|object2String| name) (|object2String| type))))
```

—————

defun Delete a file

[erase p??]
[pathname p¹⁰⁴²]

```
[$erase p??]
```

— **defun deleteFile** —

```
(defun |deleteFile| (arg)
  (declare (special $erase))
  ($erase (|pathname| arg)))
```

defun wrap

```
[lotsof p1043]
[wrap p1043]
```

— **defun wrap** —

```
(defun wrap (list-of-items wrapper)
  (prog nil
    (cond
      ((or (not (consp list-of-items)) (not wrapper))
        (return list-of-items))
      ((not (consp wrapper))
        (setq wrapper (lotsof wrapper))))
    (return
      (cons
        (if (first wrapper)
          '(',(first wrapper) ,(first list-of-items))
          (first list-of-items))
        (wrap (cdr list-of-items) (cdr wrapper))))))
```

defun lotsof

— **defun lotsof** —

```
(defun lotsof (&rest items)
  (setq items (copy-list items))
  (nconc items items))
```

defmacro startsId?

— defmacro startsId? —

```
(defmacro |startsId?| (x)
  '(or (alpha-char-p ,x) (member ,x '(#\? #\% #\!) :test #'char=)))
```

defun hput

— defun hput —

```
(defun hput (table key value)
  (setf (gethash key table) value))
```

defmacro hget

— defmacro hget —

```
(defmacro HGET (table key &rest default)
  '(gethash ,key ,table ,@default))
```

defun hkeys

— defun hkeys —

```
(defun hkeys (table)
  (let (keys)
    (maphash
     #'(lambda (key val) (declare (ignore val)) (push key keys)) table)
    keys))
```

defun digitp[digitp p[1045](#)]

— defun digitp —

```
(defun digitp (x)
  (or (and (symbolp x) (digitp (symbol-name x)))
      (and (characterp x) (digit-char-p x))
      (and (stringp x) (= (length x) 1) (digit-char-p (char x 0)))))
```

—————

defun pname

Note it is important that PNAME returns nil not an error for non-symbols

— defun pname 0 —

```
(defun pname (x)
  (cond ((symbolp x) (symbol-name x))
        ((characterp x) (string x))
        (t nil)))
```

—————

defun size

— defun size —

```
(defun size (l)
  (cond
    ((vectorp l) (length l))
    ((consp l) (list-length l))
    (t 0)))
```

—————

defun strpos

— defun strpos —

```
(defun strpos (what in start dontcare)
  (setq what (string what) in (string in))
  (if dontcare
    (progn
      (setq dontcare (character dontcare))
      (search what in :start2 start
               :test #'(lambda (x y) (or (eql x dontcare) (eql x y)))))
    (if (= start 0)
      (search what in)
      (search what in :start2 start)))))
```

defun strposl

Note that this assumes “table” is a string.

— defun strposl —

```
(defun strposl (table cvec sint item)
  (setq cvec (string cvec))
  (if (not item)
    (position table cvec :test #'(lambda (x y) (position y x)) :start sint)
    (position table cvec :test-not #'(lambda (x y) (position y x)) :start sint)))
```

defun qenum

— defun qenum 0 —

```
(defun qenum (cvec ind)
  (char-code (char cvec ind)))
```

defmacro identp

— defmacro identp 0 —

```
(defmacro identp (x)
  (if (atom x)
```

```

'(and ,x (symbolp ,x))
  (let ((xx (gensym)))
    '(let ((,xx ,x))
      (and ,xx (symbolp ,xx))))))

```

defun concat

[string-concatenate p??]

— defun concat 0 —

```

(defun concat (a b &rest l)
  (if (bit-vector-p a)
      (if l
          (apply #'concatenate 'bit-vector a b l)
          (concatenate 'bit-vector a b))
      (if l
          (apply #'system:string-concatenate a b l)
          (system:string-concatenate a b))))

```

This function was called `|functionp|` which is a lower-case version of the common lisp function called `functionp`. Camm Maguire found a bug related to this ambiguity so this was renamed.

defun canFuncall?

— defun canFuncall? —

```

(defun canFuncall? (fn)
  (if (identp fn)
      (and (fboundp fn) (not (macro-function fn)))
      (functionp fn)))

```

:: —————, NEW DEFINITION (override in msgdb.boot.pamphlet)

defun brightprint

[messageprint p1048]

— defun brightprint —

```
(defun brightprint (x)
  (messageprint x))
```

—————

;; ————— NEW DEFINITION (override in msgdb.boot.pamphlet)

defun brightprint-0

[messageprint-1 p1049]

— defun brightprint-0 —

```
(defun brightprint-0 (x)
  (messageprint-1 x))
```

—————

defun member

— defun member 0 —

```
(defun |member| (item sequence)
  (cond
    ((symbolp item) (member item sequence :test #'eq))
    ((stringp item) (member item sequence :test #'equal))
    ((and (atom item) (not (arrayp item))) (member item sequence))
    (t (member item sequence :test #'equalp))))
```

—————

defun messageprint

— defun messageprint —

```
(defun messageprint (x)
  (mapc #'messageprint-1 x))
```

defun messageprint-1

```
[identp p1046]
[messageprint-1 p1049]
[messageprint-2 p1049]
```

— defun messageprint-1 —

```
(defun messageprint-1 (x)
  (cond
    ((or (eq x '|%l|) (equal x "%l")) (terpri))
    ((stringp x) (princ x))
    ((identp x) (princ x))
    ((atom x) (princ x))
    ((princ "(")
     (messageprint-1 (car x))
     (messageprint-2 (cdr x))
     (princ ")")))))
```

defun messageprint-2

```
[messageprint-1 p1049]
[messageprint-2 p1049]
```

— defun messageprint-2 —

```
(defun messageprint-2 (x)
  (if (atom x)
      (unless x (progn (princ " . ") (messageprint-1 x)))
      (progn (princ " ") (messageprint-1 (car x)) (messageprint-2 (cdr x)))))
```

defun sayBrightly1

```
[brightprint-0 p1048]
[brightprint p1048]
```

— defun sayBrightly1 —

```
(defun sayBrightly1 (x *standard-output*)
  (if (atom x)
      (progn (brightprint-0 x) (terpri) (force-output))
      (progn (brightprint x) (terpri) (force-output))))
```

—————

defmacro assq

TPDHERE: This could probably be replaced by the default assoc using eql

— defmacro assq —

```
(defmacro assq (a b)
  '(assoc ,a ,b :test #'eq))
```

—————

defun A version of GET that works with lists

— defun getl 0 —

```
(defun getl (op prop)
  (when (and op (symbolp op)) (get op prop)))
```

—————

Chapter 69

Record, Union, Mapping, and Enumeration

— postvars —

```
(eval-when (eval load)
  (mapcar #'(lambda (alist)
    (setf (get (first alist) '|makeFunctionList|) (second alist)))
    '((|Record| |mkRecordFunList|)
      (|Union| |mkUnionFunList|)
      (|Mapping| |mkMappingFunList|)
      (|Enumeration| |mkEnumerationFunList|))))
```

—————

Chapter 70

Common Lisp Algebra Support

These functions are called directly from the algebra source code. They fall into two basic categories, one are the functions that are raw Common Lisp calls and the other are Axiom specific functions or macros.

Raw function calls are used where there is an alignment of the Axiom type and the underlying representation in Common Lisp. These form the support pillars upon which Axiom rests. For instance, the 'EQ' function is called to support the Axiom equivalent 'eq?' function.

Macros are used to add type information in order to make low level operations faster. An example is the use of macros in DoubleFloat to add Common Lisp type information. Since DoubleFloat is machine arithmetic we give the compiler explicit type information so it can generate fast code.

Functions are used to do manipulations which are Common Lisp operations but the Axiom semantics are not the same. Because Axiom was originally written in Maclisp, then VMLisp, and then Common Lisp some of these old semantics survive.

70.1 ApplicationProgramInterface

defun Report what domains get instantiated

— defun reportinstantiations —

```
(defun reportinstantiations (b)
  (setq |$reportInstantiations| b))
```

—————

70.2 InputForm

defun unparseInputForm

This fixes bug 7217. The default title generation is bogus. This is called from the unparse function in InputForm, bookvol10.3 Given a form, *u*, we try to recover the input line that created it. [*\$InteractiveMode* p22]
 [*\$formatSigAsTeX* p??]

— defun unparseInputForm —

```
(defun |unparseInputForm| (u)
  (let (|$formatSigAsTeX| |$InteractiveMode|)
    (declare (special |$formatSigAsTeX| |$InteractiveMode|))
    (setq |$formatSigAsTeX| 1)
    (setq |$InteractiveMode| nil)
    (|form2StringLocal| u)))
```

—————

70.3 Void

defun voidValue

— defun voidValue —

```
(defun |voidValue| () "()")
```

—————

70.4 U8Vector

defmacro qvlenU8

— defmacro qvlenU8 —

```
(defmacro qvlenU8 (v)
  `(length (the (simple-array (unsigned-byte 8) (*)) ,v)))
```

—————

defmacro eltU8

— defmacro eltU8 —

```
(defmacro eltU8 (v i)
  '(aref (the (simple-array (unsigned-byte 8) (*)) ,v) ,i))
```

defmacro seteltU8

— defmacro seteltU8 —

```
(defmacro seteltU8 (v i s)
  '(setf (aref (the (simple-array (unsigned-byte 8) (*)) ,v) ,i), s))
```

defun getRefvU8

— defun getRefvU8 —

```
(defun getRefvU8 (n x)
  (make-array n :initial-element x :element-type '(unsigned-byte 8)))
```

70.5 U16Vector**defmacro qvlenU16**

— defmacro qvlenU16 —

```
(defmacro qvlenU16 (v)
  '(length (the (simple-array (unsigned-byte 16) (*)) ,v)))
```

defmacro eltU16

— defmacro eltU16 —

```
(defmacro eltU16 (v i)
  '(aref (the (simple-array (unsigned-byte 16) (*)) ,v) ,i))
```

defmacro seteltU16

— defmacro seteltU16 —

```
(defmacro seteltU16 (v i s)
  '(setf (aref (the (simple-array (unsigned-byte 16) (*)) ,v) ,i), s))
```

defun getRefvU16

— defun getRefvU16 —

```
(defun getRefvU16 (n x)
  (make-array n :initial-element x :element-type '(unsigned-byte 16)))
```

70.6 U32Vector**defmacro qvlenU32**

— defmacro qvlenU32 —

```
(defmacro qvlenU32 (v)
  '(length (the (simple-array (unsigned-byte 32) (*)) ,v)))
```

defmacro eltU32

— defmacro eltU32 —

```
(defmacro eltU32 (v i)
  '(aref (the (simple-array (unsigned-byte 32) (*)) ,v) ,i))
```

defmacro seteltU32

— defmacro seteltU32 —

```
(defmacro seteltU32 (v i s)
  '(setf (aref (the (simple-array (unsigned-byte 32) (*)) ,v) ,i), s))
```

defun getRefvU32

— defun getRefvU32 —

```
(defun getRefvU32 (n x)
  (make-array n :initial-element x :element-type '(unsigned-byte 32)))
```

70.7 U8Matrix**defmacro aref2U8**

— defmacro aref2U8 —

```
(defmacro aref2U8 (v i j)
  '(aref (the (simple-array (unsigned-byte 8) (* *)) ,v) ,i ,j))
```

defmacro setAref2U8

— defmacro setAref2U8 —

```
(defmacro setAref2U8 (v i j s)
  '(setf (aref (the (simple-array (unsigned-byte 8) (* *)) ,v) ,i ,j), s))
```

—————

defmacro anrowsU8

— defmacro anrowsU8 —

```
(defmacro anrowsU8 (v)
  '(array-dimension (the (simple-array (unsigned-byte 8) (* *)) ,v) 0))
```

—————

defmacro ancolsU8

— defmacro ancolsU8 —

```
(defmacro ancolsU8 (v)
  '(array-dimension (the (simple-array (unsigned-byte 8) (* *)) ,v) 1))
```

—————

defmacro makeMatrixU8

— defmacro makeMatrixU8 —

```
(defmacro makeMatrixU8 (n m)
  '(make-array (list ,n ,m) :element-type '(unsigned-byte 8)
               :initial-element 0))
```

—————

defmacro makeMatrix1U8

— defmacro makeMatrix1U8 —

```
(defmacro makeMatrix1U8 (n m s)
  '(make-array (list ,n ,m) :element-type '(unsigned-byte 8)
               :initial-element ,s))
```

70.8 U16Matrix**defmacro aref2U16**

— defmacro aref2U16 —

```
(defmacro aref2U16 (v i j)
  '(aref (the (simple-array (unsigned-byte 16) (* *)) ,v) ,i ,j))
```

defmacro setAref2U16

— defmacro setAref2U16 —

```
(defmacro setAref2U16 (v i j s)
  '(setf (aref (the (simple-array (unsigned-byte 16) (* *)) ,v) ,i ,j), s))
```

defmacro anrowsU16

— defmacro anrowsU16 —

```
(defmacro anrowsU16 (v)
  '(array-dimension (the (simple-array (unsigned-byte 16) (* *)) ,v) 0))
```

defmacro ancolsU16

— defmacro ancolsU16 —

```
(defmacro ancolsU16 (v)
  '(array-dimension (the (simple-array (unsigned-byte 16) (* *)) ,v) 1))
```

—————

defmacro makeMatrixU16

— defmacro makeMatrixU16 —

```
(defmacro makeMatrixU16 (n m)
  '(make-array (list ,n ,m) :element-type '(unsigned-byte 16)
               :initial-element 0))
```

—————

defmacro makeMatrix1U16

— defmacro makeMatrix1U16 —

```
(defmacro makeMatrix1U16 (n m s)
  '(make-array (list ,n ,m) :element-type '(unsigned-byte 16)
               :initial-element ,s))
```

—————

70.9 U32Matrix**defmacro aref2U32**

— defmacro aref2U32 —

```
(defmacro aref2U32 (v i j)
  '(aref (the (simple-array (unsigned-byte 32) (* *)) ,v) ,i ,j))
```

—————

defmacro setAref2U32

— defmacro setAref2U32 —

```
(defmacro setAref2U32 (v i j s)
  '(setf (aref (the (simple-array (unsigned-byte 32) (* *)) ,v) ,i ,j), s))
```

—————

defmacro anrowsU32

— defmacro anrowsU32 —

```
(defmacro anrowsU32 (v)
  '(array-dimension (the (simple-array (unsigned-byte 32) (* *)) ,v) 0))
```

—————

defmacro ancolsU32

— defmacro ancolsU32 —

```
(defmacro ancolsU32 (v)
  '(array-dimension (the (simple-array (unsigned-byte 32) (* *)) ,v) 1))
```

—————

defmacro makeMatrixU32

— defmacro makeMatrixU32 —

```
(defmacro makeMatrixU32 (n m)
  '(make-array (list ,n ,m) :element-type '(unsigned-byte 32)
               :initial-element 0))
```

—————

defmacro makeMatrix1U32

— defmacro makeMatrix1U32 —

```
(defmacro makeMatrix1U32 (n m s)
  '(make-array (list ,n ,m) :element-type '(unsigned-byte 32)
               :initial-element ,s))
```

70.10 U32VectorPolynomialOperations

defmacro qsMulAdd6432

— defmacro qsMulAdd6432 —

```
(defmacro qsMulAdd6432 (x y z)
  '(the (unsigned-byte 64)
    (+ (the (unsigned-byte 64)
      (* (the (unsigned-byte 32) ,x)
         (the (unsigned-byte 32) ,y)))
      (the (unsigned-byte 64) ,z))))
```

defmacro qsMulMod32

— defmacro qsMulMod32 —

```
(defmacro qsMulMod32 (x y)
  '(the (unsigned-byte 64)
    (* (the (unsigned-byte 32) ,x)
       (the (unsigned-byte 32) ,y))))
```

defmacro qsMod6432

— defmacro qsMod6432 —

```
(defmacro qsMod6432 (x p)
  '(the (unsigned-byte 32)
    (rem (the (unsigned-byte 64) ,x) (the (unsigned-byte 32) ,p))))
```

defmacro qsMulAddMod6432

— defmacro qsMulAddMod6432 —

```
(defmacro qsMulAddMod6432 (x y z p)
  '(qsMod6432 (qsMulAdd6432 ,x ,y ,z) ,p))
```

defmacro qsMul6432

— defmacro qsMul6432 —

```
(defmacro qsMul6432 (x y)
  '(the (unsigned-byte 64)
    (* (the (unsigned-byte 32) ,x)
       (the (unsigned-byte 32) ,y))))
```

defmacro qsDot26432

— defmacro qsDot26432 —

```
(defmacro qsDot26432 (a1 b1 a2 b2)
  '(qsMulAdd6432 ,a1 ,b1 (qsMul6432 ,a2 ,b2)))
```

defmacro qsDot2Mod6432

— defmacro qsDot2Mod6432 —


```
(defmacro qsDot2Mod6432 (a1 b1 a2 b2 p)
  '(qsMod6432 (qsDot26432 ,a1 ,b1 ,a2 ,b2) ,p))
```

70.11 DirectProduct

defun vec2list

— **defun vec2list** —

```
(defun vec2list (vec) (coerce vec 'list))
```

70.12 AlgebraicFunction

defun retract

```
[objMode p??]
[objVal p??]
[isWrapped p??]
[qcar p??]
[retract1 p??]
[objNew p??]
[$EmptyMode p??]
```

— **defun retract** —

```
(defun |retract| (object)
  (labels (
    (retract1 (object)
      (let (type val underDomain objectp)
        (declare (special |$SingleInteger| |$Integer| |$NonNegativeInteger|
                          |$PositiveInteger|))
        (setq type (|objMode| object))
        (cond
          ((stringp type) '|failed|)
          (t
           (setq val (|objVal| object))
           (cond
            ((equal type |$PositiveInteger|) (|objNew| val |$NonNegativeInteger|))
```

```

((equal type |$NonNegativeInteger|) (|objNew| val |$Integer|))
((and (equal type |$Integer|) (typep (|unwrap| val) 'fixnum))
  (|objNew| val |$SingleInteger|))
(t
  (cond
    ((or (eql 1 (|#| type))
      (and (consp type) (eq (qcar type) '|Union|))
      (and (consp type) (eq (qcar type) '|FunctionCalled|)
        (and (consp (qcdr type)) (eq (qcddr type) nil)))
      (and (consp type) (eq (qcar type) '|OrderedVariableList|)
        (and (consp (qcdr type)) (eq (qcddr type) nil)))
      (and (consp type) (eq (qcar type) '|Variable|)
        (and (consp (qcdr type)) (eq (qcddr type) nil))))
      (if (setq objectp (|retract2Specialization| object))
        objectp
        '|failed|))
    ((null (setq underDomain (|underDomainOf| type)))
      '|failed|)
    ; try to retract the "coefficients", e.g. P RN -> P I or M RN -> M I
    (t
      (setq objectp (|retractUnderDomain| object type underDomain))
      (cond
        ((not (eq objectp '|failed|)) objectp)
        ; see if we can use the retract functions
        ((setq objectp (|coerceRetract| object underDomain)) objectp)
        ; see if we have a special case here
        ((setq objectp (|retract2Specialization| object)) objectp)
        (t '|failed|))))))
(let (type val ans)
  (declare (special |$EmptyMode|))
  (setq type (|objModel| object))
  (cond
    ((stringp type) '|failed|)
    ((equal type |$EmptyMode|) '|failed|)
    (t
      (setq val (|objVal| object))
      (cond
        ((and (null (|isWrapped| val))
          (null (and (consp val) (eq (qcar val) 'map))))
          '|failed|)
        (t
          (cond
            ((eq (setq ans (retract1 (|objNew| val type))) '|failed|)
              ans)
            (t
              (|objNew| (|objVal| ans) (|objModel| ans)))))))))

```

70.13 Any

defun spad2BootCoerce

— defun spad2BootCoerce —

```
(defun |spad2BootCoerce| (x source target)
  (let (xp)
    (cond
      ((null (|isValidType| source)) (|throwKeyedMsg| 'S2IE0004 (list source)))
      ((null (|isValidType| target)) (|throwKeyedMsg| 'S2IE0004 (list target)))
      ((setq xp (|coerceInteractive| (|objNewWrap| x source) target))
       (|objValUnwrap| xp))
      (t
       (|throwKeyedMsgCannotCoerceWithValue| (|wrap| x) source target)))))
```

70.14 ParametricLinearEquations

defun algCoerceInteractive

— defun algCoerceInteractive —

```
(defun |algCoerceInteractive| (p source target)
  (let (|$useConvertForCoercions| u)
    (declare (special |$useConvertForCoercions|))
    (setq |$useConvertForCoercions| t)
    (setq source (|devaluate| source))
    (setq target (|devaluate| target))
    (setq u (|coerceInteractive| (|objNewWrap| p source) target))
    (if u
      (|objValUnwrap| u)
      (|error| (list "can't convert" p "of mode" source "to mode" target)))))
```

70.15 NumberFormats

defun ncParseFromString

— defun ncParseFromString —

```
(defun |ncParseFromString| (s)
  (|zeroOneTran| (catch 'SPAD_READER (|parseFromString| s))))
```

—————

70.16 SingleInteger

defun qsquotient

— defun qsquotient 0 —

```
(defun qsquotient (a b)
  (the fixnum (truncate (the fixnum a) (the fixnum b))))
```

—————

defun qsremainder

— defun qsremainder 0 —

```
(defun qsremainder (a b)
  (the fixnum (rem (the fixnum a) (the fixnum b))))
```

—————

defmacro qsdifference

— defmacro qsdifference 0 —

```
(defmacro qsdifference (x y)
  '(the fixnum (- (the fixnum ,x) (the fixnum ,y))))
```

defmacro qslessp

— defmacro qslessp 0 —

```
(defmacro qslessp (a b)
  '(< (the fixnum ,a) (the fixnum ,b)))
```

defmacro qsadd1

— defmacro qsadd1 0 —

```
(defmacro qsadd1 (x)
  '(the fixnum (1+ (the fixnum ,x))))
```

defmacro qssub1

— defmacro qssub1 0 —

```
(defmacro qssub1 (x)
  '(the fixnum (1- (the fixnum ,x))))
```

defmacro qsminus

— defmacro qsminus 0 —

```
(defmacro qsminus (x)
  '(the fixnum (minus (the fixnum ,x))))
```

defmacro qplus

— defmacro qplus 0 —

```
(defmacro qplus (x y)
  '(the fixnum (+ (the fixnum ,x) (the fixnum ,y))))
```

—————

defmacro qtimes

— defmacro qtimes 0 —

```
(defmacro qtimes (x y)
  '(the fixnum (* (the fixnum ,x) (the fixnum ,y))))
```

—————

defmacro qsabsval

— defmacro qsabsval 0 —

```
(defmacro qsabsval (x)
  '(the fixnum (abs (the fixnum ,x))))
```

—————

defmacro qsoddp

— defmacro qsoddp 0 —

```
(defmacro qsoddp (x)
  '(oddp (the fixnum ,x)))
```

—————

defmacro qszerop

— defmacro qszerop 0 —

```
(defmacro qszerop (x)
  '(zerop (the fixnum ,x)))
```

—————

defmacro qsmax

— defmacro qsmax 0 —

```
(defmacro qsmax (x y)
  '(the fixnum (max (the fixnum ,x) (the fixnum ,y))))
```

—————

defmacro qsmin

— defmacro qsmin 0 —

```
(defmacro qsmin (x y)
  '(the fixnum (min (the fixnum ,x) (the fixnum ,y))))
```

—————

70.17 Boolean**defun The Boolean = function support**

— defun BooleanEquality 0 —

```
(defun |BooleanEquality| (x y) (if x y (null y)))
```

—————

70.18 IndexedBits

defmacro truth-to-bit

IndexedBits new function support

— **defmacro truth-to-bit** —

```
(defmacro truth-to-bit (x) '(cond (,x 1) ('else 0)))
```

—————

defun IndexedBits new function support

— **defun bvec-make-full 0** —

```
(defun bvec-make-full (n x)
  (make-array (list n) :element-type 'bit :initial-element x))
```

—————

defmacro bit-to-truth

IndexedBits elt function support

— **defmacro bit-to-truth 0** —

```
(defmacro bit-to-truth (b) '(eq ,b 1))
```

—————

defmacro bvec-elt

IndexedBits elt function support

— **defmacro bvec-elt 0** —

```
(defmacro bvec-elt (bv i) '(sbit ,bv ,i))
```

—————

defmacro bvec-setelt

IndexedBits setelt function support

— **defmacro bvec-setelt** —

```
(defmacro bvec-setelt (bv i x) '(setf (sbit ,bv ,i) ,x))
```

—————

defmacro bvec-size

IndexedBits length function support

— **defmacro bvec-size** —

```
(defmacro bvec-size (bv) '(size ,bv))
```

—————

defun IndexedBits concat function support— **defun bvec-concat 0** —

```
(defun bvec-concat (bv1 bv2) (concatenate '(vector bit) bv1 bv2))
```

—————

defun IndexedBits copy function support— **defun bvec-copy 0** —

```
(defun bvec-copy (bv) (copy-seq bv))
```

—————

defun IndexedBits = function support— **defun bvec-equal 0** —

```
(defun bvec-equal (bv1 bv2) (equal bv1 bv2))
```

defun IndexedBits < function support

— defun bvec-greater 0 —

```
(defun bvec-greater (bv1 bv2)
  (let ((pos (mismatch bv1 bv2)))
    (cond ((or (null pos) (>= pos (length bv1))) nil)
          ((< pos (length bv2)) (> (bit bv1 pos) (bit bv2 pos)))
          ((find 1 bv1 :start pos) t)
          (t nil))))
```

defun IndexedBits And function support

— defun bvec-and 0 —

```
(defun bvec-and (bv1 bv2) (bit-and bv1 bv2))
```

defun IndexedBits Or function support

— defun bvec-or 0 —

```
(defun bvec-or (bv1 bv2) (bit-ior bv1 bv2))
```

defun IndexedBits xor function support

— defun bvec-xor 0 —

```
(defun bvec-xor (bv1 bv2) (bit-xor  bv1 bv2))
```

defun IndexedBits nand function support

— defun bvec-nand 0 —

```
(defun bvec-nand (bv1 bv2) (bit-nand bv1 bv2))
```

defun IndexedBits nor function support

— defun bvec-nor 0 —

```
(defun bvec-nor (bv1 bv2) (bit-nor  bv1 bv2))
```

defun IndexedBits not function support

— defun bvec-not 0 —

```
(defun bvec-not (bv) (bit-not  bv))
```

70.19 KeyedAccessFile

defun KeyedAccessFile defstream function support

This is a simpler interface to RDEFIOSTREAM [rdefiostream p??]

— defun rdefinstream —

```
(defun rdefinstream (&rest fn)
  ;; following line prevents rdefiostream from adding a default filetype
  (unless (rest fn) (setq fn (list (pathname (car fn)))))
  (rdefiostream (list (cons 'file fn) '(mode . input))))
```

defun KeyedAccessFile defstream function support

```
[rdefiostream p??]
```

— defun rdefoutstream —

```
(defun rdefoutstream (&rest fn)
  ;; following line prevents rdefiostream from adding a default filetype
  (unless (rest fn) (setq fn (list (pathname (car fn)))))
  (rdefiostream (list (cons 'FILE fn) '(mode . OUTPUT))))
```

70.20 Table

defun Table InnerTable support

We look inside the Key domain given to Table and find if there is an equality predicate associated with the domain. If found then Table will use a HashTable representation, otherwise it will use an AssociationList representation [knownEqualPred p??]

```
[compiledLookup p1076]
```

```
[Boolean p??]
```

```
[bpiname p??]
```

```
[knownEqualPred p??]
```

— defun hashable —

```
(defun |hashable| (dom)
  (labels (
    (|knownEqualPred| (dom)
      (let ((fun (|compiledLookup| '= '((|Boolean|) $ $) dom)))
        (if fun
          (get (bpiname (car fun)) '|SPADreplace|)
          nil))))
    (member (|knownEqualPred| dom) '(eq eql equal))))
```

defun compiledLookup

```
[isDomain p??]
[NRTevalDomain p1079]
```

— defun compiledLookup —

```
(defun |compiledLookup| (op sig dollar)
  (unless (|isDomain| dollar) (setq dollar (|NRTevalDomain| dollar)))
  (|basicLookup| op sig dollar dollar))
```

—————

defun basicLookup

```
[spadcall p??]
[hashCode? p??]
[opIsHasCat p??]
[HasCategory p??]
[hashType p??]
[hashString p??]
[error p??]
[vecp p??]
[isNewWorldDomain p??]
[oldCompLookup p1079]
[lookupInDomainVector p1078]
[$hashSeg p??]
[$hashOpSet p??]
[$hashOpApply p??]
[$hashOp0 p??]
[$hashOp1 p??]
```

— defun basicLookup —

```
(defun |basicLookup| (op sig domain dollar)
  (let (hashPercent box dispatch lookupFun hashSig val boxval)
    (declare (special |$hashSeg| |$hashOpSet| |$hashOpApply| |$hashOp0|
                      |$hashOp1|))
    (cond
      ((vecp domain)
       (if (|isNewWorldDomain| domain)
           (|oldCompLookup| op sig domain dollar)
           (|lookupInDomainVector| op sig domain dollar)))
      (t
       (setq hashPercent
              (if (vecp dollar)
```

```

(|hashType| (elt dollar 0) 0)
(|hashType| dollar 0)))
(setq box (cons nil nil))
(cond
  ((null (vecp (setq dispatch (car domain))))
    (|error| '|bad domain format|))
  (t
    (setq lookupFun (elt dispatch 3))
    (cond
      ((eql (elt dispatch 0) 0)
        (setq hashSig
          (cond
            ((|hashCode?| sig) sig)
            ((|opIsHasCat| op) (|hashType| sig hashPercent))
            (t (|hashType| (cons '|Mapping| sig) hashPercent))))
        (when (symbolp op)
          (cond
            ((eq op '|Zero|) (setq op |$hashOp0|))
            ((eq op '|One|) (setq op |$hashOp1|))
            ((eq op '|elt|) (setq op |$hashOpApply|))
            ((eq op '|setelt|) (setq op |$hashOpSet|))
            (t (setq op (|hashString| (symbol-name op)))))
          (cond
            ((setq val
              (car
                (spadcall (cdr domain) dollar op hashSig box nil lookupFun)))
              val)
            ((|hashCode?| sig) nil)
            ((or (> (|#| sig) 1) (|opIsHasCat| op)) nil)
            (setq boxval
              (spadcall (cdr dollar) dollar op
                (|hashType| (car sig) hashPercent)
                box nil lookupFun))
              (cons #'identity (car boxval)))
            (t nil)))
      ((|opIsHasCat| op) (|HasCategory| domain sig))
      (t
        (when (|hashCode?| op)
          (cond
            ((eql op |$hashOp1|) (setq op '|One|))
            ((eql op |$hashOp0|) (setq op '|Zero|))
            ((eql op |$hashOpApply|) (setq op '|elt|))
            ((eql op |$hashOpSet|) (setq op '|setelt|))
            ((eql op |$hashSeg|) (setq op '|segment|)))
          (cond
            ((and (|hashCode?| sig) (eql sig hashPercent))
              (spadcall
                (car (spadcall (cdr dollar) dollar op '($) box nil lookupFun))))
            (t
              (car

```

```
(spadcall (cdr dollar) dollar op sig box nil lookupFun))))))))))
```

defun lookupInDomainVector

```
[basicLookupCheckDefaults p1078]
[spadcall p??]
```

— defun lookupInDomainVector —

```
(defun |lookupInDomainVector| (op sig domain dollar)
  (if (consp domain)
      (|basicLookupCheckDefaults| op sig domain domain)
      (spadcall op sig dollar (elt domain 1))))
```

defun basicLookupCheckDefaults

```
[vecp p??]
[error p??]
[hashType p??]
[hashCode? p??]
[hashString p??]
[spadcall p??]
[$lookupDefaults p??]
```

— defun basicLookupCheckDefaults —

```
(defun |basicLookupCheckDefaults| (op sig domain dollar)
  (declare (ignore domain))
  (let (box dispatch lookupFun hashPercent hashSig)
    (declare (special |$lookupDefaults|))
    (setq box (cons nil nil))
    (cond
      ((null (vecp (setq dispatch (car dollar))))
       (|error| '|bad domain format|))
      (t
       (setq lookupFun (elt dispatch 3))
       (cond
         ((eql (elt dispatch 0) 0)
          (setq hashPercent
                 (if (vecp dollar)
```

```

      (|hashType| (elt dollar 0) 0)
      (|hashType| dollar 0)))
    (setq hashSig
      (if (|hashCode?| sig)
          sig
          (|hashType| (cons '|Mapping| sig) hashPercent)))
    (when (symbolp op) (setq op (|hashString| (symbol-name op))))
    (car (spadcall (cdr dollar) dollar op hashSig
                  box (null |$lookupDefaults|) lookupFun)))
  (t
    (car (spadcall (cdr dollar) dollar op sig box
                  (null |$lookupDefaults|) lookupFun))))))

```

defun oldCompLookup

[lookupInDomainVector p[1078](#)]
 [\$lookupDefaults p??]

— defun oldCompLookup —

```

(defun |oldCompLookup| (op sig domvec dollar)
  (let (|$lookupDefaults| u)
    (declare (special |$lookupDefaults|))
    (setq |$lookupDefaults| nil)
    (cond
      ((setq u (|lookupInDomainVector| op sig domvec dollar))
        u)
      (t
        (setq |$lookupDefaults| t)
        (|lookupInDomainVector| op sig domvec dollar))))))

```

defun NRTevalDomain

[qcar p??]
 [eval p??]
 [evalDomain p[913](#)]

— defun NRTevalDomain —

```

(defun |NRTevalDomain| (form)
  (if (and (consp form) (eq (qcar form) 'setelt))

```



```
(|eval| form)
(|evalDomain| form))
```

70.21 Plot3d

We catch numeric errors and throw a different failure than normal. The `trapNumericErrors` macro will return a pair of the the form `Union(type-of-form, "failed")`. This pair is tested for eq-ness so it has to be unique. It lives in the defvar `$numericFailure`. The old value of the `$BreakMode` variable is saved in a defvar named `$oldBreakMode`.

defvar \$numericFailure

This is a failed union branch which is the value returned for numeric failure.

— **initvars** —

```
(defvar |$numericFailure| (cons 1 "failed"))
```

defvar \$oldBreakMode

— **initvars** —

```
(defvar |$oldBreakMode| nil "the old value of the $BreakMode variable")
```

defmacro trapNumericErrors

The following macro evaluates form returning `Union(type-of form, "failed")`. It is used in the `myTrap` local function in `Plot3d`.

— **defmacro trapNumericErrors** —

```
(defmacro |trapNumericErrors| (form)
  '(let ((|$oldBreakMode| |$BreakMode|) (|$BreakMode| '|trapNumerics|) (val))
    (declare (special |$BreakMode| |$numericFailure| |$oldBreakMode|))
    (setq val (catch '|trapNumerics| ,form))
    (if (eq val |$numericFailure|) val (cons 0 val))))
```

70.22 DoubleFloatVector

Double Float Vectors are simple arrays of lisp double-floats made available at the Spad language level. Note that these vectors are 0 based whereas other Spad language vectors are 1-based.

defmacro dlen

DoubleFloatVector Qsize function support

— **defmacro dlen** —

```
(defmacro dlen (v)
  '(length (the (simple-array double-float (*)) ,v)))
```

defmacro make-double-vector

DoubleFloatVector Qnew function support

— **defmacro make-double-vector** —

```
(defmacro make-double-vector (n)
  '(make-array (list ,n) :element-type 'double-float))
```

defmacro make-double-vector1

DoubleFloatVector Qnew1 function support

— **defmacro make-double-vector1** —

```
(defmacro make-double-vector1 (n s)
  '(make-array (list ,n) :element-type 'double-float :initial-element ,s))
```

defmacro delt

DoubleFloatVector Qelt1 function support

— **defmacro delt** —

```
(defmacro delt (v i)
  '(aref (the (simple-array double-float (*)) ,v) ,i))
```

—————

defmacro dsetelt

DoubleFloatVector Qsetelt1 function support

— **defmacro dsetelt** —

```
(defmacro dsetelt (v i s)
  '(setf (aref (the (simple-array double-float (*)) ,v) ,i) ,s))
```

—————

70.23 ComplexDoubleFloatVector

Complex Double Float Vectors are simple arrays of lisp double-floats made available at the Spad language level. Note that these vectors are 0 based whereas other Spad language vectors are 1-based. Complex array is implemented as an array of doubles. Each complex number occupies two positions in the real array.

defmacro make-cdouble-vector

ComplexDoubleFloatVector Qnew function support

— **defmacro make-cdouble-vector** —

```
(defmacro make-cdouble-vector (n)
  '(make-array (list (* 2 ,n)) :element-type 'double-float))
```

—————

defmacro cdelt

ComplexDoubleFloatVector Qelt1 function support

— **defmacro cdelt** —

```
(defmacro CDELTA(ov oi)
  (let ((v (gensym))
        (i (gensym)))
    `(let ((,v ,ov)
          (,i ,oi))
      (cons
        (aref (the (simple-array double-float (*)) ,v) (* 2 ,i))
        (aref (the (simple-array double-float (*)) ,v) (+ (* 2 ,i) 1))))))
```

defmacro cdsetelt

ComplexDoubleFloatVector Qsetelt1 function support

— **defmacro cdsetelt** —

```
(defmacro cdsetelt(ov oi os)
  (let ((v (gensym))
        (i (gensym))
        (s (gensym)))
    `(let ((,v ,ov)
          (,i ,oi)
          (,s ,os))
      (setf (aref (the (simple-array double-float (*)) ,v) (* 2 ,i))
            (car ,s))
      (setf (aref (the (simple-array double-float (*)) ,v) (+ (* 2 ,i) 1))
            (cdr ,s))
      ,s)))
```

defmacro cdlen

ComplexDoubleFloatVector Qsize function support

— **defmacro cdlen** —

```
(defmacro cdlen(v)
  `(truncate (length (the (simple-array double-float (*)) ,v)) 2))
```

70.24 DoubleFloatMatrix

defmacro make-double-matrix

DoubleFloatMatrix qnew function support

— **defmacro make-double-matrix** —

```
(defmacro make-double-matrix (n m)
  '(make-array (list ,n ,m) :element-type 'double-float))
```

—————

defmacro make-double-matrix1

DoubleFloatMatrix new function support

— **defmacro make-double-matrix1** —

```
(defmacro make-double-matrix1 (n m s)
  '(make-array (list ,n ,m) :element-type 'double-float
    :initial-element ,s))
```

—————

defmacro daref2

DoubleFloatMatrix qelt function support

— **defmacro daref2** —

```
(defmacro daref2 (v i j)
  '(aref (the (simple-array double-float (* *)) ,v) ,i ,j))
```

—————

defmacro dsetaref2

DoubleFloatMatrix qsetelt! function support

— **defmacro dsetaref2** —

```
(defmacro dsetaref2 (v i j s)
  '(setf (aref (the (simple-array double-float (* *)) ,v) ,i ,j)
    ,s))
```

—————

defmacro danrows

DoubleFloatMatrix nrow function support

— **defmacro danrows** —

```
(defmacro danrows (v)
  '(array-dimension (the (simple-array double-float (* *)) ,v) 0))
```

defmacro dancols

DoubleFloatMatrix ncol function support

— **defmacro dancols** —

```
(defmacro dancols (v)
  '(array-dimension (the (simple-array double-float (* *)) ,v) 1))
```

70.25 ComplexDoubleFloatMatrix**defmacro make-cdouble-matrix**

ComplexDoubleFloatMatrix function support

— **defmacro make-cdouble-matrix** —

```
(defmacro make-cdouble-matrix (n m)
  '(make-array (list ,n (* 2 ,m)) :element-type 'double-float))
```

defmacro cdaref2

ComplexDoubleFloatMatrix function support

— **defmacro cdaref2** —

```
(defmacro cdaref2 (ov oi oj)
  (let ((v (gensym))
        (i (gensym))
        (j (gensym)))
    '(let ((,v ,ov)
```

```

      (,i ,oi)
      (,j ,oj))
    (cons
      (aref (the (simple-array double-float (* *)) ,v) ,i (* 2 ,j))
      (aref (the (simple-array double-float (* *)) ,v)
        ,i (+ (* 2 ,j) 1))))))

```

defmacro cdsetaref2

ComplexDoubleFloatMatrix function support

— **defmacro cdsetaref2** —

```

(defmacro cdsetaref2 (ov oi oj os)
  (let ((v (gensym))
        (i (gensym))
        (j (gensym))
        (s (gensym)))
    `(let ((,v ,ov)
          (,i ,oi)
          (,j ,oj)
          (,s ,os))
      (setf (aref (the (simple-array double-float (* *)) ,v) ,i (* 2 ,j))
            (car ,s))
      (setf (aref (the (simple-array double-float (* *)) ,v)
                  ,i (+ (* 2 ,j) 1))
            (cdr ,s))
      ,s)))

```

defmacro cdanrows

ComplexDoubleFloatMatrix function support

— **defmacro cdanrows** —

```

(defmacro cdanrows (v)
  `(array-dimension (the (simple-array double-float (* *)) ,v) 0))

```

defmacro cdancols

ComplexDoubleFloatMatrix function support

— **defmacro cdancols** —

```
(defmacro cdancols (v)
  '(truncate
    (array-dimension (the (simple-array double-float (* *)) ,v) 1) 2))
```

70.26 Integer**defun Integer divide function support**

Note that this is defined as a SPADReplace function in Integer so that algebra code that uses the Integer divide function actually inlines a call to this code. The Integer domain contains the line:

```
(PUT (QUOTE |INT;divide;2$R;44|) (QUOTE |SPADreplace|) (QUOTE DIVIDE2))
```

— **defun divide2 0** —

```
(defun divide2 (x y)
  (multiple-value-call #'cons (truncate x y)))
```

defun Integer quo function support

Note that this is defined as a SPADReplace function in Integer so that algebra code that uses the Integer quo function actually inlines a call to this code. The Integer domain contains the line:

```
(PUT (QUOTE |INT;rem;3$;46|) (QUOTE |SPADreplace|) (QUOTE REMAINDER2))
```

Because these are identical except for name we make the symbol-functions equivalent. This was done in the original code for efficiency.

— **defun remainder2 0** —

```
(setf (symbol-function 'remainder2) #'rem)
```

defun Integer quo function support

Note that this is defined as a SPADReplace function in Integer so that algebra code that uses the Integer quo function actually inlines a call to this code. The Integer domain contains the line:

```
(PUT (QUOTE |INT;quo;3$;45|) (QUOTE |SPADreplace|) (QUOTE QUOTIENT2))
```

— defun quotient2 0 —

```
(defun quotient2 (x y)
  (values (truncate x y)))
```

—————

defun Integer random function support

This is used for calls to random with no arguments. If an argument is supplied to random then the common lisp random function is called directly. This could be lifted up into the spad code.

— defun random 0 —

```
(defun |random| () (random (expt 2 26)))
```

—————

70.27 IndexCard**defun IndexCard origin function support**

```
[dbPart p??]
[charPosition p??]
[substring p??]
```

— defun alqlGetOrigin —

```
(defun |alqlGetOrigin| (x)
  (let (field k)
    (setq field (|dbPart| x 5 1))
    (setq k (|charPosition| #\ ( field 2))
    (substring field 1 (1- k))))
```

—————

defun IndexCard origin function support

```
[dbPart p??]
[charPosition p??]
[substring p??]
```

— defun alqlGetParams —

```
(defun |alqlGetParams| (x)
  (let (field k)
    (setq field (|dbPart| x 5 1))
    (setq k (|charPosition| #\ ( field 2))
    (substring field k nil)))
```

—————

defun IndexCard elt function support

```
[dbPart p??]
[substring p??]
```

— defun alqlGetKindString —

```
(defun |alqlGetKindString| (x)
  (if (or (char= (elt x 0) #\a) (char= (elt x 0) #\o))
    (substring (|dbPart| x 5 1) 0 1)
    (substring x 0 1)))
```

—————

70.28 OperationsQuery**defun OperationQuery getDatabase function support**

This function, called as `getBrowseDatabase(arg)` returns a list of appropriate entries in the browser database. The legal values for `arg` are

- “o” (operations)
- “k” (constructors)
- “d” (domains)
- “c” (categories)

- “p” (packages)

```
[member p1048]
[greConstruct p??]
[$includeUnexposed? p??]
```

— defun getBrowseDatabase —

```
(defun |getBrowseDatabase| (kind)
  (let (|$includeUnexposed?|)
    (declare (special |$includeUnexposed?|))
    (setq |$includeUnexposed?| t)
    (when (|member| kind '("o" "k" "c" "d" "p"))
      (|greConstruct| "*" (intern kind))))))
```

—————

70.29 Database

defun Database elt function support

```
[basicMatch? p??]
```

— defun stringMatches? —

```
(defun |stringMatches?| (pattern subject)
  (when (integerp (|basicMatch?| pattern subject)) t))
```

—————

70.30 FileName

defun FileName filename function implementation

```
[StringToDir p1091]
```

— defun fnameMake —

```
(defun |fnameMake| (d n e)
  (if (string= e "") (setq e nil))
  (make-pathname :directory (|StringToDir| d) :name n :type e))
```

—————

defun FileName filename support function

[lastc p??]

— defun StringToDir —

```
(defun |StringToDir| (s)
  (cond
    ((string= s "/") '(:root))
    ((string= s "") nil)
    (t
     (let ((lastc (aref s (- (length s) 1))))
       (if (char= lastc #\)
           (pathname-directory (concat s "name.type"))
           (pathname-directory (concat s "/name.type")) ))) ))
```

—————

defun FileName directory function implementation

[DirToString p1091]

— defun fnameDirectory —

```
(defun |fnameDirectory| (f)
  (|DirToString| (pathname-directory f)))
```

—————

defun FileName directory function support

For example, “/” “/u/smwatt” “../src”

— defun DirToString 0 —

```
(defun |DirToString| (d)
  (cond
    ((equal d '(:root)) "/")
    ((null d) "")
    ('t (string-right-trim "/" (namestring (make-pathname :directory d))))))
```

—————

defun FileName name function implementation

— defun fNameName 0 —

```
(defun |fNameName| (f)
  (let ((s (pathname-name f)))
    (if s s "")))
```

—————

defun FileName extension function implementation

— defun fNameType 0 —

```
(defun |fNameType| (f)
  (let ((s (pathname-type f)))
    (if s s "")))
```

—————

defun FileName exists? function implementation

— defun fNameExists? 0 —

```
(defun |fNameExists?| (f)
  (if (probe-file (namestring f)) 't nil))
```

—————

defun FileName readable? function implementation

— defun fNameReadable? 0 —

```
(defun |fNameReadable?| (f)
  (let ((s (open f :direction :input :if-does-not-exist nil)))
    (cond (s (close s) t) (t nil))))
```

—————

defun FileName writeable? function implementation

[myWritable? p??]

— defun fnameWritable? —

```
(defun |fnameWritable?| (f)
  (|myWritable?| (namestring f)) )
```

—————

defun FileName writeable? function support

[error p??]

[fnameExists? p[1092](#)][fnameDirectory p[1091](#)]

[writeablep p??]

— defun myWritable? —

```
(defun |myWritable?| (s)
  (if (not (stringp s)) (|error| "'myWritable?' requires a string arg. "))
  (if (string= s "") (setq s "."))
  (if (not (|fnameExists?| s)) (setq s (|fnameDirectory| s)))
  (if (string= s "") (setq s "."))
  (if (> (|writeablep| s) 0) 't nil) )
```

—————

defun FileName new function implementation[fnameMake p[1090](#)]

— defun fnameNew —

```
(defun |fnameNew| (d n e)
  (if (not (|myWritable?| d))
      nil
      (do ((fn))
          (nil)
          (setq fn (|fnameMake| d (string (gensym n)) e))
          (if (not (probe-file (namestring fn)))
              (return-from |fnameNew| fn) ) ) )
```

—————

70.31 DoubleFloat

These macros wrap their arguments with strong type information in order to optimize doublefloat computations. They are used directly in the DoubleFloat domain (see Volume 10.3).

defmacro DFLessThan

Compute a strongly typed doublefloat comparison See Steele Common Lisp 1990 p293

— **defmacro DFLessThan** —

```
(defmacro DFLessThan (x y)
  '(< (the double-float ,x) (the double-float ,y)))
```

defmacro DFUnaryMinus

Compute a strongly typed unary doublefloat minus See Steele Common Lisp 1990 p295

— **defmacro DFUnaryMinus** —

```
(defmacro DFUnaryMinus (x)
  '(the double-float (- (the double-float ,x))))
```

defmacro DFMinusp

Compute a strongly typed unary doublefloat test for negative See Steele Common Lisp 1990 p292

— **defmacro DFMinusp** —

```
(defmacro DFMinusp (x)
  '(minusp (the double-float ,x)))
```

defmacro DFZerop

Compute a strongly typed unary doublefloat test for zero See Steele Common Lisp 1990 p292

— **defmacro DFZerop** —

```
(defmacro DFZerop (x)
  '(zerop (the double-float ,x)))
```

defmacro DFAdd

Compute a strongly typed doublefloat addition See Steele Common Lisp 1990 p295

— **defmacro DFAdd** —

```
(defmacro DFAdd (x y)
  '(the double-float (+ (the double-float ,x) (the double-float ,y))))
```

defmacro DFSubtract

Compute a strongly typed doublefloat subtraction See Steele Common Lisp 1990 p295

— **defmacro DFSubtract** —

```
(defmacro DFSubtract (x y)
  '(the double-float (- (the double-float ,x) (the double-float ,y))))
```

defmacro DFMultiply

Compute a strongly typed doublefloat multiplication See Steele Common Lisp 1990 p296

— **defmacro DFMultiply** —

```
(defmacro DFMultiply (x y)
  '(the double-float (* (the double-float ,x) (the double-float ,y))))
```

defmacro DFIntegerMultiply

Compute a strongly typed doublefloat multiplication by an integer. See Steele Common Lisp 1990 p296

— **defmacro DFIntegerMultiply** —


```
(defmacro DFIntegerMultiply (i y)
  '(the double-float (* (the integer ,i) (the double-float ,y))))
```

defmacro DFMax

Choose the maximum of two doublefloats. See Steele Common Lisp 1990 p294

— **defmacro DFMax** —

```
(defmacro DFMax (x y)
  '(the double-float (max (the double-float ,x) (the double-float ,y))))
```

defmacro DFMin

Choose the minimum of two doublefloats. See Steele Common Lisp 1990 p294

— **defmacro DFMin** —

```
(defmacro DFMin (x y)
  '(the double-float (min (the double-float ,x) (the double-float ,y))))
```

defmacro DFEql

Compare two doublefloats for equality, where equality is eq, or numbers of the same type with the same value. See Steele Common Lisp 1990 p105

— **defmacro DFEql** —

```
(defmacro DFEql (x y)
  '(eq (the double-float ,x) (the double-float ,y)))
```

defmacro DFDivide

Divide a doublefloat by a doublefloat See Steele Common Lisp 1990 p296

— **defmacro DFDivide** —

```
(defmacro DFDivide (x y)
  '(the double-float (/ (the double-float ,x) (the double-float ,y))))
```

defmacro DFIntegerDivide

Divide a doublefloat by an integer See Steele Common Lisp 1990 p296

— **defmacro DFIntegerDivide** —

```
(defmacro DFIntegerDivide (x i)
  '(the double-float (/ (the double-float ,x) (the integer ,i))))
```

defmacro DFSqrt

Compute the doublefloat square root of x . The result will be complex if the argument is negative. See Steele Common Lisp 1990 p302

— **defmacro DFSqrt** —

```
(defmacro DFSqrt (x)
  '(sqrt (the double-float ,x)))
```

defmacro DFLogE

Compute the doublefloat log of x with the base e . The result will be complex if the argument is negative. See Steele Common Lisp 1990 p301

— **defmacro DFLogE** —

```
(defmacro DFLogE (x)
  '(log (the double-float ,x)))
```

defmacro DFLog

Compute the doublefloat log of x with a given base b . The result will be complex if x is negative. See Steele Common Lisp 1990 p301

— **defmacro DFLog** —

```
(defmacro DFLog (x b)
  '(log (the double-float ,x) (the fixnum ,b)))
```

defmacro DFIntegerExpt

Compute the doublefloat expt of x with a given integer power i See Steele Common Lisp 1990 p300

— **defmacro DFIntegerExpt** —

```
(defmacro DFIntegerExpt (x i)
  '(the double-float (expt (the double-float ,x) (the integer ,i))))
```

defmacro DFExpt

Compute the doublefloat expt of x with a given power p . The result could be complex if the base is negative and the power is not an integer. See Steele Common Lisp 1990 p300

— **defmacro DFExpt** —

```
(defmacro DFExpt (x p)
  '(expt (the double-float ,x) (the double-float ,p)))
```

defmacro DFExp

Compute the doublefloat exp with power e See Steele Common Lisp 1990 p300

— **defmacro DFExp** —

```
(defmacro DFExp (x)
  '(the double-float (exp (the double-float ,x))))
```

defmacro DFSin

Compute a strongly typed doublefloat sin See Steele Common Lisp 1990 p304

— **defmacro DFSin** —

```
(defmacro DFSin (x)
  '(the double-float (sin (the double-float ,x))))
```

defmacro DFCos

Compute a strongly typed doublefloat cos See Steele Common Lisp 1990 p304

— **defmacro DFCos** —

```
(defmacro DFCos (x)
  '(the double-float (cos (the double-float ,x))))
```

defmacro DFTan

Compute a strongly typed doublefloat tan See Steele Common Lisp 1990 p304

— **defmacro DFTan** —

```
(defmacro DFTan (x)
  '(the double-float (tan (the double-float ,x))))
```

defmacro DFAsin

Compute a strongly typed doublefloat asin. The result is complex if the absolute value of the argument is greater than 1. See Steele Common Lisp 1990 p305

— **defmacro DFAsin** —

```
(defmacro DFAsin (x)
  '(asin (the double-float ,x)))
```

defmacro DFAcos

Compute a strongly typed doublefloat acos. The result is complex if the absolute value of the argument is greater than 1. See Steele Common Lisp 1990 p305

— **defmacro DFAcos** —

```
(defmacro DFAcos (x)
  '(acos (the double-float ,x)))
```

defmacro DFAtan

Compute a strongly typed doublefloat atan See Steele Common Lisp 1990 p305

— **defmacro DFAtan** —

```
(defmacro DFAtan (x)
  '(the double-float (atan (the double-float ,x))))
```

defmacro DFAtan2

Compute a strongly typed doublefloat atan with 2 arguments

$y = 0$	$x > 0$	Positive x-axis	0
$y > 0$	$x > 0$	Quadrant I	$0 < \text{result} < \pi/2$
$y > 0$	$x = 0$	Positive y-axis	$\pi/2$
$y > 0$	$x < 0$	Quadrant II	$\pi/2 < \text{result} < \pi$
$y = 0$	$x < 0$	Negative x-axis	π
$y < 0$	$x < 0$	Quadrant III	$-\pi < \text{result} < -\pi/2$
$y < 0$	$x = 0$	Negative y-axis	$-\pi/2$
$y < 0$	$x > 0$	Quadrant IV	$-\pi/2 < \text{result} < 0$
$y = 0$	$x = 0$	Origin	error

See Steele Common Lisp 1990 p306

— **defmacro DFAtan2** —

```
(defmacro DFAtan2 (y x)
  '(the double-float (atan (the double-float ,x) (the double-float ,y))))
```

defmacro DFSinh

Compute a strongly typed doublefloat sinh

$$(e^z - e^{-z})/2$$

See Steele Common Lisp 1990 p308

— **defmacro DFSinh** —

```
(defmacro DFSinh (x)
  '(the double-float (sinh (the double-float ,x))))
```

defmacro DFCosh

Compute a strongly typed doublefloat cosh

$$(e^z + e^{-z})/2$$

See Steele Common Lisp 1990 p308

— **defmacro DFCosh** —

```
(defmacro DFCosh (x)
  '(the double-float (cosh (the double-float ,x))))
```

defmacro DFTanh

Compute a strongly typed doublefloat tanh

$$(e^z - e^{-z})/(e^z + e^{-z})$$

See Steele Common Lisp 1990 p308

— **defmacro DFTanh** —

```
(defmacro DFTanh (x)
  '(the double-float (tanh (the double-float ,x))))
```

defmacro DFAsinh

Compute the inverse hyperbolic sin.

$$\log \left(z + \sqrt{1 + z^2} \right)$$

See Steele Common Lisp 1990 p308

— **defmacro DFAsinh** —

```
(defmacro DFAsinh (x)
  '(the double-float (asinh (the double-float ,x))))
```

defmacro DFAcosh

Compute the inverse hyperbolic cos. Note that the acosh function will return a complex result if the argument is less than 1.

$$\log \left(z + (z + 1) \sqrt{(z - 1)/(z + 1)} \right)$$

See Steele Common Lisp 1990 p308

— **defmacro DFAcosh** —

```
(defmacro DFAcosh (x)
  '(acosh (the double-float ,x)))
```

defmacro DFAtanh

Compute the inverse hyperbolic tan. Note that the acosh function will return a complex result if the argument is greater than 1.

$$\log \left((1 + z) \sqrt{1/(1 - z^2)} \right)$$

See Steele Common Lisp 1990 p308

— **defmacro DFAtanh** —

```
(defmacro DFAtanh (x)
  '(atanh (the double-float ,x)))
```

defun Machine specific float numerator

This is used in the DoubleFloat integerDecode function

— **defun integer-decode-float-numerator 0** —

```
(defun integer-decode-float-numerator (x)
  (integer-decode-float x))
```

defun Machine specific float denominator

This is used in the DoubleFloat integerDecode function

— **defun integer-decode-float-denominator 0** —

```
(defun integer-decode-float-denominator (x)
  (multiple-value-bind (mantissa exponent sign) (integer-decode-float x)
    (declare (ignore mantissa sign)) (expt 2 (abs exponent)))))
```

defun Machine specific float sign

This is used in the DoubleFloat integerDecode function

— **defun integer-decode-float-sign 0** —

```
(defun integer-decode-float-sign (x)
  (multiple-value-bind (mantissa exponent sign) (integer-decode-float x)
    (declare (ignore mantissa exponent)) sign))
```

defun Machine specific float bit length

This is used in the DoubleFloat integerDecode function

— **defun integer-decode-float-exponent 0** —

```
(defun integer-decode-float-exponent (x)
  (multiple-value-bind (mantissa exponent sign) (integer-decode-float x)
    (declare (ignore mantissa sign)) exponent))
```

defun Decode floating-point values

This function is used by DoubleFloat to implement the “mantissa” and “exponent” functions.

— **defun manexp 0** —

```
(defun manexp (u)
  (multiple-value-bind (f e s)
    (decode-float u)
    (cons (* s f) e)))
```

defun The cotangent routine

The cotangent function is defined as

$$\cot(z) = \frac{1}{\tan(z)}$$

— defun cot 0 —

```
(defun cot (a)
  (if (or (> a 1000.0) (< a -1000.0))
      (/ (cos a) (sin a))
      (/ 1.0 (tan a))))
```

defun The inverse cotangent function

The inverse cotangent (arc-cotangent) function is defined as

$$\operatorname{acot}(z) = \cot^{-1}(z) = \tan^{-1}\left(\frac{1}{z}\right)$$

See Steele Common Lisp 1990 pp305-307

— defun acot 0 —

```
(defun acot (a)
  (if (> a 0.0)
      (if (> a 1.0)
          (atan (/ 1.0 a))
          (- (/ pi 2.0) (atan a)))
      (if (< a -1.0)
          (- pi (atan (/ -1.0 a)))
          (+ (/ pi 2.0) (atan (- a))))))
```

defun The secant function

$$\sec(x) = \frac{1}{\cos(x)}$$

— defun sec 0 —

```
(defun sec (x) (/ 1 (cos x)))
```

defun The inverse secant function

$$\operatorname{asec}(x) = \operatorname{acos}\left(\frac{1}{x}\right)$$

— defun asec 0 —

```
(defun asec (x) (acos (/ 1 x)))
```

defun The cosecant function

$$\operatorname{csc}(x) = \frac{1}{\sin(x)}$$

— defun csc 0 —

```
(defun csc (x) (/ 1 (sin x)))
```

defun The inverse cosecant function

$$\operatorname{acsc}(x) = \frac{1}{\operatorname{asin}(x)}$$

— defun acsc 0 —

```
(defun acsc (x) (asin (/ 1 x)))
```

defun The hyperbolic cosecant function

$$csch(x) = \frac{1}{sinh(x)}$$

— defun csch 0 —

```
(defun csch (x) (/ 1 (sinh x)))
```

—————

defun The hyperbolic cotangent function

$$coth(x) = cosh(x)csch(x)$$

— defun coth 0 —

```
(defun coth (x) (* (cosh x) (csch x)))
```

—————

defun The hyperbolic secant function

$$sech(x) = \frac{1}{cosh(x)}$$

— defun sech 0 —

```
(defun sech (x) (/ 1 (cosh x)))
```

—————

defun The inverse hyperbolic cosecant function

$$acsch(x) = asinh\left(\frac{1}{x}\right)$$

— defun acsch 0 —

```
(defun acsch (x) (asinh (/ 1 x)))
```

defun The inverse hyperbolic cotangent function

$$acoth(x) = atanh\left(\frac{1}{x}\right)$$

— defun acoth 0 —

```
(defun acoth (x) (atanh (/ 1 x)))
```

defun The inverse hyperbolic secant function

$$asech(x) = acosh\left(\frac{1}{x}\right)$$

— defun asech 0 —

```
(defun asech (x) (acosh (/ 1 x)))
```

Chapter 71

OpenMath

71.1 A Technical Overview[4]

OpenMath is a standard for representing mathematical data in as unambiguous a way as possible. It can be used to exchange mathematical objects between software packages or via email, or as a persistent data format in a database. It is tightly focussed on representing semantic information and is not intended to be used directly for presentation, although tools exist to facilitate this.

The original motivation for OpenMath came from the Computer Algebra community. Computer Algebra packages were getting bigger and more unwieldy, and it seemed reasonable to adopt a generic "plug and play" architecture to allow specialised programs to be used from general purpose environments. There were plenty of mechanisms for connecting software components together, but no common format for representing the underlying data objects. It quickly became clear that any standard had to be vendor-neutral and that objects encoded in OpenMath should not be too verbose. This has led to the design outlined below.

In 1998, the Worldwide Web Consortium (W3C) produced its first recommendation for the Extensible Markup Language (XML), intended to be a universal format for representing structured information on the worldwide web. It was swiftly followed by the first MathML recommendation which is an XML application oriented mainly towards the presentation (i.e. the rendering) of mathematical expressions.

The formal definition of OpenMath is contained within The OpenMath Standard and its accompanying documents, and the reader is referred there for more details.

The OpenMath Architecture

The OpenMath representation of a mathematical structure is referred to as an OpenMath object. This is an abstract structure which is represented concretely via an OpenMath encoding. These encoded objects are what an OpenMath application would read and write,

and in practice the OpenMath objects themselves almost never exist, except on paper. The advantage of this is that OpenMath is not tied to any one underlying mechanism: in the past we have used functional, SGML and binary encodings. The current favourite is XML, as described below, and we will tend to use XML notation when describing OpenMath objects (even though strictly speaking the XML representation is an encoding). OpenMath Objects

Formally, an OpenMath object is a labelled tree whose leaves are the basic OpenMath objects integers, IEEE double precision floats, unicode strings, byte arrays, variables or symbols. Of these, symbols are the most interesting since they consist of a name and a reference to a definition in an external document called a content dictionary (or CD). Using XML notation where the element name OMS indicates an OpenMath symbol, the following:

```
<OMS name="sin" cd="transc1"/>
```

represents the usual sine function, as defined in the CD "transc1". A basic OpenMath object is an OpenMath object, although its XML representation will be:

```
<OMOBJ>
  <OMS name="sin" cd="transc1"/>
</OMOBJ>
```

OpenMath objects can be built up recursively in a number of ways. The simplest is function application, for example the expression $\sin(x)$ can be represented by the XML:

```
<OMOBJ>
  <OMA>
    <OMS name="sin" cd="transc1"/>
    <OMV name="x"/>
  </OMA>
</OMOBJ>
```

where OMV introduces a variable and OMA is the application element. Another straightforward method is attribution which as the name suggests can be used to add additional information (for example "the AXIOM command which generated me was ...") to an object without altering its fundamental meaning. More interesting are binding objects which are used to represent an expression containing bound variables, for example:

```
<OMOBJ>
  <OMA>
    <OMS cd="calculus1" name="int"/>
    <OMS cd="transc1" name="sin"/>
  </OMA>
</OMOBJ>
```

represents the integral of the sin function, but the encoding:

```
<OMOBJ>
  <OMA>
```

```

<OMS cd="calculus1" name="int"/>
<OMBIND>
  <OMS cd="fns1" name="lambda"/>
  <OMBVAR> <OMV name="x"/> </OMBVAR>
  <OMA>
    <OMS name="sin" cd="transc1"/>
    <OMV name="x"/>
  </OMA>
</OMBIND>
</OMA>
</OMOBJ>

```

represents $\sin(x)dx$. This may appear overly complicated but it is useful, for example when searching in a database for expressions which match $\sin(y)dy$. The definition of a symbol in the CD specifies whether or not it may be used to bind variables, which is why

```
<OMS cd="calculus1" name="int"/>
```

cannot be used as a binding symbol.

The final kind of OpenMath object is an error which is built up from a symbol describing the error and a sequence of OpenMath objects. For example:

```

<OMOBJ>
  <OME>
    <OMS name="unexpected_symbol" cd="error1">
    <OMS name="sine" cd="transc1">
  </OME>
</OMOBJ>

```

represents the error which might be generated when an application sees a symbol it doesn't recognise from a CD it thought it knew about.

OpenMath Encodings

We have already seen some examples of the XML encoding, but it is by no means the only encoding. In the past there was a functional encoding (which looked like Lisp) and an SGML encoding which evolved into the current XML. Both of these are now obsolete, but there is still a binary encoding described in the standard, which is much more compact than the XML one.

In fact the XML encoding is not 100% XML. When XML was in its infancy the developers of OpenMath realised that it might become significant and decided to add some XML-like features to the SGML encoding so that an OpenMath object could be encoded as valid XML. Thus it is currently the case that any well-formed OpenMath object encoded using the XML encoding as described in the standard is a valid XML document. However, if one uses standard XML tools to generate an OpenMath object in the XML encoding from the DTD given in chapter 4 of the standard, it is possible that the result will not be valid OpenMath,

although in practice this is highly unlikely. To cover all the possibilities allowed by XML would make it much more complicated to write an application to read any OpenMath object from scratch. Whether to adopt XML completely remains a hot topic of debate within the OpenMath community!

Generally speaking, it is not intended that the existing encodings should be readable by a human user or writable by hand. It is desirable that they be compact and it is also desirable that they be linear, but neither of these is a requirement. It is a property of encodings that it is possible to convert between them with no loss of information.

Content Dictionaries

Content Dictionaries (or CDs for short) are the most important, and the most interesting, aspect of OpenMath because they define the meaning of the objects being transmitted. A CD is a collection of related symbols and their definitions, encoded in an XML format. Defining the meaning of a symbol is not a trivial task, and even referring to well-known references can be fraught with pitfalls. Formal definitions and properties can be very useful but time-consuming to produce and verbose, not to mention difficult to get right. A symbol definition in an OpenMath CD consists of the following pieces of information:

- the symbol name;
- a description in plain text;
- optionally, a set of this symbol's properties in plain text
(Commented Mathematical Properties, or CMPs);
- optionally, a set of this symbol's properties encoded in OpenMath
(Formal Mathematical Properties, or FMPs);
- optionally, one or more examples of its use (encoded in OpenMath).

In practice the CMPs and FMPs can come as pairs, and often serve in the place of examples.

A very simple instance of a CD definition is:

```
<CDDefinition>
<Name> log </Name>

<Description>
This symbol represents a binary log function; the first argument is
the base, to which the second argument is log'ed.
It is defined in Abramowitz and Stegun, Handbook of Mathematical
Functions, section 4.1
</Description>
<CMP>
  a^b = c implies log_a c = b
</CMP>
<FMP>
  <OMOBJ>
    <OMA>
      <OMS cd="logic1" name="implies"/>
    </OMA>
  </OMOBJ>
</FMP>
</CDDefinition>
```

```

    <OMS cd="relation1" name="eq"/>

    <OMA>
      <OMS cd="arith1" name="power"/>
      <OMV name="a"/>
      <OMV name="b"/>
    </OMA>
    <OMV name="c"/>
  </OMA>
</OMA>
<OMS cd="relation1" name="eq"/>

  <OMA>
    <OMS cd="transc1" name="log"/>
    <OMV name="a"/>
    <OMV name="c"/>
  </OMA>
  <OMV name="b"/>
</OMA>
</OMA>
</OMOBJ>

</FMP>

<Example>
log 100 to base 10 (which is 2).
<OMOBJ>
  <OMA>
    <OMS cd="transc1" name="log"/>
    <OMF dec="10"/>
    <OMF dec="100"/>
  </OMA>
</OMOBJ>
</Example>

</CDDefinition>

```

Another example would be to print the list

[1, 1/2]

as

```

<OMOBJ>
  <OMA>
    <OMS cd="list1" name="list"/>
    <OMI>1</OMI>
  </OMA>
  <OMS cd="nums1" name="rational"/>
  <OMI>1</OMI>

```

```

    <OMI>2</OMI>
  </OMA>
</OMA>
</OMOBJ>

```

This provides a symbol to represent the log function by giving a pointer to a standard reference book. It provides the property that:

$$a^b = c \rightarrow \log_a(c) = b$$

both as plain text and as OpenMath, and also gives an example of how the symbol is used.

CDs usually consist of related symbols and collections of related CDs can be grouped together, for convenience, as CD Groups. One very important CD Group is that corresponding to the content part of MathML.

It is possible to associate extra information with CDs, in particular type information. Since there are many type systems available, each of which has its own strengths and advocates, the OpenMath community does not mandate any single system. Simple signatures can be encoded using the Simple Type System, while more formal definitions are possible using the Extended Calculus of Constructors. Other associated information can include style sheets for rendering OpenMath symbols in MathML, and mathematical definitions to be used by formal logic systems.

Given the evolutionary nature of mathematics, it is clear that the set of CDs should be forever growing and never complete. Currently there are CDs for high-school mathematics, linear algebra, polynomials and group theory to name a few, and new contributions are always welcome. There is no requirement that applications use the standard set of CDs and it is often very useful to design a "private" CD for a specific purpose.

OpenMath in Action

There is no definitive way in which OpenMath should be used, as the protocol has been designed to be as flexible as possible. Nevertheless many OpenMath applications share common characteristics which we shall discuss here.

Suppose that we wish to have two applications communicating by sending OpenMath objects to each other, e.g. a client program and a computational server. It is unlikely that the internal data structures used by the applications will be OpenMath, and so translation between the internal representations and OpenMath (almost certainly OpenMath encodings rather than objects) will have to take place. The piece of software which does this is usually referred to as a phrase-book.

It is possible to write a generic phrase-book which can handle any piece of OpenMath, but applications where this makes sense are few and far between. In practice an OpenMath phrase book will usually only handle a fixed set of CDs (and hence a fixed set of symbols). What "handle" means will vary from case to case: a computer algebra system will usually try and evaluate its input and return a result or an error, while a typesetter will print its input according to some rendering rules and not return anything. OpenMath carefully avoids

defining what the “right” behaviour is in a given circumstance, and leaves that up to the phrase-book writer. Indeed it is quite possible that a piece of software could have multiple phrase-books associated with it for different purposes. OpenMath symbols should not be regarded as verbs since they are used to construct objects rather than to send commands, and the presence of both nouns and verbs in a CD (e.g. “integral” and “integrate”) is strongly discouraged.

Writing a phrase-book may be non-trivial, and requires an understanding of the semantics of the underlying software. An OpenMath object may not map directly into a private object and vice-versa, for example in some systems a rational number might have to be represented by a float, or a sparse matrix by a dense one.

The OpenMath standard includes a section on compliance, which describes the behaviour of an OpenMath application when certain errors occur. It also insists that all compliant software has the capability to use the XML encoding, to guarantee a degree of interoperability. This is an area where the standard is expected to evolve as more OpenMath applications become available.

71.2 Technical Details[3]

This chapter describes the Axiom implementation of the OpenMath project at INRIA [3]. The code enables the exchange of OpenMath objects between two processes and more generally the input and output of OpenMath objects. First we describe the library API and then we implement the functions used by Axiom.

71.3 The Structure of the API

The library and its API are logically structured in four parts:

- Functions that deal with *devices*, the abstraction from which OpenMath objects are read and written to.
- Functions that read from and write to OpenMath devices. These functions use a simple model that read and write tokens.
- Functions that create I/O structures to be used by devices, so that, for example, an OpenMath object can be read from a file or a socket. This part is extensible by the user.
- Functions that deal with interprocess communication.

71.4 OpenMath Expressions

Expressions

The library understands the following kinds of basic OpenMath expressions:

- integers
- double precision floating-point numbers (64 bits, following IEEE 754)
- byte arrays
- character strings
- symbols
- variables

and the four kinds of constructions:

- applications $e_0(e_1, \dots, e_n)$
- errors $s(e_1, \dots, e_n)$
- binders $e_1, (v_1, \dots, v_n), e_2$
- attributed expressions $[s_1 e_1, \dots, s_n e_n] e$

where e_i are OpenMath expressions, v_i are OpenMath variables and s and s_i are OpenMath symbols.

Symbols

Symbols are constructed from a content dictionary (abbreviated as CD in the sequel) and a name. A content dictionary is identified by its name. The API permits the creation of any symbol in any content dictionary: there is nothing that prevents creating symbols that do not belong to a known CD.

Encoding and Decoding OpenMath Expressions

An OpenMath object is encoded as a sequence of bytes that is read and written sequentially. The library views this sequence as a stream of tokens. Expressions are linearized in a way that looks like Lisp with typed parenthesis. For example, the linearization of the application of S to $E_1 \dots E_n$ is:

- indicating that this is an application (a “begin application” token)
- linearizing S

- linearizing E_1, \dots, E_n
- indicating that all arguments have been given (an “end application” token)

The other constructions are linearized the same way (each one with its own begin and end tokens). Note that there is no explicit arity indication so that we don’t have to introduce a special mechanism when we don’t know beforehand how many arguments there are.

To give attributes to an expression, the attributes and their associated values are put before the expression. To give the attributes a_i with values v_i (where a_i are symbols and v_i are OpenMath expressions) to an expression E the process is:

- put a “begin attributed expression” token
- put a “begin attribute pairs” token
- put the symbol a_1 followed by the linearization of v_1 etc
- put an “end attribute pairs” token
- linearize E
- put an “end attributed expression” token

Decoding is done by first querying the type of the next OpenMath token and then invoking the right function to get this particular kind of token.

71.5 Big Integers

The library supports big integers that can potentially be given in various formats. The `OMBigIntType` describes the different possible formats.

```
typedef enum OMBigIntType {
    OMBIunknown = 0, /* this is base 10, digits in normal order */
    OMBIbase10      /* this is base 16, digits in normal order (MSB) */
    OMBigIntBase16
} OMBigIntType;
```

71.6 Functions Dealing with OpenMath Devices

OpenMath expressions are read and written through *devices*. Basically, an OpenMath device has an associated encoding and an I/O method. There are basically two encodings defined and implemented. The first one is a human readable and writable one that can be used for example as the encoding for sending OpenMath objects via e-mail or storing OpenMath objects to files. This encoding is SGML compatible in the sense that it can be used to represent OpenMath objects in SGML texts. I has an XML variant. The second encoding

is a binary one that can be used when compactness and speed of encoding and decoding is important. The encodings are defined by the `OMencodingType` type which is an enumerated type defined as

```
typedef enum OMencodingType
{
    OMencodingUnknown,
    OMencodingBinary,
    OMencodingSGML,
    OMencodingXML
} OMencodingType;
```

`OMencodingUnknown` is to be used when creating a device that does not know which kind of encoding will be used. It must be used only for input devices.

A device is created with the following function, given an encoding and an appropriate I/O method:

- `OMdev OMmakeDevice(OMencodingType encoding, OMIO IO)`

Devices are closed with the following function

- `void OMcloseDevice(OMdev dev)`

Whether a device could be used both for reading and writing is entirely dependent on its I/O method.

The user can define its own I/O method as a function returning an `OMIO` object. This could enable him, for example, to use an existing transport protocol to exchange OpenMath expressions or to implement cut-and-paste of OpenMath expression by writing I/O structures that input and output to strings. The I/O section describes the available I/O structures in the library.

An `OMdev` object is a pointer to a structure that contains a lot of state. Almost all functions taking an `OMdev` object modify it. Likewise, an `OMIO` object carries a lot of state.

71.7 Functions to Write OpenMath Expressions to Devices

Beginning and Ending Objects

The following two functions mark the beginning and end of an OpenMath object.

- `OMstatus OMputObject(OMdev dev)`
- `OMstatus OMputEndObject(OMdev dev)`

These functions should be called before and after an OpenMath object is constructed in a device. In particular, the `OMputEndObject` function insures that the object has been completely written if any buffering was used.

Writing Basic Objects

Basic OpenMath objects are written using these functions:

- `OMstatus OMputInt32(OMdev dev, int n)`
- `OMstatus OMputBigInt(OMdev dev, const char *data, int len, int sign, OMbigIntType format)`
- `OMstatus OMputFloat64(OMdev dev, double *f)`
- `OMstatus OMputByteArray(OMdev dev, const char *data, int len)`
- `OMstatus OMputString(OMdev dev, const char *s)`
- `OMstatus OMputVar(OMdev dev, const char *name)`
- `OMstatus OMputSymbol(OMdev dev, const char *cd, const char *name)`

The `char *` arguments of `OMputString`, `OMputVar` and `OMputSymbol` are null-terminated strings. There are other functions that accept non null-terminated arrays of characters with their length. These are

- `OMstatus OMputStringN(OMdev dev, const char *str, int len)`
- `OMstatus OMputVarN(OMdev dev, const char *var, int len)`
- `OMstatus OMputSymbolN(OMdev dev, const char *cd, int clen, const char *name, int nlen)`

The format for the `data` argument of the `OMputBigInt` function is given by `format`. When `format` is `OMBIbase10`, it is the sequence of character of its base 10 representation without sign (most significant digit first). The sign of the big integer is given by the `sign` argument that should be an integer greater or equal to zero for a positive integer and less than zero for a negative one. For example, the following line outputs the value of $20!$ to `dev`:

```
OMputBigInt(dev, "265252859812191058636308480000000", 33, 1, OMBIbase10);
```

Writing Structured Objects

The following functions are used to mark the beginning and end of the structured objects. They should be called in nested pairs, correctly bracketed:

- `OMstatus OMputApp(OMdev dev)`
- `OMstatus OMputEndApp(OMdev dev)`
- `OMstatus OMputAttr(OMdev dev)`
- `OMstatus OMputEndAttr(OMdev dev)`

- `OMstatus OMputBind(OMdev dev)`
- `OMstatus OMputEndBind(OMdev dev)`
- `OMstatus OMputBVar(OMdev dev)`
- `OMstatus OMputEndBVar(OMdev dev)`
- `OMstatus OMputAtp(OMdev dev)`
- `OMstatus OMputEndAtp(OMdev dev)`
- `OMstatus OMputError(OMdev dev)`
- `OMstatus OMputEndError(OMdev dev)`

Here is an example showing how to use these functions to output $\sin x + y$, where x and y are represented as variables and \sin is the symbol whose name is `sin` in the `Basic` content dictionary. This can be done using the following sequence:

```
OMputObject(dev);
OMputApp(dev);
  OMputSymbol(dev, "Basic", "sin");
  OMputApp(dev)
    OMputSymbol(dev, "Basic", "+");
    OMputVar(dev, "x");
    OMputVar(dev, "y");
  OMputEndApp(dev);
OMputEndApp(dev);
OMputEndObject(dev);
```

71.8 Functions to Extract OpenMath Expressions from Devices

Testing the type of the current token

The first step in decoding an expression from a device is to call the `OMgetType` function

- `OMstatus OMgetType(OMdev dev, OMtokenType *type)`

so that the correct function can be called to recover the current token.

`OMgetType` returns via its `type` argument an `OMtokenType` object indicating the type of the next object to be read from the device. `OMtokenType` is an enumerated type defined as

```
typedef enum OMtokenType {
  OMtokenUnknown, /* error catching trick */
  OMtokenInt32,
```

```

OMtokenBigInt,
OMtokenFloat64,
OMtokenByteArray,
OMtokenVar,
OMtokenString,
OMtokenSymbol,
OMtokenComment,
OMtokenApp,    OMtokenEndApp,
OMtokenAttr,   OMtokenEndAttr,
OMtokenAtp,    OMtokenEndAtp,
OMtokenError,  OMtokenEndError,
OMtokenObject, OMtokenEndObject,
OMtokenBind,   OMtokenEndBind,
OMtokenBVar,   OMtokenEndBVar,
} OMTokenType;

```

Note that the type of the current token can be tested multiple times. Two successive calls to `OMgetType` will always return the same result if no other `OMget...` function was called in between.

Extracting the current token

The following functions are used to read the basic OpenMath objects from devices:

- `OMstatus OMgetInt32(OMdev dev, int *i)`
- `OMstatus OMgetFloat64(OMdev dev, double *d)`
- `OMstatus OMgetBigInt(OMdev dev, char **data, int *len, int *sign, OMbigIntType *fmt)`
- `OMstatus OMgetBigIntN(OMdev dev, char *data, int len, int *sign, OMbigIntType *fmt)`
- `OMstatus OMgetByteArray(OMdev dev, char **data, int *len)`
- `OMstatus OMgetByteArrayN(OMdev dev, char *data, int len)`
- `OMstatus OMgetString(OMdev dev, char **str)`
- `OMstatus OMgetStringN(OMdev dev, char *str, int len)`
- `OMstatus OMgetVar(OMdev dev, char **var)`
- `OMstatus OMgetVarN(OMdev dev, char *var, int len)`
- `OMstatus OMgetSymbol(OMdev dev, char **cd, char **name)`
- `OMstatus OMgetSymbolN(OMdev dev, char *cd, int clen, char *name, int nlen)`

The functions that return variable size data exist in two versions. A simple version that does the necessary memory allocation itself (using `OMmalloc`) and a version (suffixed with `N`) that lets the user do the allocation itself. The size of the needed area can be determined with the following function:

- `int OMgetLength(OMdev dev)` returns the length of the next object.

that works for big integers, byte arrays, strings and variables. For symbols, the following function returns both the length of the content dictionary name and the length of the symbol name:

- `OMstatus OMgetSymbolLength(OMdev dev, int *clen, int *nlen)`

When the current token does not carry any data i.e. when `OMgetType` returns a marker, i.e. one of:

- `OMtokenApp,`
- `OMtokenEndApp,`
- `OMtokenAttr,`
- `OM tokenEndAttr,`
- `OMtokenAtp,`
- `OMtokenEndAtp,`
- `OMtokenError,`
- `OMtokenEndError,`
- `OMtokenObject,`
- `OMtokenEndObject,`
- `OMtokenBind,`
- `OMtokenEndBind,`
- `OMtokenBVar`
- `OMtokenEndBVar`

it is necessary to call the correct function to remove the marker. The available functions are

- `OMstatus OMgetObject(OMdev dev)`
- `OMstatus OMgetEndObject(OMdev dev)`
- `OMstatus OMgetApp(OMdev dev)`

- OMstatus OMgetEndApp(OMdev dev)
- OMstatus OMgetAttr(OMdev dev)
- OMstatus OMgetEndAttr(OMdev dev)
- OMstatus OMgetAtp(OMdev dev)
- OMstatus OMgetEndAtp(OMdev dev)
- OMstatus OMgetBind(OMdev dev)
- OMstatus OMgetEndBind(OMdev dev)
- OMstatus OMgetBVar(OMdev dev)
- OMstatus OMgetEndBVar(OMdev dev)
- OMstatus OMgetError(OMdev dev)
- OMstatus OMgetEndError(OMdev dev)

All the previous functions return OMsuccess when they succeed. When they return something else, there has been a problem such as calling the wrong function (OMgetApp when there is not a “beginning of application” mark) or a system error.

The sequence of calls to read an expression is thus completely similar (if we omit the calls to OMgetType) to the sequence of calls to write the expression. For example, the previous expression $(\sin x + y)$ can be recovered via the sequence:

```
OMgetObject(dev);
OMgetApp(dev);
  OMgetSymbol(dev, ...);
  OMgetApp(dev);
    OMgetSymbol(dev, ...);
    OMgetVar(dev, ...);
    OMgetVar(dev, ...);
  OMgetEndApp(dev);
OMgetEndApp(dev);
OMgetEndObject(dev);
```

OMgetInt32(OMdev dev, int *i) returns the integer through its i argument.

```
OMgetBigInt(OMdev dev, char **data, int *len, int *sign, OMbigIntType *fmt)
```

returns the data corresponding to the big integer in data, its length in len, its sign in sign and its format in fmt.

```
OMgetBigIntN(OMdev dev, char *data, int len, int *sign, OMbigIntType *fmt)
```

copies the data corresponding to the big integer in **data** buffer that should be (at least) **len** characters long. The sign and format are returned in the **sign** and **fmt** arguments.

OMgetByteArray(OMdev dev, char **data, int *len) returns the byte array through its **data** argument. Its length is returned via the **len** argument.

OMgetByteArrayN(OMdev dev, char *data, int len) copies the byte array in the **data** buffer that should be (at least) **len** characters long.

OMgetString(OMdev dev, char **str) returns the string through its **str** argument.

OMgetStringN(OMdev dev, char *str, int len) copies the string in the **str** buffer whose length should be (at least) **len**. If **len** is greater than the actual length of the string, a null character is added at the end of **str**.

OMgetVar(OMdev dev, char **var) returns the name of the variable (as a null-terminated string) in its **var** argument

OMgetVarN(OMdev dev, char *var, int len) copies the name of the variable in the **var** buffer, whose length should be (at least) **len**. If **len** is greater than the actual length of the variable name, a null character is added at the end of **var**.

OMgetSymbol(OMdev dev, char **cd, char **name) returns the content dictionary and the name of the symbol through the **cd** and **name** arguments.

OMgetSymbolN(OMdev dev, char *cd, int clen, char *name, int nlen) copies the content dictionary and the name of the symbols in the **cd** and **name** buffers. **cd** should be at least **clen** character long and **name** should be at least **nlen** long. When there is enough room (based on **clen** or **nlen**) a null character is added after the last character of the name (**cd** or **name**).

71.9 Comments in the SGML/XML Encodings

The library can also output and read comments (SGML/XML comments) with the following functions:

- **OMstatus OMputComment**(OMdev dev, char *comment)
- **OMstatus OMputCommentN**(OMdev dev, char *comment, int len)
- **OMstatus OMgetComment**(OMdev dev, char **comment)
- **OMstatus OMgetCommentN**(OMdev dev, char *comment, int len)

By default, comments are silently ignored by the library when reading OpenMath objects (and writing them using the binary encoding). The function

- **OMbool OMignoreComment**(OMdev dev, OMbool set)

changes this behaviour. When called with **OMfalse**, comments are passed to the application: the **OMgetType** function will return **OMtokenComment** when the current token is a comment and the **OMgetComment** or **OMgetCommentN** functions should be used to get the comments. When **OMignoreComment** is called with **OMtrue**, comments are ignored.

71.10 I/O Functions for Devices

We provide four functions that produce `OMIO` objects for devices. These functions provide I/O through the `stdio` library (on `FILE` object), file descriptors and character strings.

- `OMIO OMmakeIOFile(FILE *f)` associates the device with the file pointer `f`.
- `OMIO OMmakeIOfd(int fd)` associates the device with the file descriptor `fd`.
- `OMIO OMmakeIOHandle(HANDLE handle)` associates the device with a file handle *Windows specific version of `OMmakeIOfd().fd`.
- `OMIO OMmakeIOString(char **s)` associates the device with a string.

For example, the following code opens a device that reads from standard input:

```
dev = OMmakeDevice(OMencodingSGML, OMmakeIOFile(stdin));
```

The `OMmakeIOString` builds an input device that reads from a string or an output device that writes to a string. For input, `s` must point to a character string (null terminated). For output, `s` will point to a string allocated by the library (note that the string `s` points to can be reallocated by the library).

71.11 Communications

A communication layer can be put above the device layer. In fact, the I/O structure in a device provides all the necessary support to use any transmission or communication means. This library directly provides some connection-oriented, client-server facilities (based on TCP).

A set of functions are used to set up connections. Connections are described by the `OMconn` type. An `OMconn` is a (pointer to a) structure with two user-accessible fields `in` and `out`. `in` is a pointer to a device to be used for input. `out` is pointer to a device to be used for output. These devices use the binary encoding.

An `OMconn` object is made with the following function:

- `OMconn OMmakeConn(int timeout)`

where `timeout` is a timeout for the connection, expressed in milliseconds.

- `OMdev OMconnIn(OMconn conn)` returns the input device associated with the connection.
- `OMdev OMconnOut(OMconn conn)` returns the output device associated with the connection.

Functions to Initiate an OMconn

The functions we provide can be divided in two classes. The first one simply establishes an interprocess communication using IP addresses. The second one provides functions that can be used to launch a server. The addresses used are then generated by the library.

Simple Connections Functions

The following functions allow a client OpenMath application to contact an OpenMath server at a specified address:

- `OMstatus OMconnTCP(OMconn conn, char *machine, int port)`
- `OMstatus OMconnUnix(OMconn conn, char *file)`

These functions first physically establish the connection. Then, they enter negotiation with the server (they send the first message). When they return, the negotiation is finished and the devices in the `conn` argument are ready.

On the server side, the following functions provide bindings at specified addresses and take care of the negotiation:

- `OMstatus OMbindTCP(OMconn conn, int port)`
- `OMstatus OMbindUnix(OMconn conn, char *file)`

All four the previous functions block until the connection is established (and negotiation is over) or the timeout of the `conn` argument is reached.

The following function returns the file descriptor associated with a device. This is intended to be used when there is a need to poll the device (through the `select` or `poll` system calls).

- `OMdeviceFd(OMdev dev)`

Functions that Launch Servers

These functions provide the same functionalities for launching a server that were provided in the ASAP library.

In this model, the client calls `OMlaunch` with a machine name `mach` and a string `cmd` that is executed via `rsh` on machine `mach` as a shell command line. This command is supposed to launch the server program. The command is executed in an environment (in the UNIX sense) where some variables are associated with an address on the machine that runs the client. The server can then connect to the client with the `OMserveClient` function.

If the machine name is `localhost`, the command is started on the same machine (without calling `rsh`).

- `OMstatus OMlaunchEnv(OMconn conn, char *machine, char *command, char *env)`

- `OMstatus OMlaunch(OMconn conn, char *machine, char *command)`
- `OMstatus OMserveClient(OMconn conn)`

The environment variables sent to the server (launched program) are `OM_CALLER_UNIX_SOCKET` (when a local connection is required) and `OM_CALLER_MACHINE` and `OM_CALLER_PORT` (for internet connections).

The `OMlaunchEnv` function enables the command to be run with a particular environment (in the UNIX sense). For example to run a `plot` server on the `kama` machine, we could use a piece of code such as

```
conn = OMmakeConn(2000);
OMlaunchEnv(conn, "kama", "plot", "DISPLAY=rati:0 PATH=/users/bin");
```

Termination

- `OMstatus OMconnClose(OMconn conn)`

71.12 Parameters

The library internally uses three functions that can be supplied by the user.

- `extern void *(*OMmalloc) (size_t size)`
- `extern void *(*OMrealloc) (void *ptr, size_t size)`
- `extern void (*OMfree) (void *ptr)`
- `OMmalloc` is used for all memory allocations in the library. The default value is the `malloc` function.
- `OMfree` is used for deallocations. The default value is the `free` function.
- `OMfatal` is invoked when a fatal error is detected in the library (for example when memory allocation failed or when an inconsistency is detected in the library code data structures). The default value just does an `exit`.

`OMfatal` is declared as `extern void (*OMfatal)(OMstatus status)`. All memory allocations and deallocations in the library are done through the `OMmalloc` and `OMfree` functions.

71.13 Miscellaneous Functions and Variables

- `char *OMstatusToString(OMstatus status)` make a status into a human readable string.

- `char *OMtokenTypeToString(OMtokenType ttype)` makes a `tokenType` into a human readable string.
- `OMencodingType OMgetDeviceEncoding(OMdev dev)` returns the encoding actually used by the device.
- `char *OMlibDynamicInfo(void)`
- `extern const char *OMlibVersion` is the version of the library.
- `extern const char *OMlibInfo` contains some textual information about the library.

71.14 The OM.h header file

```
#ifndef __OM_h__
#define __OM_h__

/*
 *
 *          All types used through API.
 */

/* These types are anonymized by the mean of a generic pointer.
 * You should not allocate or dereference objects of these types.
 * API (hopefully) provides you with all needed methods.
 * If you find any that are not included, please refer to
 * us rather than using private structures.
 * ie: If you need to do something like
 *   malloc(sizeof(OMdevStruct));
 * or
 *   OMdevStruct * pDev;
 *   pDev->anyField = something;
 * this probably means we need to discuss your problem.
 */

/* A device is an abstraction for put/get of OpenMath tokens */
typedef struct OMdevStruct *OMdev;

/* IO is a device field, (the physical IO channel) */
typedef struct OMIOStruct *OMIO;

/* Error status that may be returned
 */
typedef enum OMstatus {
    /* Last call was successful. */
    OMsuccess = 0,
    /* Last call failed for some undetermined reason. */
    OMfailed = 1,
    /* Last call failed for memory reasons. */

```

```

OMnoMem,
/* Last call failed during some system call. */
OMerrorSys,
/* Last call to some OMget* function failed due to an unexpected EOF
   on input IO. */
OMemptyIO,
/* Last call to some OMget* function failed because there is no more
   token on device. */
OMnoMoreToken,
/* Last call to some OMget* function timedout. */
OMtimeoutedRead,
/* Last call to some OMget* function failed due to malformed input.
   (this error covers all low level lexical or syntactic problems). */
OMmalformedInput,
/* Last call to OMbindTCP failed because address is already in use
   (EADDRINUSE). */
OMaddrInUse,
/* Last call to OMconnTCP failed to set connection. */
OMconnectFailed,
/* Last call triggered some not (yet) implemented code in this lib. */
OMnotImplemented,
/* Last call caused some internal trouble. */
OMinternalError
} OMstatus;

/* All OpenMath token kinds are identified by one of these types.
 * Values given in this enum have been chosen to:
 * - avoid conflicts with specific XML characters
 *   to help automatic detection of encoding type.
 * (no: '\t'(9) '\r'(13) '\n'(10) '<'(60) or ' '(32))
 * - keep some bits (3) available for special encodings purpose
 * (eg: sharing or big len flags in binary encoding)
 */
typedef enum OMtokenType {
  OMtokenUnknown = 0, /* error catching trick */
  OMtokenInt32 = 1,
  OMtokenBigInt = 2,
  OMtokenFloat64 = 3,
  OMtokenByteArray = 4,
  OMtokenVar = 5,
  OMtokenString = 6,
  OMtokenWCString = 7,
  OMtokenSymbol = 8,
  OMtokenComment = 15,
  OMtokenApp = 16, OMtokenEndApp = 17,
  OMtokenAttr = 18, OMtokenEndAttr = 19,
  OMtokenAtp = 20, OMtokenEndAtp = 21,
  OMtokenError = 22, OMtokenEndError = 23,
  OMtokenObject = 24, OMtokenEndObject = 25,
  OMtokenBind = 26, OMtokenEndBind = 27,

```

```

    OMtokenBVar = 28,    OMtokenEndBVar = 29
} OMtokenType;

typedef enum OMbigIntType {
    OMbigIntUnknown = 0,
    /* this is base 10, digits in normal order (MSB) */
    OMbigIntBase10,
    /* this is base 16, digits in normal order (MSB) */
    OMbigIntBase16
} OMbigIntType;

/* Encodings should not be "user visible"
 * We thus refer to encoding as "symbolic constants" from this enum type. */
typedef enum OMencodingType {
    /* You may set an input stream to "unknown encoding".
     * By doing this, you let library auto detect the
     * encoding type of the device during first token input.*/
    OMencodingUnknown = 0,
    /* Binary encoding, more compact than XML one. */
    OMencodingBinary,
    /* XML-like encoding, human readable. */
    OMencodingXML,
} OMencodingType;

/* This is a portable equivalent to wchar_t for unicode strings */
typedef unsigned short OMUCS2;

/* Replacment for lacking C bools */
typedef unsigned char OMbool;
#define OMfalse (0)
#define OMtrue  (1)

/*
 *                               Some global variables
 */

/* Version of this lib (eg: "1.0") */
extern const char *OMlibVersion;

/* Some textual information about this lib (eg: "debug is on" */
extern const char *OMlibInfo;

/* These pointers allow you to redefine memory managment functions
   used in lib. */
extern void *(*OMmalloc) (size_t size);
extern void *(*OMrealloc) (void *ptr, size_t size);
extern void (*OMfree) (void *ptr);

/* If set, this function will be called by OMfatal, thus you may use it for
   error handling (by default it is set to exit()) */

```

```

extern void (*OMfatal) (OMstatus status);

/* for C++ includes */
#ifdef __cplusplus
#define OMbeginPrototypes    extern "C" {
#define OMendPrototypes      }
#else /*__cplusplus */
#define OMbeginPrototypes
#define OMendPrototypes
#endif /*__cplusplus */

/*
 *                      Prototypes of OpenMath API
 */

/* Prototypes that are spread along all headers are repeated here.
 * - This should ease the API users.
 *   (docs are fine but source is always the ultimate help)
 * - This allow a cleaner embedding of library
 *   (no need to install all .h! just take this one and the .a)
 */
OMbeginPrototypes
#ifndef OM_DEV
/* this part is automatically updated, do NOT edit below */
/** Prototypes */
/* OMPut* functions.
 *   They all take a device <dev> to put token to.
 *   Some of them need more parameters to define the token content.
 *   They are thoroughly documented in OpenMath Specification shipped
 *   with the library.
 * return: a status that reflect the operation success.
 */
extern OMstatus OMputInt32(OMdev dev, int n);
extern OMstatus OMputFloat64(OMdev dev, double *d);
extern OMstatus OMputBigInt(OMdev dev, const char *data, int len,
                           int sign, OMbigIntType format);
extern OMstatus OMputByteArray(OMdev dev, const char *data, int len);
/* OMputString*
 *   If you want to output plain 8bits C like strings there is no need
 *   to use the OMputWCString* functions. This one is more efficient
 *   (faster and more compact output for some encodings)
 */
extern OMstatus OMputString(OMdev dev, const char *str);
extern OMstatus OMputStringN(OMdev dev, const char *str, int len);
/* OMputWCString
 *   If you are using wide char strings you need to output them
 *   with that function rather than with OMputString.
 *   (It takes endianness into account)

```

```

*/
extern OMstatus OMputWCString(OMdev dev, const OMUCS2 * wcstr);
extern OMstatus OMputVar(OMdev dev, const char *var);
extern OMstatus OMputVarN(OMdev dev, const char *var, int len);
extern OMstatus OMputSymbol(OMdev dev, const char *cd, const char *name);
extern OMstatus OMputSymbolN(OMdev dev, const char *cd, int clen,
                             const char *name, int nlen);

extern OMstatus OMputApp(OMdev dev);
extern OMstatus OMputEndApp(OMdev dev);
extern OMstatus OMputAttr(OMdev dev);
extern OMstatus OMputEndAttr(OMdev dev);
extern OMstatus OMputAtp(OMdev dev);
extern OMstatus OMputEndAtp(OMdev dev);
extern OMstatus OMputBind(OMdev dev);
extern OMstatus OMputEndBind(OMdev dev);
extern OMstatus OMputBVar(OMdev dev);
extern OMstatus OMputEndBVar(OMdev dev);
extern OMstatus OMputObject(OMdev dev);
extern OMstatus OMputEndObject(OMdev dev);
extern OMstatus OMputError(OMdev dev);
extern OMstatus OMputEndError(OMdev dev);
extern OMstatus OMputComment(OMdev dev, const char *comment);
extern OMstatus OMputCommentN(OMdev dev, const char *comment, int len);
/* OMgetType
 * Get the type of the current token on device <dev>/
 * dev: device to look at.
 * type: where to store returned type.
 * return: 0 or some error code
 */
extern OMstatus OMgetType(OMdev dev, OMtokenType * type);
/* OMgetLength
 * Get the current token length.
 * dev: device to read from
 * len: where to put the token length
 * the last '\0' for string like tokens is not counted
 * (rem: for WCString it is the number of bytes not the number of
 * wide chars)
 * return: 0 or some error code
 */
extern OMstatus OMgetLength(OMdev dev, int *len);
/* OMgetSymbolLength
 * Get the current token (wich is assumed to be a symbol) lengths.
 * dev: device to read from
 * clen: where to put the cd length (not counting the last '\0')
 * nlen: where to put the name length (not counting the last '\0')
 * return: 0 or some error code
 */
extern OMstatus OMgetSymbolLength(OMdev dev, int *clen, int *nlen);
/* OMGet* functions.
 * They all take a device <dev> to get token from.

```

```

*   Some of them need more parameters to fill with the token content.
*   They are thoroughly documented in OpenMath Specification shipped with
*   the library.
* return: a status that reflect the operation success.
*/
extern OMstatus OMgetInt32(OMdev dev, int *i);
extern OMstatus OMgetFloat64(OMdev dev, double *d);
extern OMstatus OMgetBigInt(OMdev dev, char **data, int *len, int *sign,
                             OMbigIntType * format);
extern OMstatus OMgetBigIntN(OMdev dev, char *data, int len, int *sign,
                              OMbigIntType * format);
extern OMstatus OMgetByteArray(OMdev dev, char **data, int *len);
extern OMstatus OMgetByteArrayN(OMdev dev, char *data, int len);
/* OMgetString*
*   Beware! You are not supposed to use these functions unless you know
*   for sure you are reading plain 8bits strings.
*   Thus it is here only for speed/space consideration in very
*   specific applications.
*   If input is a 16 bit char string and you read it with these
*   functions you will lose the 8 most significant bits of each char.
*   You should rather refer to OMgetWCString* functions.
*/
extern OMstatus OMgetString(OMdev dev, char **str);
extern OMstatus OMgetStringN(OMdev dev, char *str, int len);
/* OMgetWCString*
*   These functions return 16 bits wide strings. (regardless input
*   was done in 8 or 16 bits mode).
*   Thus, most if not all applications should use these functions
*   preferably to OMgetString*.
*/
extern OMstatus OMgetWCString(OMdev dev, OMUCS2 ** wctr);
/* BEWARE: the <len> is supposed to be the length in bytes for the
* preallocated buffer <wctr> (not the length in number of wide chars)
*/
extern OMstatus OMgetWCStringN(OMdev dev, OMUCS2 * wctr, int len);
extern OMstatus OMgetVar(OMdev dev, char **var);
extern OMstatus OMgetVarN(OMdev dev, char *var, int len);
extern OMstatus OMgetSymbol(OMdev dev, char **cd, char **name);
extern OMstatus OMgetSymbolN(OMdev dev, char *cd, int clen, char *name,
                              int nlen);
extern OMstatus OMgetApp(OMdev dev);
extern OMstatus OMgetEndApp(OMdev dev);
extern OMstatus OMgetAttr(OMdev dev);
extern OMstatus OMgetEndAttr(OMdev dev);
extern OMstatus OMgetAtp(OMdev dev);
extern OMstatus OMgetEndAtp(OMdev dev);
extern OMstatus OMgetBind(OMdev dev);
extern OMstatus OMgetEndBind(OMdev dev);
extern OMstatus OMgetBVar(OMdev dev);
extern OMstatus OMgetEndBVar(OMdev dev);

```

```

extern OMstatus OMgetObject(OMdev dev);
extern OMstatus OMgetEndObject(OMdev dev);
extern OMstatus OMgetError(OMdev dev);
extern OMstatus OMgetEndError(OMdev dev);
extern OMstatus OMgetComment(OMdev dev, char **comment);
extern OMstatus OMgetCommentN(OMdev dev, char *comment, int len);
/* OMbeginObject
 *   Must be called before every new OpenMath object put.
 *   (Not before every token!)
 *   dev: device where new object is to be put.
 *   return: status describing operation success
 */
extern OMstatus OMbeginObject(OMdev dev);
/* OMendObject
 *   Must be called after every OpenMath object put.
 *   (Not after every token!)
 *   dev: device where object has been put.
 *   return: status describing operation success
 */
extern OMstatus OMendObject(OMdev dev);
/* OMignoreComment
 *   Set behavior of a device concerning comments.
 *   (Comments on an input device may safely be ignored.)
 *   dev: device to modify
 *   set: If set == OMtrue then device will ignore incoming comments
 *        If set == OMfalse then device will process incoming comments
 *        like other tokens.
 *        By default comments are ignored.
 *        Whatever is <set> value, output of comments is always done.
 *   return: previous value
 */
extern OMbool OMignoreComment(OMdev dev, OMbool set);
/* OMtokenCount
 *   Reports the number of tokens that have been in/output on a device
 *   dev: device to examine
 *   inTokenNb: where to store number of input tokens (if not NULL)
 *   outTokenNb: where to store number of output tokens (if not NULL)
 */
extern void OMtokenCount(OMdev dev, int *inTokenNb, int *outTokenNb);
/* OMgetDeviceEncoding
 *   Get the current encoding used by a device
 *   dev: device to examine
 *   return: current encoding
 */
extern OMencodingType OMgetDeviceEncoding(OMdev dev);
/* OMsetDeviceEncoding
 *   Set the encoding that will be used on a device
 *   BEWARE: changing encoding on a device that has already been used
 *           for IO is unsafe.
 *   but setting encoding on a new device is safe.

```

```

*   (in some occasions, it is not easy to know which encoding to
*   use at device creation)
* dev: device to modify
* encoding: encoding to use
*/
extern void OMsetDeviceEncoding(OMdev dev, OMencodingType encoding);
/* OMmakeDevice
*   Create a device from a low level IO
*   Warning: "IO" should be a "generated" (new) structure as it contains some
*   state that is private to the device. It is very dangerous for two devices
*   to share the same "IO" structure.
* encoding: encoding scheme used by device
* IO: low level I/O support for device
* return: a newly allocated device
*/
extern OMdev OMmakeDevice(OMencodingType encoding, OMIO IO);
/* OMcloseDevice
*   Close a device previously created with OMmakeDevice
*   (embedded IO is closed too)
* dev: device to close
*/
extern void OMcloseDevice(OMdev dev);
/* OMmakeIOFd
*   Create a low level IO object from a file descriptor.
*   (May be used on socket for instance.)
* fd: file descriptor to wrap into the OpenMath IO object.
* return: a newly allocated IO object.
*/
extern OMIO OMmakeIOFd(int fd);
/* OMmakeIOFile
*   Create a low level IO object from a FILE*.
*   (May be used on stdin for instance.)
* fd: FILE* to wrap into the OpenMath IO object.
* return: a newly allocated IO object.
*/
extern OMIO OMmakeIOFile(FILE * f);
/* OMmakeIOString
*   Create a low level IO object from a string (NUL terminator is not needed).
*   (May be used for copy/paste for instance.)
* s: pointer to string to use into the OpenMath IO object.
*   - In case of input device the string must be NUL terminated.
*   - In case of output device string may be reallocated
*     to fit size of outgoing objects.
* return: a newly allocated IO object.
*/
extern OMIO OMmakeIOString(char **s);
/* OMstatusToString
*   Convert a status to a human readable string that explain its meaning
* status: status to explain
* return: corresponding string

```



```

*/
extern char *OMstatusToString(OMstatus status);
/* OMtokenTypeToString
 * Convert a tokenType to a human readable string
 * ttype: type to convert
 * return: corresponding string
 */
extern char *OMtokenTypeToString(OMtokenType ttype);
/* OMsetVerbosityLevel
 * When using API some infos may be logged.
 * This set the required verbosity level.
 * level: level of verbosity.
 * 0 means nothing is nether printed
 * 1 everything is printed (default)
 * 2,... less verbose
 * return: last verbosity level
 */
extern int OMsetVerbosityLevel(int level);
/* OMsetVerbosityOutput
 * When using API some infos may be logged.
 * This set the destination for logs.
 * logFile: where to output logs (default is stderr)
 * return: last output
 */
extern FILE *OMsetVerbosityOutput(FILE * logFile);
/* OMlibDynamicInfo
 * Gather some informations about lib that can't be statically determined.
 * Complete them with some relevant static information too.
 * return: a newly allocated string
 */
extern char *OMlibDynamicInfo(void);
/**** End Prototypes */
/* end of automatically updated part */

#ifdef WIN32
#include "windows.h"

/* OMmakeIOHandle
 * Create a low level IO object from a widows handle.
 * handle: windows handle to wrap into the OpenMath IO object.
 * return: a newly allocated IO object.
 */
extern OMIO OMmakeIOHandle(HANDLE handle);
extern void OMfreeIOHandle(OMIO io);
#endif

#else /* OM_DEV */
/* The prototypes above are in fact collected from all these .h files */
#include "OMbase.h"
#include "OMdev.h"

```

```

#include "OMdevFd.h"
#include "OMdevFile.h"
#include "OMdevString.h"
#include "OMdevHandle.h"
#include "OMencBin.h"
#include "OMencXml.h"
#include "OMmisc.h"
#include "OMutf7.h"
#endif /* OM_DEV */

OMendPrototypes

#endif /* __OM_h__ */

```

71.15 Axiom OpenMath stub functions

These stub functions will eventually be expanded to handle OpenMath. See the OpenMath-Device domain in Volume 10.3. Note that the argument list for the Spad functions does not always match the argument list specified in the OpenMath specification.

There are 4 known OpenMath encodings which are set up in the OpenMathEncoding domain in Volume 10.3.

- Unknown
- Binary
- XML
- SGML

Axiom specific functions

This is used in OpenMathPackage in Volume 10.4.

```

(read OMdev)           -> LispObject
(listCDs)              -> List(String)
(listSymbols)          -> List(String)
(supportsCD cd)        -> Boolean
(supportsSymbol cd name) -> Boolean

```

defun om-Read

Read an OpenMath object from dev.
 — defun om-Read —

```
(defun om-Read (dev)
  (declare (ignore dev)))
```

defun om-listCDs

Lists all of the CDs supported by Axiom.

— **defun om-listCDs** —

```
(defun om-listCDs ())
```

defun om-listSymbols

Lists all the symbols in CD

— **defun om-listSymbols** —

```
(defun om-listSymbols ())
```

defun om-supportsCD

Return true if Axiom supports this CD.

— **defun om-supportsCD** —

```
(defun om-supportsCD (cd)
  (declare (ignore cd)))
```

defun om-supportsSymbol

— **defun om-supportsSymbol** —

```
(defun om-supportsSymbol (cd name)
  (declare (ignore cd name)))
```

Lisp conversion functions

The lisp conversion functions are:

(toDev	LispObject)	-> OMdev
(fromDev	OMdev)	-> LispObject
(toStatus	LispObject)	-> LispObject
(fromStatus	OMstatus)	-> LispObject
(toEncodingType	LispObject)	-> OMencodingType
(fromEncodingType	OMencodingType)	-> LispObject
(toBigNumStr	LispObject)	-> char *
(fromBigNumStr	char *,int,int, OMbigIntType)	-> LispObject
(toConn	LispObject)	-> OMconn
(fromConn	OMconn)	-> LispObject
(toCString	LispObject)	-> char **
(fromCString	char **)	-> LispObject
(lispStringFromCString	LispObject)	-> LispObject
(cStringFromLispString	LispObject)	-> LispObject

defun om-setDevEncoding

This sets the encoding used for reading or writing OpenMath objects to or from dev to enc.

— defun om-setDevEncoding —

```
(defun om-setDevEncoding (dev enc)
  (declare (ignore dev enc)))
```

Device manipulation functions

(openFileDev	LispObject, ints, ...)	-> LispObject
(openStrDev	LispObject, LispObject, LispObject)	-> LispObject
(closeDev	LispObject, LispObject)	-> LispObject

defun om-openFileDev

This opens file fname for reading or writing OpenMath objects. The mode can be “r” for read, “w” for write, or “a” for append.

— defun om-openFileDev —

```
(defun om-openFileDev (fname fmode enc)
  (declare (ignore fname fmode enc)))
```

defun om-openStringDev

This opens the string str for reading and writing OpenMath objects in encoding enc.

— **defun om-openStringDev** —

```
(defun om-openStringDev (str enc)
  (declare (ignore str enc)))
```

—————

defun om-closeDev

This closes dev, flushing output if necessary.

— **defun om-closeDev** —

```
(defun om-closeDev (dev)
  (declare (ignore dev)))
```

—————

Connection manipulation functions

These are covered in the OpenMathConnection domain in Volume 10.3.

```
(makeConn      LispObject, LispObject) -> LispObject
(closeConn     LispObject, LispObject) -> LispObject
(getConnInDev  LispObject, LispObject) -> LispObject
(getConnOutDev LispObject, LispObject) -> LispObject
```

defun om-makeConn

— **defun om-makeConn** —

```
(defun om-makeConn (conn)
  (declare (ignore conn)))
```

—————

defun om-closeConn

— **defun om-closeConn** —

```
(defun om-closeConn (conn)
  (declare (ignore conn)))
```

defun om-getConnInDev

— defun om-getConnInDev —

```
(defun om-getConnInDev (conn)
  (declare (ignore conn)))
```

defun om-getConnOutDev

— defun om-getConnOutDev —

```
(defun om-getConnOutDev (conn)
  (declare (ignore conn)))
```

Client/Server functions

These are covered in the OpenMathConnection domain in Volume 10.3. See OMconn.h

```
(bindTCP    LispObject, LispObject, LispObject) -> LispObject
(connectTCP LispObject, int, ...)               -> LispObject
```

defun om-bindTCP

— defun om-bindTCP —

```
(defun om-bindTCP (conn port)
  (declare (ignore conn port)))
```

defun om-connectTCP

— defun om-connectTCP —

```
(defun om-connectTCP (conn host port)
  (declare (ignore conn host port)))
```

—————

Device input/output functions

Most of these functions are in the OpenMathDevice domain in Volume 10.3. The only exception seems to be the om-stringPtrToString and om-stringToStringPtr functions which are called in the domains that export primitives. Currently these are:

- Complex (10.3)
- DoubleFloat (10.3)
- Float (10.3)
- Fraction (10.3)
- Integer (10.3)
- List (10.3)
- SingleInteger (10.3)
- String (10.3)
- Symbol (10.3)
- ExpressionToOpenMath (10.4)
- OpenMathPackage (10.4)

Note that putSymbol2 is not implemented.

(getApp	LispObject, LispObject)	-> LispObject
(getAtp	LispObject, LispObject)	-> LispObject
(getAttr	LispObject, LispObject)	-> LispObject
(getBind	LispObject, LispObject)	-> LispObject
(getBVar	LispObject, LispObject)	-> LispObject
(getByteArray	LispObject, LispObject)	-> LispObject
(getEndApp	LispObject, LispObject)	-> LispObject
(getEndAtp	LispObject, LispObject)	-> LispObject
(getEndAttr	LispObject, LispObject)	-> LispObject

```

(getEndBind      LispObject, LispObject) -> LispObject
(getEndBVar      LispObject, LispObject) -> LispObject
(getEndError     LispObject, LispObject) -> LispObject
(getEndObject    LispObject, LispObject) -> LispObject
(getError        LispObject, LispObject) -> LispObject
(getFloat        LispObject, LispObject) -> LispObject
(getInt          LispObject, LispObject) -> LispObject
(getObject       LispObject, LispObject) -> LispObject
(getString       LispObject, LispObject) -> LispObject
(getSymbol       LispObject, LispObject) -> LispObject
(getType         LispObject, LispObject) -> LispObject
(getVar          LispObject, LispObject) -> LispObject
(putApp          LispObject, LispObject) -> LispObject
(putAtp         LispObject, LispObject) -> LispObject
(putAttr        LispObject, LispObject) -> LispObject
(putBind        LispObject, LispObject) -> LispObject
(putBVar        LispObject, LispObject) -> LispObject
(putByteArray    LispObject, LispObject, LispObject) -> LispObject
(putEndApp       LispObject, LispObject) -> LispObject
(putEndAtp       LispObject, LispObject) -> LispObject
(putEndAttr      LispObject, LispObject) -> LispObject
(putEndBind      LispObject, LispObject) -> LispObject
(putEndBVar      LispObject, LispObject) -> LispObject
(putEndError     LispObject, LispObject) -> LispObject
(putEndObject    LispObject, LispObject) -> LispObject
(putError        LispObject, LispObject) -> LispObject
(putFloat        LispObject, LispObject, LispObject) -> LispObject
(putInt          LispObject, LispObject, LispObject) -> LispObject
(putObject       LispObject, LispObject) -> LispObject
(putString       LispObject, LispObject, LispObject) -> LispObject
(putSymbol       LispObject, LispObject, LispObject) -> LispObject
(putSymbol2      LispObject, int nargs, ...) -> LispObject
(putVar          LispObject, LispObject, LispObject) -> LispObject
(stringPtrToString LispObject, LispObject) -> LispObject
(stringToStringPtr LispObject, LispObject) -> LispObject

```

defun om-getApp

Reads a begin application token from dev.

— defun om-getApp —

```

(defun om-getApp (dev)
  (declare (ignore dev)))

```

—————

defun om-getAtp

Reads a begin attribute pair token from dev.

— **defun om-getAtp** —

```
(defun om-getAtp (dev)
  (declare (ignore dev)))
```

defun om-getAttr

Reads a begin attribute token from dev

— **defun om-getAttr** —

```
(defun om-getAttr (dev)
  (declare (ignore dev)))
```

defun om-getBind

Reads a begin binder token from dev.

— **defun om-getBind** —

```
(defun om-getBind (dev)
  (declare (ignore dev)))
```

defun om-getBVar

Reads a begin bound variable list token from dev.

— **defun om-getBVar** —

```
(defun om-getBVar (dev)
  (declare (ignore dev)))
```

defun om-getByteArray

Reads a byte array from dev.

— **defun om-getByteArray** —

```
(defun om-getByteArray (dev))
```

defun om-getEndApp

Reads an end application token from dev

— **defun om-getEndApp** —

```
(defun om-getEndApp (dev)
  (declare (ignore dev)))
```

defun om-getEndAtp

Reads an end attribute pair token from dev.

— **defun om-getEndAtp** —

```
(defun om-getEndAtp (dev)
  (declare (ignore dev)))
```

defun om-getEndAttr

Reads an end attribute token from dev.

— **defun om-getEndAttr** —

```
(defun om-getEndAttr (dev)
  (declare (ignore dev)))
```

defun om-getEndBind

Reads an end binder token from dev.

— **defun om-getEndBind** —

```
(defun om-getEndBind (dev)
  (declare (ignore dev)))
```

—————

defun om-getEndBVar

Reads an end bound variable list token from dev.

— **defun om-getEndBVar** —

```
(defun om-getEndBVar (dev)
  (declare (ignore dev)))
```

—————

defun om-getEndError

Reads an end error token from dev.

— **defun om-getEndError** —

```
(defun om-getEndError (dev)
  (declare (ignore dev)))
```

—————

defun om-getEndObject

Reads an end object token from dev.

— **defun om-getEndObject** —

```
(defun om-getEndObject (dev)
  (declare (ignore dev)))
```

—————

defun om-getError

Reads a begin error token from dev.

— **defun om-getError** —

```
(defun om-getError (dev)
  (declare (ignore dev)))
```

—————

defun om-getFloat

Reads a float from dev.

— **defun om-getFloat** —

```
(defun om-getFloat (dev)
  (declare (ignore dev)))
```

—————

defun om-getInt

Reads an integer from dev.

— **defun om-getInt** —

```
(defun om-getInt (dev)
  (declare (ignore dev)))
```

—————

defun om-getObject

Reads a begin object token from dev.

— **defun om-getObject** —

```
(defun om-getObject (dev)
  (declare (ignore dev)))
```

—————

defun om-getString

Reads a string from dev.

— **defun om-getString** —

```
(defun om-getString (dev)
  (declare (ignore dev)))
```

—————

defun om-getSymbol

Reads a symbol from dev.

— **defun om-getSymbol** —

```
(defun om-getSymbol (dev)
  (declare (ignore dev)))
```

—————

defun om-getType

Returns the type of the next object on dev.

— **defun om-getType** —

```
(defun om-getType (dev)
  (declare (ignore dev)))
```

—————

defun om-getVar

Reads a variable from dev.

— **defun om-getVar** —

```
(defun om-getVar (dev)
  (declare (ignore dev)))
```

—————

defun om-putApp

Writes a begin application token to dev.

— **defun om-putApp** —

```
(defun om-putApp (dev)
  (declare (ignore dev)))
```

—————

defun om-putAtp

This writea a begin application pair token to dev.

— **defun om-putAtp** —

```
(defun om-putAtp (dev)
  (declare (ignore dev)))
```

—————

defun om-putAttr

This writes a begin attribute token to dev.

— **defun om-putAttr** —

```
(defun om-putAttr (dev)
  (declare (ignore dev)))
```

—————

defun om-putBind

This writes a begin binder token to dev.

— **defun om-putBind** —

```
(defun om-putBind (dev)
  (declare (ignore dev)))
```

—————

defun om-putBVar

This writes a begin bound variable list token to dev.

— **defun om-putBVar** —

```
(defun om-putBVar (dev)
  (declare (ignore dev)))
```

—————

defun om-putByteArray

This writes a byte array to dev.

— **defun om-putByteArray** —

```
(defun om-putByteArray (dev b)
  (declare (ignore dev b)))
```

—————

defun om-putEndApp

This writes an end application token to dev.

— **defun om-putEndApp** —

```
(defun om-putEndApp (dev)
  (declare (ignore dev)))
```

—————

defun om-putEndAtp

This writes an end attribute pair to dev.

— **defun om-putEndAtp** —

```
(defun om-putEndAtp (dev)
  (declare (ignore dev)))
```

—————

defun om-putEndAttr

This writes an end attribute token to dev.

— **defun om-putEndAttr** —

```
(defun om-putEndAttr (dev)
  (declare (ignore dev)))
```

—————

defun om-putEndBind

This writes an end binder token to dev.

— **defun om-putEndBind** —

```
(defun om-putEndBind (dev)
  (declare (ignore dev)))
```

—————

defun om-putEndBVar

This writes and end bound variable list token to dev

— **defun om-putEndBVar** —

```
(defun om-putEndBVar (dev)
  (declare (ignore dev)))
```

—————

defun om-putEndError

This writes an end error token to dev

— **defun om-putEndError** —

```
(defun om-putEndError (dev)
  (declare (ignore dev)))
```

—————

defun om-putEndObject

This writes an end object token to dev.

— **defun om-putEndObject** —

```
(defun om-putEndObject (dev)
  (declare (ignore dev)))
```

—————

defun om-putError

This writes a begin error token to dev.

— **defun om-putError** —

```
(defun om-putError (dev)
  (declare (ignore dev)))
```

—————

defun om-putFloat

This writes the float f to dev.

— **defun om-putFloat** —

```
(defun om-putFloat (dev f)
  (declare (ignore dev f)))
```

—————

defun om-putInt

This writes the integer i to dev

— **defun om-putInt** —

```
(defun om-putInt (dev i)
  (declare (ignore dev i)))
```

—————

defun om-putObject

This writes a begin object token to dev.

— **defun om-putObject** —

```
(defun om-putObject (dev)
  (declare (ignore dev)))
```

—————

defun om-putString

This writes the string s to dev.

— **defun om-putString** —

```
(defun om-putString (dev s)
  (declare (ignore dev s)))
```

—————

defun om-putSymbol

This writes the symbol nm using semantics from cd to dev.

— **defun om-putSymbol** —

```
(defun om-putSymbol (dev cd nm)
  (declare (ignore dev cd nm)))
```

—————

defun om-putVar

This writes the variable v to dev.

— **defun om-putVar** —

```
(defun om-putVar (dev v)
  (declare (ignore dev v)))
```

—————

defun om-stringToStringPtr

This is used in the SingleInteger domain in Volume 10.3. This is supposed to return the string from its address? It would appear to be a nop in lisp.

— **defun om-stringToStringPtr** —

```
(defun om-stringToStringPtr (str)
  (declare (ignore str)))
```

—————

defun om-stringPtrToString

This is used in the SingleInteger domain in Volume 10.3. This is supposed to return the string address from a string? It would appear to be a nop in lisp.

— **defun om-stringPtrToString** —

```
(defun om-stringPtrToString (str)
  (declare (ignore str)))
```

—————

Chapter 72

NRLIB code.lisp support code

defun makeByteWordVec2

— defun makeByteWordVec2 0 —

```
(defun |makeByteWordVec2| (maxelement initialvalue)
  (let ((n (cond ((null initialvalue) 7) ('t maxelement))))
    (make-array (length initialvalue)
      :element-type (list 'mod (1+ n))
      :initial-contents initialvalue)))
```

—————

defmacro spadConstant

— defmacro spadConstant 0 —

```
(defmacro |spadConstant| (dollar n)
  '(spadcall (svref ,dollar (the fixnum ,n))))
```

—————

Chapter 73

Monitoring execution

MONITOR

This file contains a set of function for monitoring the execution of the functions in a file. It constructs a hash table that contains the function name as the key and monitor-data structures as the value

The technique is to use a :cond parameter on trace to call the monitor-incr function to incr the count every time a function is called

```
*monitor-table*                                HASH TABLE
  is the monitor table containing the hash entries
*monitor-nrlibs*                               LIST of STRING
  list of nrlib filenames that are monitored
*monitor-domains*                             LIST of STRING
  list of domains to monitor-report (default is all exposed domains)
monitor-data                                  STRUCTURE
  is the defstruct name of records in the table
  name is the first field and is the name of the monitored function
  count contains a count of times the function was called
  monitorp is a flag that skips counting if nil, counts otherwise
  sourcefile is the name of the file that contains the source code
```

***** SETUP, SHUTDOWN *****

```
monitor-inittable ()                          FUNCTION
  creates the hashtable and sets *monitor-table*
  note that it is called every time this file is loaded
monitor-end ()                                FUNCTION
  unhooks all of the trace hooks
```

***** TRACE, UNTRACE *****

```

monitor-add (name &optional sourcefile)      FUNCTION
  sets up the trace and adds the function to the table
monitor-delete (fn)                          FUNCTION
  untraces a function and removes it from the table
monitor-enable (&optional fn)                FUNCTION
  starts tracing for all (or optionally one) functions that
  are in the table
monitor-disable (&optional fn)              FUNCTION
  stops tracing for all (or optionally one) functions that
  are in the table

```

***** COUNTING, RECORDING *****

```

monitor-reset (&optional fn)                FUNCTION
  reset the table count for the table (or optionally, for a function)
monitor-incr (fn)                           FUNCTION
  increments the count information for a function
  it is called by trace to increment the count
monitor-decr (fn)                           FUNCTION
  decrements the count information for a function
monitor-info (fn)                           FUNCTION
  returns the monitor-data structure for a function

```

***** FILE IO *****

```

monitor-write (items file)                  FUNCTION
  writes a list of symbols or structures to a file
monitor-file (file)                         FUNCTION
  will read a file, scan for defuns, monitor each defun
  NOTE: monitor-file assumes that the file has been loaded

```

***** RESULTS *****

```

monitor-results ()                          FUNCTION
  returns a list of the monitor-data structures
monitor-untested ()                         FUNCTION
  returns a list of files that have zero counts
monitor-tested (&optional delete)           FUNCTION
  returns a list of files that have nonzero counts
  optionally calling monitor-delete on those functions

```

***** CHECKPOINT/RESTORE *****

```

monitor-checkpoint (file)                   FUNCTION
  save the *monitor-table* in a loadable form
monitor-restore (file)                      FUNCTION
  restore a checkpointed file so that everything is monitored

```

***** ALGEBRA *****

```

monitor-autoload ()                         FUNCTION
  traces autoload of algebra to monitor corresponding source files

```

NOTE: this requires the /spad/int/algebra directory

```
monitor-dirname (args)          FUNCTION
    expects a list of 1 libstream (loadvol's arglist) and monitors the source
    this is a function called by monitor-autoload
monitor-nrllib (nrllib)        FUNCTION
    takes an nrllib name as a string (eg POLY) and returns a list of
    monitor-data structures from that source file
monitor-report ()              FUNCTION
    generate a report of the monitored activity for domains in
    *monitor-domains*
monitor-spadfile (name)        FUNCTION
    given a spad file, report all nrllibs it creates
    this adds each nrllib name to *monitor-domains* but does not
    trace the functions from those domains
monitor-percent ()             FUNCTION
    ratio of (functions executed)/(functions traced)
monitor-apropos (str)          FUNCTION
    given a string, find all monitored symbols containing the string
    the search is case-insensitive. returns a list of monitor-data items
```

for example:

suppose we have a file "/u/daly/testmon.lisp" that contains:

```
(defun foo1 () (print 'foo1))
(defun foo2 () (print 'foo2))
(defun foo3 () (foo1) (foo2) (print 'foo3))
(defun foo4 () (print 'foo4))
```

an example session is:

```
; FIRST WE LOAD THE FILE (WHICH INITIS *monitor-table*)
```

```
>(load "/u/daly/monitor.lisp")
Loading /u/daly/monitor.lisp
Finished loading /u/daly/monitor.lisp
T
```

```
; SECOND WE LOAD THE TESTMON FILE
```

```
>(load "/u/daly/testmon.lisp")
T
```

```
; THIRD WE MONITOR THE FILE
```

```
>(monitor-file "/u/daly/testmon.lisp")
monitoring "/u/daly/testmon.lisp"
NIL
```

```
; FOURTH WE CALL A FUNCTION FROM THE FILE (BUMP ITS COUNT)
```

```
>(foo1)
```

```
F001
```

```
F001
```



```

; AND ANOTHER FUNCTION (BUMP ITS COUNT)
>(foo2)

FOO2
FOO2

; AND A THIRD FUNCTION THAT CALLS THE OTHER TWO (BUMP ALL THREE)
>(foo3)

FOO1
FOO2
FOO3
FOO3

; CHECK THAT THE RESULTS ARE CORRECT

>(monitor-results)
(#S(MONITOR-DATA NAME FOO1 COUNT 2 MONITORP T SOURCEFILE
    "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME FOO2 COUNT 2 MONITORP T SOURCEFILE
    "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME FOO3 COUNT 1 MONITORP T SOURCEFILE
    "/u/daly/testmon.lisp"))
 #S(MONITOR-DATA NAME FOO4 COUNT 0 MONITORP T SOURCEFILE
    "/u/daly/testmon.lisp"))

; STOP COUNTING CALLS TO FOO2

>(monitor-disable 'foo2)
NIL

; INVOKE FOO2 THRU FOO3

>(foo3)

FOO1
FOO2
FOO3
FOO3

; NOTICE THAT FOO1 AND FOO3 WERE BUMPED BUT NOT FOO2
>(monitor-results)
(#S(MONITOR-DATA NAME FOO1 COUNT 3 MONITORP T SOURCEFILE
    "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME FOO2 COUNT 2 MONITORP NIL SOURCEFILE
    "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME FOO3 COUNT 2 MONITORP T SOURCEFILE
    "/u/daly/testmon.lisp"))
 #S(MONITOR-DATA NAME FOO4 COUNT 0 MONITORP T SOURCEFILE
    "/u/daly/testmon.lisp"))

```

```

"/u/daly/testmon.lisp"))

; TEMPORARILY STOP ALL MONITORING

>(monitor-disable)
NIL

; CHECK THAT NOTHING CHANGES

>(foo3)

F001
F002
F003
F003

; NO COUNT HAS CHANGED

>(monitor-results)
(#S(MONITOR-DATA NAME F001 COUNT 3 MONITORP NIL SOURCEFILE
    "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME F002 COUNT 2 MONITORP NIL SOURCEFILE
    "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME F003 COUNT 2 MONITORP NIL SOURCEFILE
    "/u/daly/testmon.lisp"))
 #S(MONITOR-DATA NAME F004 COUNT 0 MONITORP T SOURCEFILE
    "/u/daly/testmon.lisp"))

; MONITOR ONLY CALLS TO F001

>(monitor-enable 'foo1)
T

; F003 CALLS F001

>(foo3)

F001
F002
F003
F003

; F001 HAS CHANGED BUT NOT F002 OR F003

>(monitor-results)
(#S(MONITOR-DATA NAME F001 COUNT 4 MONITORP T SOURCEFILE
    "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME F002 COUNT 2 MONITORP NIL SOURCEFILE
    "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME F003 COUNT 2 MONITORP NIL SOURCEFILE
    "/u/daly/testmon.lisp"))

```

```

        "/u/daly/testmon.lisp"))
#S(MONITOR-DATA NAME F004 COUNT 0 MONITORP T SOURCEFILE
    "/u/daly/testmon.lisp"))

; MONITOR EVERYBODY

>(monitor-enable)
NIL

; CHECK THAT EVERYBODY CHANGES

>(foo3)

F001
F002
F003
F003

; EVERYBODY WAS BUMPED

>(monitor-results)
(#S(MONITOR-DATA NAME F001 COUNT 5 MONITORP T SOURCEFILE
    "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME F002 COUNT 3 MONITORP T SOURCEFILE
    "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME F003 COUNT 3 MONITORP T SOURCEFILE
    "/u/daly/testmon.lisp"))
#S(MONITOR-DATA NAME F004 COUNT 0 MONITORP T SOURCEFILE
    "/u/daly/testmon.lisp"))

; WHAT FUNCTIONS WERE TESTED?

>(monitor-tested)
(F001 F002 F003)

; WHAT FUNCTIONS WERE NOT TESTED?

>(monitor-untested)
(F004)

; UNTRACE THE WHOLE WORLD, MONITORING CANNOT RESTART

>(monitor-end)
NIL

; CHECK THE RESULTS

>(monitor-results)
(#S(MONITOR-DATA NAME F001 COUNT 5 MONITORP T SOURCEFILE
    "/u/daly/testmon.lisp")

```

```

#S(MONITOR-DATA NAME F002 COUNT 3 MONITORP T SOURCEFILE
   "/u/daly/testmon.lisp")
#S(MONITOR-DATA NAME F003 COUNT 3 MONITORP T SOURCEFILE
   "/u/daly/testmon.lisp"))
#S(MONITOR-DATA NAME F004 COUNT 0 MONITORP T SOURCEFILE
   "/u/daly/testmon.lisp"))

; CHECK THAT THE FUNCTIONS STILL WORK

>(foo3)

F001
F002
F003
F003

; CHECK THAT MONITORING IS NOT OCCURING

>(monitor-results)
(#S(MONITOR-DATA NAME F001 COUNT 5 MONITORP T SOURCEFILE
   "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME F002 COUNT 3 MONITORP T SOURCEFILE
   "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME F003 COUNT 3 MONITORP T SOURCEFILE
   "/u/daly/testmon.lisp"))
 #S(MONITOR-DATA NAME F004 COUNT 0 MONITORP T SOURCEFILE
   "/u/daly/testmon.lisp"))

```

defvar \$*monitor-domains*

— initvars —

```
(defvar *monitor-domains* nil "a list of domains to report")
```

—————

defvar \$*monitor-nrlibs*

— initvars —

```
(defvar *monitor-nrlibs* nil "a list of nrlibs that have been traced")
```

—————

defvar \$*monitor-table*

— initvars —

```
(defvar *monitor-table* nil "a table of all of the monitored data")
```

—————

— postvars —

```
(eval-when (eval load)
  (unless *monitor-table* (monitor-inittable)))
```

—————

defstruct \$monitor-data

— initvars —

```
(defstruct monitor-data name count monitorp sourcefile)
```

—————

defstruct \$libstream

— initvars —

```
(defstruct libstream mode dirname (indextable nil) (indexstream nil))
```

—————

defun Initialize the monitor statistics hashtable

[*monitor-table* p1164]

— defun monitor-inittable 0 —

```
(defun monitor-inittable ()
  "initialize the monitor statistics hashtable"
  (declare (special *monitor-table*))
  (setq *monitor-table* (make-hash-table)))
```

defun End the monitoring process, we cannot restart

[*monitor-table* p1164]

— defun monitor-end 0 —

```
(defun monitor-end ()
  "End the monitoring process. we cannot restart"
  (declare (special *monitor-table*))
  (maphash
   #'(lambda (key value)
       (declare (ignore value))
       (eval '(untrace ,key)))
   *monitor-table*))
```

defun Return a list of the monitor-data structures

[*monitor-table* p1164]

— defun monitor-results 0 —

```
(defun monitor-results ()
  "return a list of the monitor-data structures"
  (let (result)
    (declare (special *monitor-table*))
    (maphash
     #'(lambda (key value)
         (declare (ignore key))
         (push value result))
     *monitor-table*)
    (mapcar #'(lambda (x) (pprint x))
            (sort result #'string-lessp :key #'monitor-data-name))))
```

defun Add a function to be monitored

```
[monitor-delete p1166]
[make-monitor-data p??]
[*monitor-table* p1164]

— defun monitor-add 0 —

(defun monitor-add (name &optional sourcefile)
  "add a function to be monitored"
  (declare (special *monitor-table*))
  (unless (fboundp name) (load sourcefile))
  (when (gethash name *monitor-table*)
    (monitor-delete name))
  (eval '(trace (,name :cond (progn (monitor-incr ',name) nil))))
  (setf (gethash name *monitor-table*)
    (make-monitor-data
      :name name :count 0 :monitorp t :sourcefile sourcefile)))
```

defun Remove a function being monitored

```
[*monitor-table* p1164]

— defun monitor-delete 0 —

(defun monitor-delete (fn)
  "Remove a function being monitored"
  (declare (special *monitor-table*))
  (eval '(untrace ,fn))
  (remhash fn *monitor-table*))
```

defun Enable all (or optionally one) function for monitoring

```
[*monitor-table* p1164]

— defun monitor-enable 0 —

(defun monitor-enable (&optional fn)
  "enable all (or optionally one) function for monitoring"
  (declare (special *monitor-table*))
  (if fn
```

```
(progn
  (eval '(trace (,fn :cond (progn (monitor-incr ',fn) nil))))
  (setf (monitor-data-monitorp (gethash fn *monitor-table*)) t))
(maphash
 #'(lambda (key value)
   (declare (ignore value))
   (eval '(trace (,key :cond (progn (monitor-incr ',key) nil))))
   (setf (monitor-data-monitorp (gethash key *monitor-table*)) t))
 *monitor-table*))
```

defun Disable all (optionally one) function for monitoring

[*monitor-table* p1164]

— defun monitor-disable 0 —

```
(defun monitor-disable (&optional fn)
  "disable all (optionally one) function for monitoring"
  (declare (special *monitor-table*))
  (if fn
    (progn
      (eval '(untrace ,fn))
      (setf (monitor-data-monitorp (gethash fn *monitor-table*)) nil))
    (maphash
     #'(lambda (key value)
       (declare (ignore value))
       (eval '(untrace ,key))
       (setf (monitor-data-monitorp (gethash key *monitor-table*)) nil))
     *monitor-table*)))
```

defun Reset the table count for the table (or a function)

[*monitor-table* p1164]

— defun monitor-reset 0 —

```
(defun monitor-reset (&optional fn)
  "reset the table count for the table (or a function)"
  (declare (special *monitor-table*))
  (if fn
    (setf (monitor-data-count (gethash fn *monitor-table*)) 0)
```



```
(maphash
  #'(lambda (key value)
    (declare (ignore value))
    (setf (monitor-data-count (gethash key *monitor-table*)) 0))
  *monitor-table*))
```

defun Incr the count of fn by 1

[*monitor-table* p1164]

— defun monitor-incr 0 —

```
(defun monitor-incr (fn)
  "incr the count of fn by 1"
  (let (data)
    (declare (special *monitor-table*))
    (setq data (gethash fn *monitor-table*))
    (if data
      (incf (monitor-data-count data)) ;; change table entry by side-effect
      (warn "~s is monitored but not in table..do (untrace ~s)~%" fn fn))))
```

defun Decr the count of fn by 1

[*monitor-table* p1164]

— defun monitor-decr 0 —

```
(defun monitor-decr (fn)
  "decr the count of fn by 1"
  (let (data)
    (declare (special *monitor-table*))
    (setq data (gethash fn *monitor-table*))
    (if data
      (decf (monitor-data-count data)) ;; change table entry by side-effect
      (warn "~s is monitored but not in table..do (untrace ~s)~%" fn fn))))
```

defun Return the monitor information for a function

[*monitor-table* p1164]

— defun monitor-info 0 —

```
(defun monitor-info (fn)
  "return the monitor information for a function"
  (declare (special *monitor-table*))
  (gethash fn *monitor-table*))
```

—————

defun Hang a monitor call on all of the defuns in a file

[done p??]
[done p??]
[monitor-add p1166]

— defun monitor-file 0 —

```
(defun monitor-file (file)
  "hang a monitor call on all of the defuns in a file"
  (let (expr (package "BOOT"))
    (format t "monitoring ~s~%" file)
    (with-open-file (in file)
      (catch 'done
        (loop
          (setq expr (read in nil 'done))
          (when (eq expr 'done) (throw 'done nil))
          (if (and (consp expr) (eq (car expr) 'in-package))
              (if (and (consp (second expr)) (eq (first (second expr)) 'quote))
                  (setq package (string (second (second expr))))
                  (setq package (second expr)))
              (when (and (consp expr) (eq (car expr) 'defun))
                (monitor-add (intern (string (second expr)) package) file))))))))))
```

—————

defun Return a list of the functions with zero count fields

[*monitor-table* p1164]

— defun monitor-untested 0 —

```
(defun monitor-untested ()
  "return a list of the functions with zero count fields"
  (let (result)
    (declare (special *monitor-table*))
    (maphash
      #'(lambda (key value)
        (if (and (monitor-data-monitorp value) (= (monitor-data-count value) 0))
            (push key result)))
      *monitor-table*))
  (sort result #'string-lessp)))
```

defun Return a list of functions with non-zero counts

```
[monitor-delete p1166]
[*monitor-table*) p??]
```

— defun monitor-tested 0 —

```
(defun monitor-tested (&optional delete)
  "return a list of functions with non-zero counts, optionally deleting them"
  (let (result)
    (declare (special *monitor-table*))
    (maphash
      #'(lambda (key value)
        (when (and (monitor-data-monitorp value)
                    (> (monitor-data-count value) 0))
          (when delete (monitor-delete key))
          (push key result)))
      *monitor-table*))
  (sort result #'string-lessp)))
```

defun Write out a list of symbols or structures to a file

— defun monitor-write 0 —

```
(defun monitor-write (items file)
  "write out a list of symbols or structures to a file"
  (with-open-file (out file :direction :output)
    (dolist (item items)
      (if (symbolp item)
```

```
(format out "~s~%" item)
(format out "~s~50t~s~100t~s~%"
  (monitor-data-sourcefile item)
  (monitor-data-name item)
  (monitor-data-count item))))))
```

defun Save the **monitor-table in loadable form**

```
[*monitor-table* p1164]
[*print-package* p??]
```

— defun monitor-checkpoint 0 —

```
(defun monitor-checkpoint (file)
  "save the *monitor-table* in loadable form"
  (let ((*print-package* t))
    (declare (special *print-package* *monitor-table*))
    (with-open-file (out file :direction :output)
      (format out "(in-package \"BOOT\")~%" )
      (format out "(monitor-inittable)~%" )
      (dolist (data (monitor-results))
        (format out "(monitor-add '~s ~s)~%"
          (monitor-data-name data)
          (monitor-data-sourcefile data))
        (format out "(setf (gethash '~s *monitor-table*)
          (make-monitor-data :name '~s :count ~s :monitorp ~s
            :sourcefile ~s))~%"
          (monitor-data-name data)
          (monitor-data-name data)
          (monitor-data-count data)
          (monitor-data-monitorp data)
          (monitor-data-sourcefile data))))))
```

defun restore a checkpointed file

— defun monitor-restore 0 —

```
(defun monitor-restore (file)
  "restore a checkpointed file"
  (load file))
```

defun Printing help documentation

— defun monitor-help 0 —

```
(defun monitor-help ()
  (format t "%
;;; MONITOR
;;;
;;; This file contains a set of function for monitoring the execution
;;; of the functions in a file. It constructs a hash table that contains
;;; the function name as the key and monitor-data structures as the value
;;;
;;; The technique is to use a :cond parameter on trace to call the
;;; monitor-incr function to incr the count every time a function is called
;;;
;;; *monitor-table*                                HASH TABLE
;;;   is the monitor table containing the hash entries
;;; *monitor-nrlibs*                                LIST of STRING
;;;   list of nrllib filenames that are monitored
;;; *monitor-domains*                                LIST of STRING
;;;   list of domains to monitor-report (default is all exposed domains)
;;; monitor-data                                    STRUCTURE
;;;   is the defstruct name of records in the table
;;;   name is the first field and is the name of the monitored function
;;;   count contains a count of times the function was called
;;;   monitorp is a flag that skips counting if nil, counts otherwise
;;;   sourcefile is the name of the file that contains the source code
;;;
;;; ***** SETUP, SHUTDOWN *****
;;;
;;; monitor-inittable ()                            FUNCTION
;;;   creates the hashtable and sets *monitor-table*
;;;   note that it is called every time this file is loaded
;;; monitor-end ()                                  FUNCTION
;;;   unhooks all of the trace hooks
;;;
;;; ***** TRACE, UNTRACE *****
;;;
;;; monitor-add (name &optional sourcefile)          FUNCTION
;;;   sets up the trace and adds the function to the table
;;; monitor-delete (fn)                              FUNCTION
;;;   untraces a function and removes it from the table
;;; monitor-enable (&optional fn)                    FUNCTION
;;;   starts tracing for all (or optionally one) functions that
;;;   are in the table
;;; monitor-disable (&optional fn)                  FUNCTION
```

```

;;; stops tracing for all (or optionally one) functions that
;;; are in the table
;;;
;;; ***** COUNTING, RECORDING *****
;;;
;;; monitor-reset (&optional fn)                FUNCTION
;;; reset the table count for the table (or optionally, for a function)
;;; monitor-incr (fn)                            FUNCTION
;;; increments the count information for a function
;;; it is called by trace to increment the count
;;; monitor-decr (fn)                            FUNCTION
;;; decrements the count information for a function
;;; monitor-info (fn)                            FUNCTION
;;; returns the monitor-data structure for a function
;;;
;;; ***** FILE IO *****
;;;
;;; monitor-write (items file)                   FUNCTION
;;; writes a list of symbols or structures to a file
;;; monitor-file (file)                         FUNCTION
;;; will read a file, scan for defuns, monitor each defun
;;; NOTE: monitor-file assumes that the file has been loaded
;;;
;;; ***** RESULTS *****
;;;
;;; monitor-results ()                           FUNCTION
;;; returns a list of the monitor-data structures
;;; monitor-untested ()                         FUNCTION
;;; returns a list of files that have zero counts
;;; monitor-tested (&optional delete)          FUNCTION
;;; returns a list of files that have nonzero counts
;;; optionally calling monitor-delete on those functions
;;;
;;; ***** CHECKPOINT/RESTORE *****
;;;
;;; monitor-checkpoint (file)                   FUNCTION
;;; save the *monitor-table* in a loadable form
;;; monitor-restore (file)                     FUNCTION
;;; restore a checkpointed file so that everything is monitored
;;;
;;; ***** ALGEBRA *****
;;;
;;; monitor-autoload ()                         FUNCTION
;;; traces autoload of algebra to monitor corresponding source files
;;; NOTE: this requires the /spad/int/algebra directory
;;; monitor-dirname (args)                     FUNCTION
;;; expects a list of 1 libstream (loadvol's arglist) and monitors the source
;;; this is a function called by monitor-autoload
;;; monitor-nrllib (nrllib)                   FUNCTION
;;; takes an nrllib name as a string (eg POLY) and returns a list of

```

```

;;; monitor-data structures from that source file
;;; monitor-report () FUNCTION
;;; generate a report of the monitored activity for domains in
;;; *monitor-domains*
;;; monitor-spadfile (name) FUNCTION
;;; given a spad file, report all nrlibs it creates
;;; this adds each nrlib name to *monitor-domains* but does not
;;; trace the functions from those domains
;;; monitor-percent () FUNCTION
;;; ratio of (functions executed)/(functions traced)
;;; monitor-apropos (str) FUNCTION
;;; given a string, find all monitored symbols containing the string
;;; the search is case-insensitive. returns a list of monitor-data items
") nil)

```

Monitoring algebra files

defun Monitoring algebra code.lsp files

[*monitor-nrlibs* p1163]

— defun monitor-dirname 0 —

```

(defun monitor-dirname (args)
  "expects a list of 1 libstream (loadvol's arglist) and monitors the source"
  (let (name)
    (declare (special *monitor-nrlibs*))
    (setq name (libstream-dirname (car args)))
    (setq name (file-namestring name))
    (setq name (concatenate 'string "/spad/int/algebra/" name "/code.lsp"))
    (when (probe-file name)
      (push name *monitor-nrlibs*)
      (monitor-file name))))

```

defun Monitor autoloaded files

— defun monitor-autoload 0 —

```

(defun monitor-autoload ()

```

```
"traces autoload of algebra to monitor corresponding source files"
(trace (vmlisp::loadvol
      :entrycond nil
      :exitcond (progn (monitor-dirname system::arglist) nil))))
```

defun Monitor an nrlib

[*monitor-table* p1164]

— defun monitor-nrlib 0 —

```
(defun monitor-nrlib (nrlib)
  "takes an nrlib name as a string (eg POLY) and returns a list of
  monitor-data structures from that source file"
  (let (result)
    (declare (special *monitor-table*))
    (maphash
      #'(lambda (k v)
          (declare (ignore k))
          (when (string= nrlib
                        (pathname-name (car (last
                                           (pathname-directory (monitor-data-sourcefile v))))))
            (push v result)))
      *monitor-table*)
    result))
```

defun Given a monitor-data item, extract the nrlib name

— defun monitor-libname 0 —

```
(defun monitor-libname (item)
  "given a monitor-data item, extract the nrlib name"
  (pathname-name (car (last
                       (pathname-directory (monitor-data-sourcefile item))))))
```

defun Is this an exposed algebra function?

— defun monitor-exposedp 0 —

```
(defun monitor-exposedp (fn)
  "exposed functions have more than 1 semicolon. given a symbol, count them"
  (> (count #\; (symbol-name fn)) 1))
```

—————

defun Monitor exposed domains

TPDHERE: note that the file `interp.exposed` no longer exists. The exposure information is now in `bookvol5`. This needs to work off the internal exposure list, not the file.

```
[done p??]
[done p??]
[*monitor-domains* p1163]
```

— defun monitor-readinterp 0 —

```
(defun monitor-readinterp ()
  "read interp.exposed to initialize *monitor-domains* to exposed domains.
  this is the default action. adding or deleting domains from the list
  will change the report results"
  (let (skip expr name)
    (declare (special *monitor-domains*))
    (setq *monitor-domains* nil)
    (with-open-file (in "/spad/src/algebra/interp.exposed")
      (read-line in)
      (read-line in)
      (read-line in)
      (read-line in)
      (catch 'done
        (loop
          (setq expr (read-line in nil "done"))
          (when (string= expr "done") (throw 'done nil))
          (cond
            ((string= expr "basic") (setq skip nil))
            ((string= expr "categories") (setq skip t))
            ((string= expr "hidden") (setq skip t))
            ((string= expr "defaults") (setq skip nil)))
          (when (and (not skip) (> (length expr) 58))
            (setq name (subseq expr 58 (length expr)))
            (setq name (string-right-trim '("#\space") name))
            (when (> (length name) 0)
              (push name *monitor-domains*))))))))))
```

defun Generate a report of the monitored domains

[monitor-readinterp p1176]
 [*monitor-domains* p1163]

— defun monitor-report 0 —

```
(defun monitor-report ()
  "generate a report of the monitored activity for domains in *monitor-domains*"
  (let (nrlibs nonzero total)
    (declare (special *monitor-domains*))
    (unless *monitor-domains* (monitor-readinterp))
    (setq nonzero 0)
    (setq total 0)
    (maphash
     #'(lambda (k v)
         (declare (ignore k))
         (let (nextlib point)
           (when (> (monitor-data-count v) 0) (incf nonzero))
           (incf total)
           (setq nextlib (monitor-libname v))
           (setq point (member nextlib nrlibs :test #'string= :key #'car))
           (if point
               (setf (cdr (first point)) (cons v (cdr (first point))))
               (push (cons nextlib (list v)) nrlibs))))
      *monitor-table*)
    (format t "~d of ~d (~d percent) tested~%" nonzero total
            (round (/ (* 100.0 nonzero) total)))
    (setq nrlibs (sort nrlibs #'string< :key #'car))
    (dolist (pair nrlibs)
      (let ((exposedcount 0) (testcount 0))
        (when (member (car pair) *monitor-domains* :test #'string=)
          (format t "for library ~s~%" (car pair))
          (dolist (item (sort (cdr pair) #'> :key #'monitor-data-count))
            (when (monitor-exposedp (monitor-data-name item))
              (incf exposedcount)
              (when (> (monitor-data-count item) 0) (incf testcount))
              (format t "~5d ~s~%"
                      (monitor-data-count item)
                      (monitor-data-name item))))
          (if (= exposedcount testcount)
              (format t "~a has all exposed functions tested~%" (car pair))
              (format t "Daly bug:~a has untested exposed functions~%" (car pair))))))
    nil))
```

defun Parse an)abbrev expression for the domain name

— defun monitor-parse 0 —

```
(defun monitor-parse (expr)
  (let (point1 point2)
    (setq point1 (position #\space expr :test #'char=))
    (setq point1 (position #\space expr :start point1 :test-not #'char=))
    (setq point1 (position #\space expr :start point1 :test #'char=))
    (setq point1 (position #\space expr :start point1 :test-not #'char=))
    (setq point2 (position #\space expr :start point1 :test #'char=))
    (subseq expr point1 point2)))
```

defun Given a spad file, report all nrlibs it creates

```
[done p??]
[done p??]
[monitor-parse p1178]
[*monitor-domains* p1163]
```

— defun monitor-spadfile 0 —

```
(defun monitor-spadfile (name)
  "given a spad file, report all nrlibs it creates"
  (let (expr)
    (declare (special *monitor-domains*))
    (with-open-file (in name)
      (catch 'done
        (loop
          (setq expr (read-line in nil 'done))
          (when (eq expr 'done) (throw 'done nil))
          (when (and (> (length expr) 4) (string= (subseq expr 0 4) ")abb"))
            (setq *monitor-domains*
                  (adjoin (monitor-parse expr) *monitor-domains* :test #'string=)))))))
```

defun Print percent of functions tested

[*monitor-table* p1164]

— defun monitor-percent 0 —

```
(defun monitor-percent ()
  "Print percent of functions tested"
  (let (nonzero total)
    (declare (special *monitor-table*))
    (setq nonzero 0)
    (setq total 0)
    (maphash
     #'(lambda (k v)
         (declare (ignore k))
         (when (> (monitor-data-count v) 0) (incf nonzero))
         (incf total)))
     *monitor-table*)
    (format t "~d of ~d (~d percent) tested~%" nonzero total
            (round (/ (* 100.0 nonzero) total)))))
```

defun Find all monitored symbols containing the string

[*monitor-table* p1164]

— defun monitor-afropos 0 —

```
(defun monitor-afropos (str)
  "given a string, find all monitored symbols containing the string
  the search is case-insensitive. returns a list of monitor-data items"
  (let (result)
    (maphash
     #'(lambda (k v)
         (when
          (search (string-upcase str)
                  (string-upcase (symbol-name k))
                  :test #'string=)
          (push v result))))
     *monitor-table*)
    result))
```

Chapter 74

HyperDoc Basic Command support

Most of the functions create a new page with a call to the function `htMakePage`. This function takes an association list which has several possible keys.

- **domainConditions** with tests such as `(—isDomain— S (—String—))` constraining the domains. The possible tests are
 - **isDomain**
- **text** which takes a string argument which may contain latex-like format strings.
 - a plain string
 - **beginmenu**
 - **blankline**
 - **centerline**
 - **em** with an argument to be emphasized
 - **indent** sets the column
 - **indentrel** does a relative indent by a positive or negative amount
 - **inputStrings**
 - **item** occurs between a **beginmenu** and **endmenu** text
 - **lisdownlink** takes a string and a function to call
 - **lisplinks**
 - **menuitemstyle** takes a set of characters as an argument
 - **newline**
 - **space** with a numeric argument of the number of spaces

- **tab** with a numeric argument indicating the tab column
- **vspace** with the number of blank lines needed
- **bcStrings** which takes a list. The first element is the width of the input box, the second is the default contents, the third is the name of the variable to hold the contents, and the fourth is the domains allowed as input (see **domainConditions** above).
- **bcLinks** which takes a list containing strings and function calls. It will link to another page by calling the page generation function for that page.
- **doneButton** which takes 2 arguments, a label and a function to call.
- **radioButtons** takes a button name and set of lists, each one creating a new radio button
- **inputStrings**
- **bcHt**

The `htMakeDoneButton` will put a button on the page with the given title and a function to call when pressed.

defun Basic Command matrix entry

[`bcReadMatrix` p1182]

— defun bcMatrix —

```
(defun |bcMatrix| () (|bcReadMatrix| nil))
```

—————

defun Read Matrix

[`htInitPage` p1262]

[`htpSetProperty` p1254]

[`htMakePage` p1263]

[`htShowPage` p1263]

This routine is called from several places to enter a matrix. The argument **bcReadMatrix** is the name of a function to call when the matrix has been entered. This value is set as an **exit-Function** in the page's association table.

— **defun bcReadMatrix** —

```
(defun |bcReadMatrix| (exitFunctionOrNil)
  (let (page)
    (setq page (|htInitPage| "Matrix Basic Command" nil))
    (|htSetProperty| page '|exitFunction| exitFunctionOrNil)
    (|htMakePage|
      '((|domainConditions| (|isDomain| PI (|PositiveInteger|)))
        (|text| . "Enter the size of the matrix:")
        (|inputStrings|
          ("Number of {\em rows}:\space{3}" "" 5 2 |rows| PI)
          ("Number of {\em columns}: " "" 5 2 |cols| PI))
        (|text| . "\\blankline ")
        (|text| . "How would you like to enter the matrix?")
        (|text| . "\\beginmenu") (|text| . "\\item ")
        (|bcLinks|
          ("\\menuitemstyle{By entering individual entries}" ""
            |bcInputExplicitMatrix| |explicit|))
        (|text| . "\\item ")
        (|bcLinks|
          ("\\menuitemstyle{By formula}" ""
            |bcInputMatrixByFormula| |formula|))
        (|text| . "\\endmenu"))))
    (|htShowPage|)))
```

defun Input Matrix By Formula

```
[|htInitPage| p1262]
[|htMakePage| p1263]
[|htMakeDoneButton| p1284]
[|objValUnwrap| p??]
[|htpLabelSpadValue| p1256]
[|parse-integer| p??]
[|htpLabelInputString| p1254]
[|htpSetProperty| p1254]
[|htShowPage| p1263]
[|$bcParseOnly| p1249]
```

Pressing the **Continue** button will call the function **bcInputMatrixByFormulaGen** due to this line:

```
(|htMakeDoneButton| "Continue" ' |bcInputMatrixByFormulaGen|)
```

— defun bcInputMatrixByFormula —

```
(defun |bcInputMatrixByFormula| (htPage junk)
  (declare (ignore junk))
  (let (page nrows ncols)
    (declare (special |$bcParseOnly|))
    (setq page (|htInitPage| "Basic Matrix Command" (|httpPropertyList| htPage)))
    (|htMakePage|
      '((|domainConditions| (|isDomain| S (|Symbol|))
        (|isDomain| FE (|Expression| (|Integer|))))
        (|text| . "\\menuitemstyle{\\tab{2}}")
        (|text| . "Enter the {\\em row variable}: ")
        (|text| . "\\tab{36}") (|bcStrings| (6 |i| |rowVar| S))
        (|text| . "\\blankline ") (|text| . "\\newline ")
        (|text| . "\\menuitemstyle{\\tab{2}}")
        (|text| . "Enter the {\\em column variable}: ")
        (|text| . "\\tab{36}") (|bcStrings| (6 |j| |colVar| S))
        (|text| . "\\blankline ") (|text| . "\\newline ")
        (|text| . "\\menuitemstyle{\\tab{2}}")
        (|text|
          . "Enter the general {\\em formula} for the entries:")
        (|text| . "\\newline\\tab{2} ")
        (|bcStrings| (40 "1/(x - i - j - 1)" |formula| FE))))
    (|htMakeDoneButton| "Continue" ' |bcInputMatrixByFormulaGen|)
    (setq nrows
      (if (null |$bcParseOnly|)
        (|objValUnwrap| (|httpLabelSpadValue| htPage ' |rows|))
        (parse-integer (|httpLabelInputString| htPage ' |rows|))))
    (setq ncols
      (if (null |$bcParseOnly|)
        (|objValUnwrap| (|httpLabelSpadValue| htPage ' |cols|))
```

```

      (parse-integer (|httpLabelInputString| htPage '|cols|))))
    (|httpSetProperty| page '|nrows| nrows)
    (|httpSetProperty| page '|ncols| ncols)
    (|htShowPage|)))

```

defun Basic Command Matrix by Formula generate

```

[httpProperty p1254]
[httpLabelInputString p1254]
[bcGen p1245]
[stringimage p??]
[strconc p??]

```

— defun bcInputMatrixByFormulaGen —

```

(defun |bcInputMatrixByFormulaGen| (htPage)
  (let (fun formula rowVar colVar nrows ncols)
    (cond
      ((setq fun (|httpProperty| htPage '|exitFunction|))
       (funcall fun htPage))
      (t
       (setq formula (|httpLabelInputString| htPage '|formula|))
       (setq rowVar (|httpLabelInputString| htPage '|rowVar|))
       (setq colVar (|httpLabelInputString| htPage '|colVar|))
       (setq nrows (|httpProperty| htPage '|nrows|))
       (setq ncols (|httpProperty| htPage '|ncols|))
       (|bcGen| (strconc "matrix([" formula
                        " for " colVar
                        " in 1.." (stringimage ncols)
                        "]" for " rowVar
                        " in 1.." (stringimage nrows)
                        "]))))))))

```

defun Input Explicit Matrix

```

[objValUnwrap p??]
[httpLabelSpadValue p1256]
[httpLabelInputString p1254]
[parse-integer p??]
[length p??]
[stringimage p??]

```

```
[nreverse0 p??]
[strconc p??]
[htInitPage p1262]
[htpPropertyList p1253]
[bcHt p1260]
[htMakePage p1263]
[htMakeDoneButton p1284]
[htpSetProperty p1254]
[htShowPage p1263]
[$EmptyMode p??]
[$bcParseOnly p1249]
```

Enter t
R
R
R
R

Pressing the **Continue** button will call the function **bcGenExplicitMatrix** due to this line:

```
([htMakeDoneButton| "Continue" '|bcGenExplicitMatrix|)
```

— defun bcInputExplicitMatrix —

```
(defun |bcInputExplicitMatrix| (htPage junk)
  (declare (ignore junk))
  (let (nrows ncols cond wrows wcols rowpart colpart prefix k name
        labelList page t1 t2)
    (declare (special |$EmptyMode| |$bcParseOnly|))
    (setq nrows
      (if (null |$bcParseOnly|)
          (|objValUnwrap| (|htpLabelSpadValue| htPage '|rows|))
          (parse-integer (|htpLabelInputString| htPage '|rows|))))
    (setq ncols
      (if (null |$bcParseOnly|)
          (|objValUnwrap| (|htpLabelSpadValue| htPage '|cols|))
          (parse-integer (|htpLabelInputString| htPage '|cols|))))
    (setq k 0)
    (setq wrows (|#| (stringimage nrows)))
    (setq wcols (|#| (stringimage ncols)))
    (setq labelList
      (do ((i 1 (1+ i))) ((> i nrows) t1)
          (setq t2 nil)
```

```

(setq t1
  (append t1
    (do ((j 1 (1+ j))) (> j ncols) (nreverse0 t2))
    (setq t2
      (cons
        (progn
          (setq rowpart (strconc "{\\em Row" (|htStringPad| i wrows)))
          (setq colpart (strconc ", Column" (|htStringPad| j wcols)
                                ":{\\space{2}}"))
          (setq prefix (strconc rowpart colpart))
          (setq name (intern (stringimage (setq k (1+ k)))))
          (list prefix "" 30 0 name 'P))
        t2))))))
(setq labelList
  (list
    (list '|domainConditions|
      '|(isDomain| P (|Polynomial| |$EmptyMode|))
      cond)
    (cons '|inputStrings| labelList)))
(setq page (|htInitPage| "Solve Basic Command" (|httpPropertyList| htPage)))
(|bcHt| "Enter the entries of the matrix:")
(|htMakePage| labelList)
(|htMakeDoneButton| "Continue" '|bcGenExplicitMatrix|)
(|httpSetProperty| page '|nrows| nrows)
(|httpSetProperty| page '|ncols| ncols)
(|htShowPage|))

```

defun Basic Command generate explicit matrix

[\[httpSetProperty p1254\]](#)
[\[httpInputAreaAlist p1253\]](#)
[\[httpProperty p1254\]](#)
[\[bcGen p1245\]](#)
[\[bcMatrixGen p1188\]](#)

— defun bcGenExplicitMatrix —

```

(defun |bcGenExplicitMatrix| (htPage)
  (let (fun)
    (|httpSetProperty| htPage '|matrix| (|httpInputAreaAlist| htPage))
    (if (setq fun (|httpProperty| htPage '|exitFunction|))
      (funcall fun htPage)
      (|bcGen| (|bcMatrixGen| htPage)))))

```

defun Basic Command generate matrix

```
[httpProperty p1254]
[lassoc p??]
[strconc p??]
[stringimage p??]
[bcwords2liststring p1246]
[systemError p??]
```

— defun bcMatrixGen —

```
(defun |bcMatrixGen| (htPage)
  (let (nrows ncols formula rowVar colVar mat k matform matstring)
    (setq nrows (|httpProperty| htPage '|nrows|))
    (setq ncols (|httpProperty| htPage '|ncols|))
    (setq mat (|httpProperty| htPage '|matrix|))
    (cond
      ((setq formula (lassoc '|formula| mat))
        (setq formula (elt formula 0))
        (setq rowVar (elt (lassoc '|rowVar| mat) 0))
        (setq colVar (elt (lassoc '|colVar| mat) 0))
        (strconc "matrix([" formula
                  " for " colVar
                  " in 1.." (stringimage ncols)
                  "]" for " rowVar
                  " in 1.." (stringimage nrows)
                  "]))"))
      ((setq mat (|httpProperty| htPage '|matrix|))
        (setq mat (reverse mat))
        (setq k (- 1))
        (setq matform
          (loop for i from 0 to (1- nrows)
                collect (loop for j from 0 to (1- ncols)
                              collect (elt (elt mat (incf k)) 1))))
        (setq matstring
          (|bcwords2liststring|
            (loop for t1 in matform collect (|bcwords2liststring| t1))))
        (strconc "matrix(" matstring ")"))
      (t (|systemError| nil)))))
```

;-Hypertext commands other than solve and matrix

defun Basic Command iteration

[bcMatrixGen p1188]

— defun bcDrawIt2 —

```
(defun |bcDrawIt2| (ind a b)
  (strconc "{}" ind "=" a "{}.." b "{}"))
```

—————

defun Indefinite Integration Basic Command

[htInitPage p1262]

[htMakePage p1263]

[htShowPage p1263]

[\$EmptyMode p??]

Enter the functi

1/(x**2 + 6)_

Enter the variab

Pressing
the **Continue** button will call the function **bcIndefiniteIntegrateGen** due to this line:

```
(|doneButton| "Continue" |bcIndefiniteIntegrateGen|)))
```

— defun bcIndefiniteIntegrate —

```
(defun |bcIndefiniteIntegrate| ()
  (declare (special |$EmptyMode|))
  (|htInitPage| '|Indefinite Integration Basic Command| nil)
  (|htMakePage|
    '((|domainConditions| (|isDomain| EM |$EmptyMode|)
      (|isDomain| S (|String|)) (|isDomain| SY (|Symbol|))))
    (|text| . "\\newline ")
    (|text| . "\\menuitemstyle{\\tab{2}}")
    (|text| . "Enter the {\\em function} you would like to integrate:")
    (|text| . "\\newline\\tab{2} ")
    (|bcStrings| (45 "1/(x**2 + 6)" |integrand| EM))
    (|text| . "\\blankline") (|text| . "\\newline ")
    (|text| . "\\menuitemstyle{\\tab{2}}")
```

```
(|text| . "Enter the {\em variable of integration}:")
(|text| . "\\tab{37}") (|bcStrings| (10 |x| |symbol| SY))
(|doneButton| "Continue" |bcIndefiniteIntegrateGen|))
(|htShowPage|))
```

defun bcIndefiniteIntegrateGen

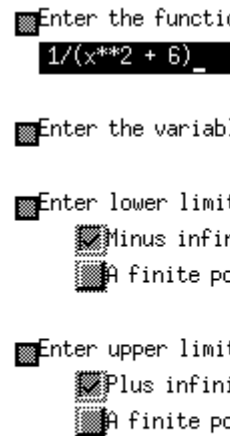
```
[|htLabelInputString| p1254]
[|strconc| p??]
[|bcGen| p1245]
```

— defun bcIndefiniteIntegrateGen —

```
(defun |bcIndefiniteIntegrateGen| (htPage)
  (let (integrand var)
    (setq integrand (|htLabelInputString| htPage '|integrand|))
    (setq var (|htLabelInputString| htPage '|symbol|))
    (|bcGen| (strconc "integrate(" integrand "," var ")"))))
```

defun Definite Integration Basic Command

```
[|htInitPage| p1262]
[|htMakePage| p1263]
[|htShowPage| p1263]
[|$EmptyMode| p??]
```



Pressing the **Continue** button will call the function **bcDefiniteIntegrateGen** due to this line:

```
(|doneButton| "Continue" |bcDefiniteIntegrateGen|)
```

— defun bcDefiniteIntegrate —

```
(defun |bcDefiniteIntegrate| ()
  (declare (special |$EmptyMode|))
  (|htInitPage| ' |Definite Integration Basic Command| NIL)
  (|htMakePage|
    '((|domainConditions| (|isDomain| EM |$EmptyMode|)
      (|isDomain| S (|String|)) (|isDomain| SY (|Symbol|)))
      (|text| . "\\newline ")
      (|text| . "\\menuitemstyle{\\tab{2}}")
      (|text| . "Enter the {\\em function} you would like to integrate:")
      (|text| . "\\newline\\tab{2} ")
      (|bcStrings| (45 "1/(x**2 + 6)" |integrand| EM))
      (|text| . "\\blankline") (|text| . "\\newline ")
      (|text| . "\\menuitemstyle{\\tab{2}}")
      (|text| . "Enter the {\\em variable of integration}:")
      (|text| . "\\tab{37}") (|bcStrings| (10 |x| |symbol| SY))
      (|text| . "\\blankline") (|text| . "\\newline ")
      (|text| . "\\menuitemstyle{\\tab{2}}")
      (|text| . "\\newline Enter {\\em lower limit}:")
      (|radioButtons| |fromButton|
        (" " "Minus infinity" |minusInfinity|)
        (" "
          (|text| . "A finite point:\\tab{15}")
          (|bcStrings| (10 0 |from| EM . |bcOptional|))))))
```



```

      |fromPoint|))
(|text| . "\\blankline") (|text| . "\\newline ")
(|text| . "\\menuitemstyle{\\tab{2}}")
(|text| . "\\indent{2}\\newline Enter {\\em upper limit}:")
(|radioButtons| |toButton|
  (" " "Plus infinity" |plusInfinity|)
  (" "
    ((|text| "A finite point:\\tab{15}")
      (|bcStrings| (10 |y| |to| EM . |bcOptional|)))
    |toPoint|))
  (|doneButton| "Continue" |bcDefiniteIntegrateGen|)))
(|htShowPage|))

```

defun bcDefiniteIntegrateGen

```

[htpLabelInputString p1254]
[htpButtonValue p1252]
[strconc p??]
[bcGen p1245]

```

— defun bcDefiniteIntegrateGen —

```

(defun |bcDefiniteIntegrateGen| (htPage)
  (let (integrand var lowerLimit upperLimit varpart)
    (setq integrand (|htpLabelInputString| htPage '|integrand|))
    (setq var (|htpLabelInputString| htPage '|symbol|))
    (setq lowerLimit
      (if (eq (|htpButtonValue| htPage '|fromButton|) '|fromPoint|)
        (|htpLabelInputString| htPage '|from|)
        "%minusInfinity"))
    (setq upperLimit
      (if (eq (|htpButtonValue| htPage '|toButton|) '|toPoint|)
        (|htpLabelInputString| htPage '|to|)
        "%plusInfinity"))
    (setq varpart (strconc var " = " lowerLimit ".." upperLimit))
    (|bcGen| (strconc "integrate(" integrand "," varpart "))))

```

defun Sum Basic Command

```

[htInitPage p1262]
[htMakePage p1263]

```

[htShowPage p1263]
 [\$EmptyMode p??]

Enter the function
 i^{**3}

Enter the summation

Enter the limits
 From: 1

Pressing

the **Continue** button will call the function **bcSumGen** due to this line:

```
(|doneButton| "Continue" |bcSumGen|)
```

— defun bcSum —

```
(defun |bcSum| ()
  (declare (special |$EmptyMode|))
  (|htInitPage| ' |Sum Basic Command| NIL)
  (|htMakePage|
    ' ( (|domainConditions| (|isDomain| EM |$EmptyMode|)
        (|isDomain| S (|String|)) (|isDomain| SY (|Symbol|)))
      (|text| . "\\newline ")
      (|text| . "\\menuitemstyle{}\\tab{2}")
      (|text| . "Enter the {\\em function} you would like to sum:")
      (|text| . "\\newline\\tab{2} ")
      (|bcStrings| (44 "i**3" |summand| EM))
      (|text| . "\\blankline ") (|text| . "\\newline ")
      (|text| . "\\menuitemstyle{}\\tab{2}")
      (|text| . "Enter the {\\em summation index}:")
      (|text| . "\\tab{36}") (|bcStrings| (10 |i| |index| SY))
      (|text| . "\\blankline ") (|text| . "\\newline ")
      (|text| . "\\menuitemstyle{}\\tab{2}")
      (|text| . "Enter the limits of the sum:")
      (|text| . "\\newline\\tab{10}{\\em From:}")
      (|bcStrings| (10 1 |first| S))
      (|text| . "\\tab{32}{\\em To:}") (|text| . "\\tab{36}")
      (|bcStrings| (10 |n| |last| S))
      (|doneButton| "Continue" |bcSumGen|)))
  (|htShowPage|))
```

defun bcSumGen

```
[htpLabelInputString p1254]
[strconc p??]
[bcGen p1245]
```

— defun bcSumGen —

```
(defun |bcSumGen| (htPage)
  (let (mand index car last)
    (setq mand (|htpLabelInputString| htPage '|summand|))
    (setq index (|htpLabelInputString| htPage '|index|))
    (setq car (|htpLabelInputString| htPage '|first|))
    (setq last (|htpLabelInputString| htPage '|last|))
    (|bcGen| (strconc "sum(" mand "," index " = " car ".." last ")"))))
```

—————

defun Sum Basic Command

```
[htInitPage p1262]
[htMakePage p1263]
[htShowPage p1263]
[$EmptyMode p??]
```

— defun bcProduct —

```
(defun |bcProduct| ()
  (declare (special |$EmptyMode|))
  (|htInitPage| '|Product Basic Command| NIL)
  (|htMakePage|
    '((|domainConditions| (|isDomain| EM |$EmptyMode|)
      (|isDomain| S (|String|)) (|isDomain| SY (|Symbol|)))
      (|text| .
        "Enter the {\em function} you would like to compute the product of:")
      (|inputStrings| (" " " 45 "i**2" |mand| EM))
      (|text| . "\vspace{1}\newline")
      (|inputStrings|
        ("Enter the {\em index of the product}:" " 5 |i| |index| SY))
      (|text| . "\vspace{1}\newline Enter the limits of the index:")
      (|inputStrings|
        ("\\newline{\em From}:" " 10 "1" |first| EM)
        ("{\em To}:\space{2}" " 10 "n" |last| EM))
      (|doneButton| "Continue" |bcProductGen|)))
  (|htShowPage|))
```

—————

defun bcProductGen

```
[htLabelInputString p1254]
[strconc p??]
[bcGen p1245]
```

— defun bcProductGen —

```
(defun |bcProductGen| (htPage)
  (let (mand index car last)
    (setq mand (|htLabelInputString| htPage '|mand|))
    (setq index (|htLabelInputString| htPage '|index|))
    (setq car (|htLabelInputString| htPage '|first|))
    (setq last (|htLabelInputString| htPage '|last|))
    (|bcGen| (strconc "product(" mand "," index "," car "," last ")"))))
```

—————

defun Differentiate Basic Command

```
[htInitPage p1262]
[htMakePage p1263]
[htMakeDoneButton p1284]
[htShowPage p1263]
[$EmptyMode p??]
```

```
■ Enter the function you want to differentiate
  sin(x*y)
■ List the variables you want to differentiate
  x y
■ List the number of times you want to differentiate each)
  1 2
```

Pressing the **Continue** button will call the function **bcDifferentiateGen** due to this line:

```
(|htMakeDoneButton| "Continue" '|bcDifferentiateGen|)
```

— defun bcDifferentiate —

```

(defun |bcDifferentiate| ()
  (declare (special |$EmptyModel|))
  (|htInitPage| '|Differentiate Basic Command| nil)
  (|htMakePage|
    '((|domainConditions| (|isDomain| EM |$EmptyModel|)
      (|isDomain| S (|String|)) (|isDomain| SY (|Symbol|)))
      (|text| . "\\newline ")
      (|text| . "\\menuitemstyle{\\tab{2}}")
      (|text| . "Enter the {\\em function} you want to differentiate:")
      (|text| . "\\newline\\tab{2} ")
      (|bcStrings| (55 "sin(x*y)" |diffand| EM))
      (|text| . "\\blankline") (|text| . "\\newline ")
      (|text| . "\\menuitemstyle{\\tab{2}}")
      (|text| .
        "\\newline List the {\\em variables} you want to differentiate with respect to?")
      (|text| . "\\newline\\tab{2} ")
      (|bcStrings| (55 "x y" |variables| S . |quoteString|))
      (|text| . "\\blankline") (|text| . "\\newline ")
      (|text| . "\\menuitemstyle{\\tab{2}}")
      (|text| .
        "\\newline List the number of {\\em times} you want to differentiate with respect to each variable?")
      (|text| . "\\newline\\tab{2} ")
      (|bcStrings| (55 "1 2" |times| S . |quoteString|))))
    (|htMakeDoneButton| "Continue" '|bcDifferentiateGen|)
    (|htShowPage|))

```

defun bcDifferentiateGen

```

[|htLabelInputString| p1254]
[|bcString2WordList| p1246]
[|bcwords2liststring| p1246]
[length p??]
[|bcError| p1247]
[|strconc| p??]
[|bcGen| p1245]

```

— defun bcDifferentiateGen —

```

(defun |bcDifferentiateGen| (|htPage|)
  (let (|mand| |varlist| |indexList| |varpart| |indexpart| |lastPart|)
    (setq |mand| (|htLabelInputString| |htPage| '|diffand|))
    (setq |varlist|
      (|bcString2WordList| (|htLabelInputString| |htPage| '|variables|)))
    (setq |indexList|
      (|bcString2WordList| (|htLabelInputString| |htPage| '|times|)))

```

```

(setq varpart
  (if (> (|#| varlist) 1)
    (|bcwords2liststring| varlist)
    (car varlist)))
(setq indexpart
  (cond
    ((null indexList) nil)
    ((null (cdr indexList)) (car indexList))
    ((= (|#| indexList) (|#| varlist)) (|bcwords2liststring| indexList))
    (t (|bcError|
      "You must say how many times you want to differentiate with respect to each variable---or leave that entry blank"
      (setq lastPart (if indexpart (strconc " " indexpart " ") " ")
        (|bcGen| (strconc "differentiate(" mand " " varpart lastPart)))))))

```

defun Draw Basic Command

```

[htInitPage p1262]
[bcHt p1260]
[htShowPage p1263]

```

What would you like

A function of one variable
 A parametrically defined curve
 A solution to a polynomial equation

A function of two variables
 A parametrically defined surface
 A parameterically defined surface

— defun bcDraw —

```

(defun |bcDraw| ()
  (|htInitPage| "Draw Basic Command" NIL)
  (|bcHt| "What would you like to draw?")
  (|bcHt| "\\newline\\centerline{{\\em Two Dimensional Plots}}\\newline")
  (|bcHt| "\\lispdownlink{A function of one variable}{{(|bcDraw2Dfun|)}}")
  (|bcHt| "\\space{2}y = f(x)\\newline")
  (|bcHt| "\\lispdownlink{A parametrically defined curve}{{(|bcDraw2Dpar|)}}")
  (|bcHt| "\\space{2}(x(t), y(t))\\newline")
  (|bcHt|
    "\\lispdownlink{A solution to a polynomial equation}{{(|bcDraw2DSolve|)}}")
  (|bcHt| "\\space{2} p(x,y) = 0\\newline")

```

```
(|bcHt| "\\vspace{1}\\newline ")
(|bcHt| "\\centerline{{\\em Three Dimensional Surfaces}}\\newline\\newline")
(|bcHt| "\\lispdownlink{A function of two variables}{(|bcDraw3Dfun|)}")
(|bcHt| "\\space{2} z = f(x,y)\\newline")
(|bcHt| "\\lispdownlink{A parametrically defined tube}{(|bcDraw3Dpar|)}")
(|bcHt| "\\space{2}(x(t), y(t), z(t))\\newline")
(|bcHt| "\\lispdownlink{A parameterically defined surface}{(|bcDraw3Dpar1|)}")
(|bcHt| "\\space{2}(x(u,v), y(u,v), z(u,v))\\newline")
(|htShowPage|))
```

defun Draw Basic Command by Function

```
[htInitPage p1262]
[htMakePage p1263]
[htShowPage p1263]
[$EmptyMode p??]
```

What fun
x*cos(x

Enter de

Enter in
Variable

Optional

Pressing
the **Continue** button will call the function **bcDraw2DfunGen** due to this line:

```
(|doneButton| "Continue" |bcDraw2DfunGen|)
```

— defun bcDraw2Dfun —

```
(defun |bcDraw2Dfun| ()
```

```

(declare (special |$EmptyModel|))
(|htInitPage| "Draw Basic Command" NIL)
(|htMakePage|
  '((|domainConditions| (|isDomain| EM |$EmptyModel|)
    (|isDomain| F (|Float|)) (|isDomain| SY (|Symbol|)))
    (|text| "\\centerline{Drawing {\em y = f(x)}\\newline "
      "\\centerline{where {\em y} is the dependent variable and}\\newline "
      "\\centerline{where {\em x} is the independent variable}\\vspace{1}\\newline "
      "\\menuitemstyle{\\tab{2}What {\em function} f would you like to draw?\\newline\\tab{2}"}
        (|bcStrings| (55 "x*cos(x)" |function| EM))
        (|text| .
      "\\vspace{1}\\newline\\menuitemstyle{\\tab{2}Enter {\em dependent} variable:")
        (|bcStrings| (6 |y| |dependent| SY))
        (|text| . "\\newline\\vspace{1}\\newline ")
        (|text| .
      "\\menuitemstyle{\\tab{2}Enter {\em independent} variable and {\em range}:\\newline\\tab{2} "
        (|text| . "{\em Variable:}") (|bcStrings| (6 |x| |ind| SY))
        (|text| . "ranges {\em from:}")
        (|bcStrings| (9 0 |from1| F)) (|text| . "{\em to:}")
        (|bcStrings| (9 30 |to1| F))
        (|text| "\\indent{0}\\vspace{1}\\newline\\menuitemstyle{\\tab{2} "
          "Optionally enter a {\em title} for your curve:")
        (|bcStrings| (15 "y = x*cos(x)" |title| S))
        (|text| . "\\indent{0}")
        (|doneButton| "Continue" |bcDraw2DfunGen|) (|text| . "{ }"))
(|htShowPage|))

```

defun bcDraw2DfunGen

[[httpLabelInputString](#) p1254]
 [strconc p??]
 [bcFinish p1243]
 [bcDrawIt2 p1189]

— defun bcDraw2DfunGen —

```

(defun |bcDraw2DfunGen| (htPage)
  (let (fun dep ind from1 to1 title titlePart)
    (setq fun (|httpLabelInputString| htPage '|function|))
    (setq dep (|httpLabelInputString| htPage '|dependent|))
    (setq ind (|httpLabelInputString| htPage '|ind|))
    (setq from1 (|httpLabelInputString| htPage '|from1|))
    (setq to1 (|httpLabelInputString| htPage '|to1|))
    (setq title (|httpLabelInputString| htPage '|title|))
    (cond

```



```

(not (string-equal title ""))
  (setq titlePart (strconc "{}" "title ==\" title "\\\"))
  (|bcFinish| "draw" fun (|bcDrawIt2| ind from1 to1) titlePart))
(t
  (|bcFinish| "draw" fun (|bcDrawIt2| ind from1 to1))))))

```

defun Draw Basic Command by Parameters

```

[htInitPage p1262]
[htMakePage p1263]
[htShowPage p1263]
[$EmptyMode p??]

```

Enter the
Function
Function

Enter inc
Variable:

Optional.

Pressing
the **Continue** button will call the function **bcDraw2DparGen** due to this line:

```
(|doneButton| "Continue" |bcDraw2DparGen|)
```

— defun bcDraw2Dpar —

```

(defun |bcDraw2Dpar| ()
  (declare (special |$EmptyMode|))
  (|htInitPage| "Draw Basic Command" NIL)
  (|htMakePage|
    '((|domainConditions| (|isDomain| EM |$EmptyMode|)

```

```

      (|isDomain| F (|Float|)) (|isDomain| SY (|Symbol|)))
(|text| "\\centerline{Drawing a parametrically defined curve:}\\newline "
 "\\centerline{{\\em ( f1(t), f2(t) )}}\\newline "
 "\\centerline{in terms of two functions {\\em f1} and {\\em f2}}")
 "\\centerline{and an independent variable {\\em t}}\\vspace{1}\\newline"
 "\\menuitemstyle{\\tab{2}Enter the two {\\em functions:}}")
(|text| . "\\newline\\tab{2}{\\em Function 1:}")
(|bcStrings| (44 "-9*sin(4*t/5)" |function1| EM))
(|text| . "\\newline\\tab{2}{\\em Function 2:}")
(|bcStrings| (44 "8*sin(t)" |function2| EM))
(|text| .
 "\\vspace{1}\\newline\\menuitemstyle{\\tab{2}Enter {\\em independent} variable and range:\\newline\\tab{2}
 {\\em Variable:}}") (|bcStrings| (6 |t| |ind| SY))
(|text| . "ranges {\\em from:}")
(|bcStrings| (9 "-5*\\%pi" |from1| F))
(|text| . "{\\em to:}") (|bcStrings| (9 "5*\\%pi" |to1| F))
(|text| "\\vspace{1}\\newline\\menuitemstyle{\\tab{2}
 \"Optionally enter a {\\em title} for your curve:}")
(|bcStrings| (15 "Lissajous" |title| S))
(|text| . "\\indent{0}")
(|doneButton| "Continue" |bcDraw2DparGen|)))
(|htShowPage|))

```

defun bcDraw2DparGen

```

[htpLabelInputString p1254]
[strconc p??]
[bcFinish p1243]
[bcDrawIt2 p1189]

```

— defun bcDraw2DparGen —

```

(defun |bcDraw2DparGen| (htPage)
  (let (fun1 fun2 ind from1 to1 title curvePart titlePart)
    (setq fun1 (|htpLabelInputString| htPage '|function1|))
    (setq fun2 (|htpLabelInputString| htPage '|function2|))
    (setq ind (|htpLabelInputString| htPage '|ind|))
    (setq from1 (|htpLabelInputString| htPage '|from1|))
    (setq to1 (|htpLabelInputString| htPage '|to1|))
    (setq title (|htpLabelInputString| htPage '|title|))
    (setq curvePart (strconc "curve(" "{}" fun1 ",{" fun2 ")"))
    (cond
      ((not (string-equal title ""))
        (setq titlePart (strconc "{" "title ==\" title "\""))
        (|bcFinish| "draw" curvePart (|bcDrawIt2| ind from1 to1) titlePart))
    )
  )

```

```
(t
  (|bcFinish| "draw" curvePart (|bcDrawIt2| ind from1 to1))))))
```

defun Draw Basic Command by Equation Solution

```
[htInitPage p1262]
[htMakePage p1263]
[htMakeDoneButton p1284]
[htShowPage p1263]
[$EmptyMode p??]
```

Enter the
y**2+7*x

Enter the
Variable 1
Variable 2

Optionally

Pressing the **Continue** button will call the function **bcDraw2DSolveGen** due to this line:

```
(|htMakeDoneButton| "Continue" ' |bcDraw2DSolveGen|)
```

— defun bcDraw2DSolve —

```
(defun |bcDraw2DSolve| ()
  (declare (special |$EmptyMode|))
  (|htInitPage| "Draw Basic Command" nil)
  (|htMakePage|
    '((|domainConditions| (|isDomain| EM |$EmptyMode|)
      (|isDomain| F (|Float|)) (|isDomain| SY (|Symbol|)))
      (|text| "\\centerline{Plotting the solution to {\em p(x,y) = 0}, where} "
        "\\centerline{{\em p} is a polynomial in two variables {\em x} and {\em y}} "
        "\\vspace{1}\newline\menuitemstyle{\tab{2}Enter the {\em polynomial} p:"
```

```

"\newline\tab{2}")
(|bcStrings| (40 "y**2+7*x*y-(x**3+16*x)" |function| EM))
(|text| .
"\vspace{1}\newline\menuitemstyle{}\tab{2}Enter the {\em variables}:")
(|text| . "\newline\tab{2}{\em Variable 1:} ")
(|bcStrings| (4 |x| |independent1| SY))
(|text| . "ranges {\em from:}")
(|bcStrings| (9 -15 |from1| F)) (|text| . "{\em to:}")
(|bcStrings| (9 10 |to1| F))
(|text| . "\newline\tab{2}{\em Variable 2:} ")
(|bcStrings| (4 |y| |independent2| SY))
(|text| . "ranges {\em from:}")
(|bcStrings| (9 -10 |from2| F)) (|text| . "{\em to:}")
(|bcStrings| (9 50 |to2| F))
(|text| "\indent{0}\vspace{1}\newline\menuitemstyle{}\tab{2} "
"Optionally enter a {\em title} for your curve:")
(|bcStrings| (15 "" |title| S)) (|text| . "\indent{0}"))
(|htMakeDoneButton| "Continue" '|bcDraw2DSolveGen|)
(|htShowPage|))

```

defun bcDraw2DSolveGen

```

[htLabelInputString p1254]
[strconc p??]
[bcFinish p1243]

```

— defun bcDraw2DSolveGen —

```

(defun |bcDraw2DSolveGen| (htPage)
  (let (fun ind1 from1 to1 ind2 from2 to2 title clipPart titlePart)
    (setq fun (|htLabelInputString| htPage '|function|))
    (setq ind1 (|htLabelInputString| htPage '|independent1|))
    (setq from1 (|htLabelInputString| htPage '|from1|))
    (setq to1 (|htLabelInputString| htPage '|to1|))
    (setq ind2 (|htLabelInputString| htPage '|independent2|))
    (setq from2 (|htLabelInputString| htPage '|from2|))
    (setq to2 (|htLabelInputString| htPage '|to2|))
    (setq title (|htLabelInputString| htPage '|title|))
    (setq clipPart (strconc "{" "range==" "{"
                           from1 ".." to1 '|,{|
                           from2 ".." to2 "]" ))
    (cond
      ((not (string-equal title ""))
       (setq titlePart (strconc "{" "title ==\" title "\""))
       (|bcFinish| "draw" (strconc fun " = 0 ") ind1 ind2 clipPart titlePart))
    )
  )

```

```
(t
  (|bcFinish| "draw" (strconc fun " = 0 ") ind1 ind2 clipPart))))
```

defun Draw Basic Command by 3D function

```
[htInitPage p1262]
[htMakePage p1263]
[htShowPage p1263]
[$EmptyMode p??]
```

What func
exp(cos(
Enter dep
Enter ind
Variable:
Variable:
Optionall

Pressing the **Continue** button will call the function **bcDraw3DfunGen** due to this line:

```
(|doneButton| "Continue" |bcDraw3DfunGen|)
```

— defun bcDraw3Dfun —

```
(defun |bcDraw3Dfun| ()
  (declare (special |$EmptyMode|))
  (|htInitPage| "Three Dimensional Draw Basic Command" nil)
  (|htMakePage|
    '((|domainConditions| (|isDomain| EM |$EmptyMode|)
      (|isDomain| F (|Float|)) (|isDomain| SY (|Symbol|)))
      (|text| "\\centerline{Drawing {\em z = f(x,y)}\\newline "
        "\\centerline{where {\em z} is the dependent variable and}\\newline "
```

```
"\\centerline{where {\em x, y} are the independent variables}\\vspace{1}\\newline\\menuitemstyle{}\\tab{2}
  "What {\em function} f which you like to draw?\\newline\\tab{2}"
  (|bcStrings| (55 "exp(cos(x-y)-sin(x*y))-2" |function| EM))
  (|text| .
    "\\newline\\menuitemstyle{}\\tab{2}Enter {\em dependent} variable:")
  (|bcStrings| (6 |z| |dependent| SY))
  (|text| "\\vspace{1}\\newline\\menuitemstyle{}\\tab{2}"
    "Enter {\em independent} variables and ranges:\\newline\\tab{2} "
    "{\em Variable:}")
  (|bcStrings| (6 |x| |independent1| SY))
  (|text| . "ranges {\em from:}")
  (|bcStrings| (9 -5 |from1| F)) (|text| . "{\em to:}")
  (|bcStrings| (9 5 |to1| F))
  (|text| . "\\newline\\tab{2}{\em Variable:}")
  (|bcStrings| (6 |y| |independent2| SY))
  (|text| . "ranges {\em from:}")
  (|bcStrings| (9 -5 |from2| F)) (|text| . "{\em to:}")
  (|bcStrings| (9 5 |to2| F))
  (|text| "\\indent{0}\\vspace{1}\\newline\\menuitemstyle{}\\tab{2} "
    "Optionally enter a {\em title} for your surface:")
  (|bcStrings| (15 "" |title| S)) (|text| . "\\indent{0}")
  (|doneButton| "Continue" |bcDraw3DfunGen|)))
(|htShowPage|))
```

defun bcDraw3DfunGen

[htpLabelInputString p1254]
 [strconc p??]
 [bcFinish p1243]
 [bcDrawIt2 p1189]

— defun bcDraw3DfunGen —

```
(defun |bcDraw3DfunGen| (htPage)
  (let (fun dep ind1 from1 to1 ind2 from2 to2 title titlePart)
    (setq fun (|htpLabelInputString| htPage '|function|))
    (setq dep (|htpLabelInputString| htPage '|dependent|))
    (setq ind1 (|htpLabelInputString| htPage '|independent1|))
    (setq from1 (|htpLabelInputString| htPage '|from1|))
    (setq to1 (|htpLabelInputString| htPage '|to1|))
    (setq ind2 (|htpLabelInputString| htPage '|independent2|))
    (setq from2 (|htpLabelInputString| htPage '|from2|))
    (setq to2 (|htpLabelInputString| htPage '|to2|))
    (setq title (|htpLabelInputString| htPage '|title|))
    (cond
```

```
((not (string-equal title ""))
  (setq titlePart (strconc "{" "title ==\" title \"\"))
  (|bcFinish| "draw" fun
    (|bcDrawIt2| ind1 from1 to1)
    (|bcDrawIt2| ind2 from2 to2) titlePart))
(t
  (|bcFinish| "draw" fun
    (|bcDrawIt2| ind1 from1 to1)
    (|bcDrawIt2| ind2 from2 to2))))))
```

defun Draw Basic Command by 3D parameterized tube

```
[htInitPage p1262]
[htMakePage p1263]
[htShowPage p1263]
[$EmptyMode p??]
```

Enter the three
Function f1: 1
Function f2: 1
Function f3: 2

Enter independent
Variable: t

Optionally enter

Pressing the **Continue** button will call the function **bcDraw3DparGen** due to this line:

```
(|doneButton| "Continue" |bcDraw3DparGen|)
```

— defun bcDraw3Dpar —

```
(defun |bcDraw3Dpar| ()
```

```

(declare (special |$EmptyModel|))
(|htInitPage| "Draw Basic Command" NIL)
(|htMakePage|
  '((|domainConditions| (|isDomain| EM |$EmptyModel|
    (|isDomain| F (|Float|)) (|isDomain| SY (|Symbol|))))
    (|text| "\\centerline{Drawing a parametrically defined curve:"
      "{\\em ( f1(t), f2(t), f3(t) )}\\}\\newline "
      "\\centerline{in terms of three functions {\\em f1}, {\\em f2}, and {\\em f3}\\}\\newline "
      "\\centerline{and an independent variable {\\em t}\\}\\vspace{1}\\}\\newline\\menuitemstyle{\\}\\tab{2} "
      "Enter the three {\\em functions} of the independent variable:")
      (|text| . "\\newline\\tab{2}{\\em Function f1:}")
      (|bcStrings| (42 "1.3*cos(2*t)*cos(4*t) + sin(4*t)*cos(t)" |function1| EM))
      (|text| . "\\newline\\tab{2}{\\em Function f2:}")
      (|bcStrings| (42 "1.3*sin(2*t)*cos(4*t) - sin(4*t)*sin(t)" |function2| EM))
      (|text| . "\\newline\\tab{2}{\\em Function f3:}")
      (|bcStrings| (42 "2.5*cos(4*t)" |function3| EM))
      (|text| .
        "\\vspace{1}\\}\\newline\\menuitemstyle{\\}\\tab{2}Enter {\\em independent} variable and range:\\}\\newline\\tab{2}
        (|text| . "{\\em Variable:}") (|bcStrings| (6 |t| |ind| SY))
        (|text| . "ranges {\\em from:}")
        (|bcStrings| (9 0 |from1| F)) (|text| "{\\em to:}")
        (|bcStrings| (9 "4*\\%pi" |to1| F))
        (|text| "\\indent{0}\\}\\vspace{1}\\}\\newline\\menuitemstyle{\\}\\tab{2} "
          "Optionally enter a {\\em title} for your surface:")
        (|bcStrings| (15 "knot" |title| S)) (|text| . "\\indent{0}")
        (|doneButton| "Continue" |bcDraw3DparGen|)))
(|htShowPage|))

```

defun bcDraw3DparGen

[[httpLabelInputString p1254](#)]

[[strconc p??](#)]

[[bcFinish p1243](#)]

[[bcDrawIt2 p1189](#)]

— defun bcDraw3DparGen —

```

(defun |bcDraw3DparGen| (htPage)
  (let (fun1 fun2 fun3 ind from1 to1 title curvePart tubePart titlePart)
    (setq fun1 (|httpLabelInputString| htPage '|function1|))
    (setq fun2 (|httpLabelInputString| htPage '|function2|))
    (setq fun3 (|httpLabelInputString| htPage '|function3|))
    (setq ind (|httpLabelInputString| htPage '|ind|))
    (setq from1 (|httpLabelInputString| htPage '|from1|))
    (setq to1 (|httpLabelInputString| htPage '|to1|))

```



```
(setq title (|htLabelInputString| htPage '|title|))
(setq curvePart (strconc "curve(" "{" fun1 ",{" fun2 ",{" fun3 ")"))
(setq tubePart "{" tubeRadius==.25,{" tubePoints==16")
(cond
  ((not (string-equal title ""))
   (setq titlePart (strconc "{" "title ==\" title "\""))
   (|bcFinish| "draw" curvePart
    (|bcDrawIt2| ind from1 to1) tubePart titlePart))
  (t
   (|bcFinish| "draw" curvePart
    (|bcDrawIt2| ind from1 to1) tubePart))))))
```

defun Draw Basic Command by 3D parameterized function

```
[htInitPage p1262]
[htMakePage p1263]
[htMakeDoneButton p1284]
[htShowPage p1263]
[$EmptyMode p??]
```

☐ Enter the
Function
Function
Function
☐ Enter ind
Variable
Variable
☐ Optionall

Pressing the **Continue** button will call the function **bcDraw3Dpar1Gen** due to this line:

```
(|htMakeDoneButton| "Continue" '|bcDraw3Dpar1Gen|)
```

— defun bcDraw3Dpar1 —

```

(defun |bcDraw3Dpar1| ()
  (declare (special |$EmptyModel|))
  (|htInitPage| "Draw Basic Command" NIL)
  (|htMakePage|
    '((|domainConditions| (|isDomain| EM |$EmptyModel|)
      (|isDomain| F (|Float|)) (|isDomain| SY (|Symbol|)))
      (|text| "\\centerline{Drawing a parametrically defined surface:}\\newline "
        "\\centerline{{\\em ( f1(u,v), f2(u,v), f3(u,v) )}}\\newline "
        "\\centerline{in terms of three functions {\\em f1}, {\\em f2}, and {\\em f3}}\\newline "
        "\\centerline{and two independent variables {\\em u} and {\\em v}}\\vspace{1}\\newline\\menuitemstyle{\\tab{2}
          "Enter the three {\\em functions} of the independent variables:")
        (|text| . "\\newline\\tab{2}")
        (|text| . "{\\em Function f1:}")
        (|bcStrings| (43 "u*sin(v)" |function1| EM))
        (|text| . "\\newline\\tab{2}")
        (|text| . "{\\em Function f2:}")
        (|bcStrings| (43 "v*cos(u)" |function2| EM))
        (|text| . "\\newline\\tab{2}")
        (|text| . "{\\em Function f3:}")
        (|bcStrings| (43 "u*cos(v)" |function3| EM))
        (|text| .
          "\\newline\\menuitemstyle{\\tab{2}Enter independent {\\em variables} and ranges:")
        (|text| . "\\newline\\tab{2}")
        (|text| . "{\\em Variable 1:}")
        (|bcStrings| (5 |u| |ind1| SY))
        (|text| . "ranges {\\em from:}")
        (|bcStrings| (9 "-\\%pi" |from1| F)) (|text| . "{\\em to:}")
        (|bcStrings| (9 "\\%pi" |to1| F))
        (|text| . "\\newline\\tab{2}")
        (|text| . "{\\em Variable 2:}")
        (|bcStrings| (5 |v| |ind2| SY))
        (|text| . "ranges {\\em from:}")
        (|bcStrings| (9 "-\\%pi/2" |from2| F))
        (|text| . "{\\em to:}") (|bcStrings| (9 "\\%pi/2" |to2| F))
        (|text| "\\indent{0}\\newline\\menuitemstyle{\\tab{2} "
          "Optionally enter a {\\em title} for your surface:")
        (|bcStrings| (15 "surface" |title| S))
        (|text| . "\\indent{0}"))
    (|htMakeDoneButton| "Continue" '|bcDraw3Dpar1Gen|)
    (|htShowPage|))

```

defun bcDraw3Dpar1Gen

[htpLabelInputString p1254]

[bcDrawIt2 p1189]

[strconc p??]

[bcFinish p1243]

— defun bcDraw3Dpar1Gen —

```
(defun |bcDraw3Dpar1Gen| (htPage)
  (let (fun1 fun2 fun3 ind1 from1 to1 ind2 from2 to2
        title r1 r2 surfacePart titlePart)
    (setq fun1 (|httpLabelInputString| htPage '|function1|))
    (setq fun2 (|httpLabelInputString| htPage '|function2|))
    (setq fun3 (|httpLabelInputString| htPage '|function3|))
    (setq ind1 (|httpLabelInputString| htPage '|ind1|))
    (setq from1 (|httpLabelInputString| htPage '|from1|))
    (setq to1 (|httpLabelInputString| htPage '|to1|))
    (setq ind2 (|httpLabelInputString| htPage '|ind2|))
    (setq from2 (|httpLabelInputString| htPage '|from2|))
    (setq to2 (|httpLabelInputString| htPage '|to2|))
    (setq title (|httpLabelInputString| htPage '|title|))
    (setq r1 (|bcDrawIt2| ind1 from1 to1))
    (setq r2 (|bcDrawIt2| ind2 from2 to2))
    (setq surfacePart (strconc "surface(" "{" fun1 ",{" fun2 ",{" fun3 ")"))
    (cond
      ((not (string= title ""))
        (setq titlePart (strconc "{" "title ==\" title "\\\""))
        (|bcFinish| "draw" surfacePart r1 r2 titlePart))
      (t (|bcFinish| "draw" surfacePart r1 r2))))))
```

defun Series Basic Command

[htInitPage p1262]
 [htMakePage p1263]
 [htShowPage p1263]
 [\$EmptyMode p??]

— defun bcSeries —

```
(defun |bcSeries| ()
  (declare (special |$EmptyMode|))
  (|htInitPage| "Series Basic Command" nil)
  (|htMakePage|
    '((|domainConditions| (|isDomain| EM |$EmptyMode|)
      (|isDomain| S (|String|)) (|isDomain| SY (|Symbol|)))
      (|text| . "Create a series by: ") (|text| . "\\beginmenu"))
```

```

(|text| . "\\item ")
(|bcLinks| ("\\menuitemstyle{Expansion}" "" |bcSeriesExpansion| nil))
(|text| . "\\tab{11}Expand a function in a series around a point")
(|text| . "\\item ")
(|bcLinks| ("\\menuitemstyle{Formula}" "" |bcSeriesByFormula| nil))
(|text| . "\\tab{11}Give a formula for the {\em i}'th coefficient")
(|text| . "\\endmenu"))
(|htShowPage|)

```

defun Series Basic Command expand around a point

```

[htInitPage p1262]
[htMakePage p1263]
[htMakeDoneButton p1284]
[htShowPage p1263]
[$EmptyMode p??]

```

Enter the function

log(cot(x))_

Enter the power s

Enter the point a

Pressing
the **Continue** button will call the function **bcSeriesExpansionGen** due to this line:

```

(|htMakeDoneButton| "Continue" ' |bcSeriesExpansionGen|)

```

— defun bcSeriesExpansion —

```

(defun |bcSeriesExpansion| (a b)
  (declare (ignore a b))
  (declare (special |$EmptyMode|))
  (|htInitPage| "Series Expansion Basic Command" nil)
  (|htMakePage|
    '((|domainConditions| (|isDomain| EM |$EmptyMode|)
      (|isDomain| EEM (|Expression| |$EmptyMode|))
      (|isDomain| S (|String|)) (|isDomain| SY (|Symbol|)))
      (|text| . "\\newline ")

```

```
(|text| . "\\menuitemstyle{\\tab{2}}")
(|text| . "Enter the {\\em function} you want to expand in a power series")
(|text| . "\\newline\\tab{2} ")
(|bcStrings| (55 "log(cot(x))" |function| EM))
(|text| . "\\blankline ")
(|text| . "\\newline ")
(|text| . "\\menuitemstyle{\\tab{2}}")
(|text| . "Enter the {\\em power series variable}")
(|text| . "\\tab{49}")
(|bcStrings| (8 |x| |variable| SY))
(|text| . "\\blankline ")
(|text| . "\\newline ")
(|text| . "\\menuitemstyle{\\tab{2}}")
(|text| . "Enter the {\\em point} about which you want to expand")
(|text| . "\\tab{49}")
(|bcStrings| (8 "\\%pi/2" |point| EM))))
(|htMakeDoneButton| "Continue" '|bcSeriesExpansionGen|)
(|htShowPage|))
```

defun bcSeriesExpansionGen

```
[htLabelInputString p1254]
[strconc p??]
[bcFinish p1243]
```

— defun bcSeriesExpansionGen —

```
(defun |bcSeriesExpansionGen| (htPage)
  (let (fun var point terms)
    (setq fun (|htLabelInputString| htPage '|function|))
    (setq var (|htLabelInputString| htPage '|variable|))
    (setq point (|htLabelInputString| htPage '|point|))
    (setq terms (|htLabelInputString| htPage '|numberOfTerms|))
    (|bcFinish| "series" fun (strconc var " = " point))))
```

defun Series Basic Command series by formula

```
[htInitPage p1262]
[htMakePage p1263]
[htShowPage p1263]
```

Select the kind of power series you want

■ Taylor Series

Series where the exponent ranges over an arbitrary positive integer step size

■ Laurent Series

Series where the exponent ranges from integer step size

■ Puiseux Series

Series where the exponent ranges from positive rational number step size

— defun bcSeriesByFormula —

```
(defun |bcSeriesByFormula| (a b)
  (declare (ignore a b))
  (|htInitPage| "Power Series Basic Command" NIL)
  (|htMakePage|
    '(|text| . "Select the kind of power series you want to create:")
    (|text| . "\\beginmenu") (|text| . "\\item ")
    (|bcLinks|
      ("\\menuitemstyle{Taylor Series}" "" |bcTaylorSeries| |taylor|))
    (|text| .
      "\\newline Series where the exponent ranges over the integers from a {\\em non-negative integer} value to plus infinity by an arbitrary positive integer step size")
    (|text| . "\\item ")
    (|bcLinks|
      ("\\menuitemstyle{Laurent Series}" "" |bcLaurentSeries| |laurent|))
    (|text| .
      "\\newline Series where the exponent ranges from an arbitrary {\\em integer} value to plus infinity by an arbitrary positive integer step size")
    (|text| . "\\item ")
    (|bcLinks|
      ("\\menuitemstyle{Puisseux Series}" "" |bcPuisseuxSeries| |puiseux|))
    (|text| .
      "\\newline Series where the exponent ranges from an arbitrary {\\em rational value} to plus infinity by an arbitrary positive rational number step size")
    (|text| . "\\endmenu"))
  (|htShowPage|))
```

defun Taylor Series Basic Command

```
[|htInitPage| p1262]
[|htMakePage| p1263]
[|htShowPage| p1263]
[$EmptyMode p??]
```

Enter the formula for the
`1/factorial(i)`

Enter the index variable
 Enter the power series variable
 Enter the point about which

For Taylor Series, the expansion is about a non-negative integer, to

Enter the initial value
 Enter the step size (a p

Pressing

the **Continue** button will call the function **bcTaylorSeriesGen** due to this line:

```
(|doneButton| "Continue" |bcTaylorSeriesGen|)
```

— defun bcTaylorSeries —

```
(defun |bcTaylorSeries| (a b)
  (declare (ignore a b))
  (declare (special |$EmptyMode|))
  (|htInitPage| "Taylor Series Basic Command" NIL)
  (|htMakePage|
    '((|domainConditions| (|isDomain| EM |$EmptyMode|)
      (|isDomain| EEM (|Expression| |$EmptyMode|))
      (|isDomain| S (|String|)) (|isDomain| SY (|Symbol|)))
      (|text| . "\\menuitemstyle{\\tab{2}}")
      (|text| . "Enter the formula for the general coefficient of the series")
      (|text| . "\\newline\\tab{2} ")
      (|bcStrings| (55 "1/factorial(i)" |formula| EM))
      (|text| . "\\blankline ")
      (|text| . "\\menuitemstyle{\\tab{2}}")
      (|text| . "Enter the {\\em index variable} for your formula")
      (|text| . "\\tab{49}") (|bcStrings| (8 |i| |index| SY))
      (|text| . "\\newline ")
      (|text| . "\\menuitemstyle{\\tab{2}}")
      (|text| . "Enter the {\\em power series variable}")
      (|text| . "\\tab{49}") (|bcStrings| (8 |x| |variable| SY))
      (|text| . "\\newline ")
      (|text| . "\\menuitemstyle{\\tab{2}}")
      (|text| . "Enter the {\\em point} about which you want to expand"))
```

```

(|text| . "\\tab{49}") (|bcStrings| (8 0 |point| EM))
(|text| . "\\blankline ")
(|text| .
"
For Taylor Series, the exponent of the power series variable ranges from an {\em initial value}, an arbitrary
(|text| . "\\blankline ") (|text| . "\\newline ")
(|text| . "\\menuitemstyle{\\tab{2}}")
(|text| . "Enter the {\em initial value} of the index (an integer)")
(|text| . "\\tab{49}") (|bcStrings| (8 "0" |min| I))
(|text| . "\\newline ")
(|text| . "\\menuitemstyle{\\tab{2}}")
(|text| . "Enter the {\em step size} (a positive integer)")
(|text| . "\\tab{49}") (|bcStrings| (8 "1" |step| PI))
(|doneButton| "Continue" |bcTaylorSeriesGen|))
(|htShowPage|))

```

defun bcSeriesByFormulaGen

[bcNotReady p1247]

— defun bcSeriesByFormulaGen —

```

(defun |bcSeriesByFormulaGen| (htPage)
  (declare (ignore htPage))
  (|bcNotReady|))

```

defun Laurent Series Basic Command

[htInitPage p1262]
 [htMakePage p1263]
 [htShowPage p1263]
 [\$EmptyMode p??]

Enter the formula for the
 $(-1)^{n-1}/(n+2)$

Enter the index variable
 Enter the power series variable
 Enter the point about which to expand

For Laurent Series, the expansion point must be an integer value, to plus infinity or minus infinity.

Enter the initial value
 Enter the step size (a positive integer)

Pressing the **Continue** button will call the function **bcLaurentSeriesGen** due to this line:

```
(|doneButton| "Continue" |bcLaurentSeriesGen|)
```

— defun bcLaurentSeries —

```
(defun |bcLaurentSeries| (a b)
  (declare (special |$EmptyMode|) (ignore a b))
  (|htInitPage| "Laurent Series Basic Command" NIL)
  (|htMakePage|
    '((|domainConditions| (|isDomain| EM |$EmptyMode|)
      (|isDomain| EEM (|Expression| |$EmptyMode|))
      (|isDomain| S (|String|)) (|isDomain| I (|Integer|))
      (|isDomain| PI (|PositiveInteger|))
      (|isDomain| SY (|Symbol|)))
      (|text| . "\\newline ")
      (|text| . "\\menuitemstyle{\\tab{2}}")
      (|text| . "Enter the formula for the general coefficient of the series")
      (|text| . "\\newline\\tab{2} ")
      (|bcStrings| (55 "(-1)**(n - 1)/(n + 2)" |formula| EM))
      (|text| . "\\vspace{1}\\newline ")
      (|text| . "\\menuitemstyle{\\tab{2}}")
      (|text| . "Enter the {\em index variable} for your formula")
      (|text| . "\\tab{49}") (|bcStrings| (8 |n| |index| SY))
      (|text| . "\\newline ")
      (|text| . "\\menuitemstyle{\\tab{2}}")
      (|text| . "Enter the {\em power series variable}")
      (|text| . "\\tab{49}") (|bcStrings| (8 |x| |variable| SY))
      (|text| . "\\newline ")
```

```

(|text| . "\\menuitemstyle{\\tab{2}}")
(|text| . "Enter the {\\em point} about which you want to expand")
(|text| . "\\tab{49}")
(|bcStrings| (8 0 |point| F))
(|text| . "\\blankline")
(|text| .
"\\newline For Laurent Series, the exponent of the power series variable ranges from an {\\em initial value}
(|text| . "\\blankline")
(|text| . "\\menuitemstyle{\\tab{2}}")
(|text| . "Enter the {\\em initial value} of the index (an integer)")
(|text| . "\\tab{49}") (|bcStrings| (8 "-1" |min| I))
(|text| . "\\newline ")
(|text| . "\\menuitemstyle{\\tab{2}}")
(|text| . "Enter the {\\em step size} (a positive integer)")
(|text| . "\\tab{49}") (|bcStrings| (8 "1" |step| PI))
(|doneButton| "Continue" |bcLaurentSeriesGen|)))
(|htShowPage|))

```

defun Puiseux Series Basic Command

```

[htInitPage p1262]
[htMakePage p1263]
[htShowPage p1263]
[$EmptyMode p??]

```

- Enter the formula for the general coefficient

$$(-1)^n \frac{(3n-4)!}{6 \cdot n!}$$
- Enter the index variable for your formula
- Enter the power series variable
- Enter the point about which you want to expand

For Puiseux Series, the exponent of the power series variable ranges from a rational number, to plus infinity; the

- Enter the initial value of index (a rational number)
- Enter the step size (a positive rational number)

Pressing the **Continue** button will call the function **bcPuisseuxSeriesGen** due to this line:

```
(|doneButton| "Continue" |bcPuisseuxSeriesGen|)
```

— defun bcPuisseuxSeries —

```
(defun |bcPuisseuxSeries| (a b)
  (declare (special |$EmptyModel|) (ignore a b))
  (|htInitPage| "Puisseux Series Basic Command" nil)
  (|htMakePage|
    '((|domainConditions| (|isDomain| EM |$EmptyModel|)
      (|isDomain| EEM (|Expression| |$EmptyModel|))
      (|isDomain| S (|String|)) (|isDomain| I (|Integer|))
      (|isDomain| PI (|PositiveInteger|))
      (|isDomain| RN (|Fraction| (|Integer|)))
      (|isDomain| SY (|Symbol|)))
      (|text| . "\\newline ")
      (|text| . "\\menuitemstyle{\\tab{2}}")
      (|text| .
        "Enter the {\em formula} for the general coefficient of the series")
      (|text| . "\\newline\\tab{2} ")
      (|bcStrings| (55 "(-1)**((3*n - 4)/6)/factorial(n - 1/3)" |formula| EM))
      (|text| . "\\vspace{1}\\newline ")
      (|text| . "\\menuitemstyle{\\tab{2}}")
      (|text| . "Enter the {\em index variable} for your formula")
      (|text| . "\\tab{49}") (|bcStrings| (8 |n| |index| SY))
      (|text| . "\\newline ")
      (|text| . "\\menuitemstyle{\\tab{2}}")
      (|text| . "Enter the {\em power series variable}")
      (|text| . "\\tab{49}") (|bcStrings| (8 |x| |variable| SY))
      (|text| . "\\newline ")
      (|text| . "\\menuitemstyle{\\tab{2}}")
      (|text| . "Enter the {\em point} about which you want to expand")
      (|text| . "\\tab{49}") (|bcStrings| (8 0 |point| F))
      (|text| . "\\blankline ")
      (|text| .
        "For Puisseux Series, the exponent of the power series variable ranges from an {\em initial value}
        (|text| . "\\blankline ") (|text| . "\\newline ")
        (|text| . "\\menuitemstyle{\\tab{2}}")
        (|text| . "Enter the {\em initial value} of index (a rational number)")
        (|text| . "\\tab{51}") (|bcStrings| (6 "4/3" |min| RN))
        (|text| . "\\newline ")
        (|text| . "\\menuitemstyle{\\tab{2}}")
        (|text| . "Enter the {\em step size} (a positive rational number)")
        (|text| . "\\tab{51}") (|bcStrings| (6 "2" |step| RN))
        (|doneButton| "Continue" |bcPuisseuxSeriesGen|)))
  (|htShowPage|))
```

defun bcTaylorSeriesGen

[bcSeriesGen p1219]

— defun bcTaylorSeriesGen —

```
(defun |bcTaylorSeriesGen| (htPage)
  (|bcSeriesGen| htPage))
```

—————

defun bcLaurentSeriesGen

[bcSeriesGen p1219]

— defun bcLaurentSeriesGen —

```
(defun |bcLaurentSeriesGen| (htPage)
  (|bcSeriesGen| htPage))
```

—————

defun bcPuisseuxSeriesGen

[bcSeriesGen p1219]

— defun bcPuisseuxSeriesGen —

```
(defun |bcPuisseuxSeriesGen| (htPage)
  (|bcSeriesGen| htPage))
```

—————

defun bcSeriesGen

[htpLabelInputString p1254]

[strconc p??]

[bcFinish p1243]

— defun bcSeriesGen —

```
(defun |bcSeriesGen| (htPage)
```

```
(let (step min formula index var point varPart minPart)
  (setq step (|httpLabelInputString| htPage '|step|))
  (setq min (|httpLabelInputString| htPage '|min|))
  (setq formula (|httpLabelInputString| htPage '|formula|))
  (setq index (|httpLabelInputString| htPage '|index|))
  (setq var (|httpLabelInputString| htPage '|variable|))
  (setq point (|httpLabelInputString| htPage '|point|))
  (setq varPart (strconc var " = " point))
  (setq minPart (strconc min ".."))
  (|bcFinish| "series" (strconc index " +-> " formula) varPart minPart step)))
```

defun Limit Basic Command

```
[htInitPage p1262]
[htMakePage p1263]
[htShowPage p1263]
[$EmptyMode p??]
```

What kind of limit do you want to compute?

☒ A real limit? The limit as the variable approaches a real value along the real axis

☐ A complex limit? The limit as the variable approaches a complex value in the complex plane

— defun bcLimit —

```
(defun |bcLimit| ()
  (declare (special |$EmptyMode|))
  (|htInitPage| "Limit Basic Command" NIL)
  (|htMakePage|
    '((|domainConditions| (|isDomain| EM |$EmptyMode|)
      (|isDomain| S (|String|)) (|isDomain| SY (|Symbol|)))
      (|text| . "What kind of limit do you want to compute? ")
      (|text| . "\\blankline ")
      (|text| . "\\beginmenu")
      (|text| . "\\item ")
      (|bcLinks| ("\\menuitemstyle{A real limit?}" "" |bcRealLimit| |real|))
      (|text| . "\\indentrel{17}\\tab{0}")
      (|text| .
        "The limit as the variable approaches a {\\em real} value along the real axis")
      (|text| . "\\indentrel{-17}") (|text| . "\\item ")
      (|text| . "\\blankline ")
      (|bcLinks|
        ("\\menuitemstyle{A complex limit?}" "" |bcComplexLimit| |complex|))
      (|text| . "\\indentrel{17}\\tab{0}"))
```

```

(|text| .
"The limit as the variable approaches a {\em complex} value along any path in the complex plane")
(|text| . "\\indentrel{-17}")
(|text| . "\\endmenu"))))
(|htShowPage|))

```

defun Real Limit Basic Command

```

[htInitPage p1262]
[htMakePage p1263]
[htShowPage p1263]
[$EmptyMode p??]

```



Pressing the **Continue** button will call the function **bcRealLimitGen** due to this line:

```
(|doneButton| "Continue" |bcRealLimitGen|)
```

— defun bcRealLimit —

```

(defun |bcRealLimit| (a b)
  (declare (special |$EmptyMode|) (ignore a b))
  (|htInitPage| "Real Limit Basic Command" NIL)
  (|htMakePage|
    '((|domainConditions| (|isDomain| EM |$EmptyMode|)
      (|isDomain| S (|String|)) (|isDomain| F (|Float|))
      (|isDomain| SY (|Symbol|))))
      (|text| . "\\newline ")
      (|text| . "\\menuitemstyle{}\\tab{2}")
      (|text| . "Enter the {\em function} you want to compute the limit of:"))

```

```

(|text| . "\\newline\\tab{2} ")
(|bcStrings| (45 "x*sin(1/x)" |expression| EM))
(|text| . "\\blankline") (|text| . "\\newline ")
(|text| . "\\menuitemstyle{\\tab{2}}")
(|text| . "Enter the name of the {\\em variable}: ")
(|text| . "\\tab{41}")
(|bcStrings| (6 |x| |variable| SY))
(|text| . "\\blankline") (|text| . "\\newline ")
(|text| . "\\menuitemstyle{\\tab{2}}")
(|text| . "Compute the limit at")
(|radioButtons| |location|
  ("A finite point:"
    ((|text| . "\\tab{33}") (|bcStrings| (6 0 |point| F))) |finitePoint|)
    ("Plus infinity" "" |plusInfinity|)
    ("Minus infinity" "" |minusInfinity|))
  (|doneButton| "Continue" |bcRealLimitGen|)))
(|htShowPage|))

```

defun Real Limit Basic Command options

```

[htpButtonValue p1252]
[htpLabelInputString p1254]
[bcFinish p1243]
[htInitPage p1262]
[htMakePage p1263]
[htpSetProperty p1254]
[htShowPage p1263]

```

— defun bcRealLimitGen —

```

(defun |bcRealLimitGen| (htPage)
  (let (|p| |fun| |var| |loc| |page|)
    (cond
      ((not (eq (setq |p| (|htpButtonValue| htPage '|location|)) '|finitePoint|))
        (setq |fun| (|htpLabelInputString| htPage '|expression|))
        (setq |var| (|htpLabelInputString| htPage '|variable|))
        (setq |loc|
          (if (eq |p| '|plusInfinity|) "%plusInfinity" "%minusInfinity"))
        (|bcFinish| "limit" |fun| (strconc |var| " = " |loc|)))
      (t

```

```
(setq |page| (|htInitPage| "Real Limit Basic Command" nil))
(|htMakePage|
  '(|text| . "Compute the limit")
  (|lisplinks|
    ("\\menuitemstyle{From both directions}" "" |bcRealLimitGen1| |both|)
    ("\\menuitemstyle{From the right}" "" |bcRealLimitGen1| |right|)
    ("\\menuitemstyle{From the left}" "" |bcRealLimitGen1| |left|)))
(|httpSetProperty| |page| '|fun|
  (|httpLabelInputString| htPage '|expression|))
(|httpSetProperty| |page| '|var|
  (|httpLabelInputString| htPage '|variable|))
(|httpSetProperty| |page| '|loc|
  (|httpLabelInputString| htPage '|point|))
(|htShowPage|))))
```

defun bcRealLimitGen1

[[httpProperty](#) p1254]
 [[strconc](#) p??]
 [[bcFinish](#) p1243]

— defun bcRealLimitGen1 —

```
(defun |bcRealLimitGen1| (htPage key)
  (let (direction fun var loc varPart)
    (setq direction
      (cond
        ((eq key '|right|) "\"right\"")
        ((eq key '|left|) "\"left\"")
        (t nil)))
    (setq fun (|httpProperty| htPage '|fun|))
    (setq var (|httpProperty| htPage '|var|))
    (setq loc (|httpProperty| htPage '|loc|))
    (setq varPart (strconc var " = " loc))
    (|bcFinish| "limit" fun varPart direction)))
```

defun Complex Limit Basic Command

[[htInitPage](#) p1262]
 [[htMakePage](#) p1263]
 [[htShowPage](#) p1263]

[\$EmptyMode p??]

Pressing the **Continue** button will call the function **bcComplexLimitGen** due to this line:

```
(|doneButton| "Continue" |bcComplexLimitGen|)
```

— defun bcComplexLimit —

```
(defun |bcComplexLimit| (a b)
  (declare (special |$EmptyMode|) (ignore a b))
  (|htInitPage| "Complex Limit Basic Command" nil)
  (|htMakePage|
    '((|domainConditions| (|isDomain| EM |$EmptyMode|)
      (|isDomain| S (|String|)) (|isDomain| F (|Float|))
      (|isDomain| SY (|Symbol|)))
      (|text| . "\\newline ")
      (|text| . "\\menuitemstyle{\\tab{2}}")
      (|text| . "Enter the {\\em function} you want to compute the limit of:")
      (|text| . "\\newline\\tab{2} ")
      (|bcStrings| (40 "sin(a*x)/tan(b*x)" |expression| EM))
      (|text| . "\\blankline ") (|text| . "\\newline ")
      (|text| . "\\menuitemstyle{\\tab{2}}")
      (|text| . "Enter the name of the {\\em variable}: ")
      (|text| . "\\tab{37}") (|bcStrings| (5 |x| |variable| SY))
      (|text| . "\\blankline ") (|text| . "\\newline ")
      (|text| . "\\menuitemstyle{\\tab{2}}")
      (|text| . "Compute the limit at")
      (|radioButtons| |location|
        ("A finite point:"
          ((|text| . "\\newline\\space{0}Real part:\\space{3}")
            (|bcStrings| (20 0 |real| F))
            (|text| . "\\newline Complex part:"))
```

```

      (|bcStrings| (20 0 |complex| F)))
      |finitePoint|)
      ("Complex infinity" "" |complexInfinity|))
      (|doneButton| "Continue" |bcComplexLimitGen|))
      (|htShowPage|))

```

defun bcComplexLimitGen

```

[htpLabelInputString p1254]
[htpButtonValue p1252]
[strconc p??]
[bcFinish p1243]

```

— defun bcComplexLimitGen —

```

(defun |bcComplexLimitGen| (htPage)
  (let (fun var p real comp complexPart loc varPart)
    (setq fun (|htpLabelInputString| htPage '|expression|))
    (setq var (|htpLabelInputString| htPage '|variable|))
    (setq loc
      (cond
        ((eq (setq p (|htpButtonValue| htPage '|location|)) '|finitePoint|)
          (setq real (|htpLabelInputString| htPage '|real|))
          (setq comp (|htpLabelInputString| htPage '|complex|))
          (setq complexPart
            (cond
              ((string= comp "0") "")
              ((string= comp "1") "%i")
              (t (strconc comp "%i"))))
            (cond
              ((string= real "0") (if (string= complexPart "") '|0| complexPart))
              ((string= complexPart "") real)
              (t (strconc real " + " complexPart))))
            (t "%infinity"))
          (setq varPart (strconc var " = " loc))
          (|bcFinish| "complexLimit" fun varPart)))

```

defvar \$systemType

— initvars —

```
(setq |$systemType| nil)
```

defvar \$numberOfEquations

— initvars —

```
(defvar |$numberOfEquations| 0)
```

defvar \$solutionMethod

— initvars —

```
(defvar |$solutionMethod| nil)
```

defun Solve Basic Command

```
[htInitPage p1262]
[htMakePage p1263]
[htShowPage p1263]
[$EmptyMode p??]
```

— defun bcSolve —

```
(defun |bcSolve| ()
  (|htInitPage| "Solve Basic Command" nil)
  (|htMakePage|
    '(|text| . "What do you want to solve? ")
    (|text| . "\\beginmenu") (|text| . "\\item ")
    (|bcLinks|
      ("\\menuitemstyle{A System Of Linear Equations}" ""
```

```

      |bcLinearSolve| |linear|))
(|text| . "\\item ")
(|bcLinks|
  ("\\menuitemstyle{A System of Polynomial Equations}" ""
   |bcSystemSolve| |polynomial|))
(|text| . "\\item ")
(|bcLinks|
  ("\\menuitemstyle{A Single Polynomial Equation}" ""
   |bcSolveSingle| |onePolynomial|))
(|text| . "\\endmenu"))
(|htShowPage|))

```

defun Linear Solve Basic Command

```

[htInitPage p1262]
[htMakePage p1263]
[htShowPage p1263]
[$EmptyMode p??]

```

How do you want to enter the equations?

☐ Directly as equations

☐ In matrix form $AX = B$,

```

— defun bcLinearSolve —

(defun |bcLinearSolve| (p nn)
  (declare (ignore p nn))
  (|htInitPage| "Basic Solve Command" NIL)
  (|htMakePage|
    '(|text| . "How do you want to enter the equations?")
    (|text| . "\\beginmenu")
    (|text| . "\\item ")
    (|text| . "\\newline ")
    (|bcLinks|
      ("\\menuitemstyle{Directly as equations}" ""
       |bcLinearSolveEqns| |equations|))
    (|text| . "\\item ")
    (|text| . "\\newline ")
    (|bcLinks|
      ("\\menuitemstyle{In matrix form}" ""
       |bcLinearSolveMatrix| |matrix|))
    (|text| . "\\indentrel{16}\\tab{0}")
    (|text| .
      " \\spad{AX = B}, where \\spad{A} is a matrix of coefficients and \\spad{B} is a vector")
    (|text| . "\\indentrel{-16}\\item ")
    (|text| . "\\endmenu"))
  )

```

```
(|htShowPage|))
```

defun Linear Solve Equations Basic Command

```
[htInitPage p1262]
[htMakePage p1263]
[htMakeDoneButton p1284]
[htShowPage p1263]
[$EmptyMode p??]
```

Ente

Pressing the **Continue** button will call the function **bcLinearSolveEqns1** due to this line:

```
(|htMakeDoneButton| "Continue" '|bcLinearSolveEqns1|)
```

— defun bcLinearSolveEqns —

```
(defun |bcLinearSolveEqns| (htPage p)
  (declare (ignore htPage p))
  (|htInitPage| "Basic Solve Command" nil)
  (|htMakePage|
    '((|domainConditions| (|isDomain| PI (|PositiveInteger|)))
      (|inputStrings|
        ("Enter the {\em number} of equations:" "" 5 2
          |numberOfEquations| PI))))
  (|htMakeDoneButton| "Continue" '|bcLinearSolveEqns1|)
  (|htShowPage|))
```

defun bcSystemSolve

```
[htInitPage p1262]
[htMakePage p1263]
[htMakeDoneButton p1284]
[htShowPage p1263]
```

Enter the number

Pressing the **Continue** button will call the function **bcSystemSolveEqns1** due to this line:

```
(|htMakeDoneButton| "Continue" ' |bcSystemSolveEqns1|)
```

— defun bcSystemSolve —

```
(defun |bcSystemSolve| (htPage p)
  (declare (ignore htPage p))
  (|htInitPage| "Basic Solve Command" NIL)
  (|htMakePage|
    '((|domainConditions| (|isDomain| PI (|PositiveInteger|)))
      (|inputStrings|
        ("Enter the {\em number} of equations:" "" 5 2
          |numberOfEquations| PI))))
  (|htMakeDoneButton| "Continue" ' |bcSystemSolveEqns1|)
  (|htShowPage|))
```

defun bcSolveSingle

```
[|httpSetProperty| p1254]
[|bcInputEquations| p1231]
```

— defun bcSolveSingle —

```
(defun |bcSolveSingle| (htPage p)
  (declare (ignore p))
  (|httpSetProperty| htPage '|systemType| '|onePolynomial|)
  (|httpSetProperty| htPage '|exitFunction| '|bcInputSolveInfo|)
  (|bcInputEquations| htPage '|exact|))
```

defun bcSystemSolveEqns1

```
[|httpSetProperty| p1254]
[|bcInputEquations| p1231]
```

— defun bcSystemSolveEqns1 —

```
(defun |bcSystemSolveEqns1| (htPage)
  (|httpSetProperty| htPage '|systemType| '|polynomial|)
  (|httpSetProperty| htPage '|exitFunction| '|bcInputSolveInfo|)
  (|bcInputEquations| htPage '|exact|))
```

—————

defun bcLinearSolveEqns1

```
[httpSetProperty p1254]
[bcInputEquations p1231]
```

— defun bcLinearSolveEqns1 —

```
(defun |bcLinearSolveEqns1| (htPage)
  (|httpSetProperty| htPage '|systemType| '|linear|)
  (|httpSetProperty| htPage '|exitFunction| '|bcLinearSolveEqnsGen|)
  (|bcInputEquations| htPage '|exact|))
```

—————

defun bcInputSolveInfo

```
[htInitPage p1262]
[httpPropertyList p1253]
[httpSetProperty p1254]
[httpInputAreaList p??]
[htMakePage p1263]
[htShowPage p1263]
```

— defun bcInputSolveInfo —

```
(defun |bcInputSolveInfo| (htPage)
  (let (page)
    (setq page (|htInitPage| "Solve Basic Command" (|httpPropertyList| htPage)))
    (|httpSetProperty| page '|numberOfEquations|
      (|httpProperty| htPage '|numberOfEquations|))
    (|httpSetProperty| page '|inputArea| (|httpInputAreaAlist| htPage))
    (|htMakePage|
      '((|domainConditions| (|isDomain| PI (|PositiveInteger|)))
        (|text| . "What would you like?"))
```

```

(|text| . "\\beginmenu") (|text| . "\\item ")
(|bcLinks|
  ("\\menuitemstyle{Exact Solutions}" "" |bcSolveEquations| |exact|))
(|text| . "\\indentrel{18}\\tab{0} ")
(|text| .
  "Solutions expressed in terms of {\\em roots} of irreducible polynomials")
(|text| . "\\indentrel{-18}")
(|text| . "\\item ")
(|bcLinks|
  ("\\menuitemstyle{Numeric Solutions}" ""
   |bcSolveEquationsNumerically| |numeric|))
(|text| . "\\indentrel{18}\\tab{0} ")
(|text| .
  "Solutions expressed in terms of approximate real or complex {\\em numbers}")
(|text| . "\\indentrel{-18}")
(|text| . "\\item ")
(|bcLinks|
  ("\\menuitemstyle{Radical Solutions}" "" |bcSolveEquations| |radical|))
(|text| . "\\indentrel{18}\\tab{0} ")
(|text| .
  "Solutions expressed in terms of {\\em radicals} if it is possible")
(|text| . "\\indentrel{-18}")
(|text| . "\\endmenu"))
(|htShowPage|))

```

defun bcInputEquations

```

[strconc p??]
[stringimage p??]
[bcMakeLinearEquations p1234]
[bcMakeEquations p1234]
[htProperty p??]
[parse-integer p??]
[objValUnwrap p??]
[htInitPage p1262]
[htpPropertyList p1253]
[htpSetProperty p1254]
[htSay p??]
[htMakePage p1263]
[bcHt p1260]
[bcMakeUnknowns p1233]
[htMakeDoneButton p1284]
[htShowPage p1263]
[$EmptyMode p??]

```


`[$bcParseOnly p1249]`

— **defun bcInputEquations** —

```
(defun |bcInputEquations| (htPage solutionMethod)
(labels (
(f (i n linearp)
(let (spacer prefix lnam rnam var)
(setq spacer (cond ((> i 99) 0) ((> i 9) 1) (t 2)))
(setq prefix
(strconc "\\newline\\tab{2}{\\em Equation " (stringimage i) ":}"))
(setq prefix (strconc prefix "\\space{" (stringimage spacer) "}"))
(setq lnam (intern (strconc "l" (stringimage i))))
(setq rnam (intern (strconc "r" (stringimage i))))
(setq var (if linearp
(|bcMakeLinearEquations| i n)
(|bcMakeEquations| i n)))
(cons
(cons '|text| prefix)
(list (list '|bcStrings| (list 30 var lnam 'p))
'|text| . " = "
(list '|bcStrings| (list 5 '|0| rnam 'p))))))
(let (numEqs linearPred labelList equationPart page)
(declare (special |$EmptyMode| |$bcParseOnly|))
(setq numEqs
(cond
((eq (|httpProperty| htPage '|systemType|) '|onePolynomial|) 1)
(|$bcParseOnly|
(parse-integer (|httpLabelInputString| htPage '|numberOfEquations|)))
(t
(|objValUnwrap| (|httpLabelSpadValue| htPage '|numberOfEquations|))))
(setq linearPred (eq (|httpProperty| htPage '|systemType|) '|linear|))
(setq labelList
(cond
((eq1 numEqs 1)
'(|bcStrings| (42 "x^2+1" l1 p)) (|text| . " = "
(|bcStrings| (6 0 r1 P))))
(t
(loop for i from 1 to numEqs
append (f i numEqs linearPred)))))
(setq equationPart
(cons '(|domainConditions|
(|isDomain| P (|Polynomial| |$EmptyMode|))
(|isDomain| S (|String|))
(|isDomain| PI (|PositiveInteger|)))
labelList))
(setq page (|htInitPage| "Solve Basic Command" (|httpPropertyList| htPage)))
(|httpSetProperty| page '|numberOfEquations| numEqs)
(|httpSetProperty| page '|solutionMethod| solutionMethod)
(|htSay| "\\newline\\menuitemstyle{\\tab{2}}")
```

```
(|htSay| (if (eq1 numEqs 1)
             "Enter the {\em Equation}:"
             "Enter the {\em Equations}:"))
(|htSay| "\newline\tab{2}")
(|htMakePage| equationPart)
(|bcHt| "\blankline ")
(|htSay| "\newline\menuitemstyle{}\tab{2}")
(|htMakePage|
  (if (eq1 numEqs 1)
    '(|text| . "Enter the {\em unknown} (leave blank if implied): ")
    (|text| . "\tab{48}")
    (|bcStrings| (6 "x" unknowns S . |quoteString|)))
  (list
    '(|text| . "Enter the unknowns (leave blank if implied):")
    '(|text| . "\tab{44}")
    (list ' |bcStrings|
      (list 10 (|bcMakeUnknowns| numEqs) ' |unknowns| 'p))))
(|htMakeDoneButton| "Continue" ' |bcInputEquationsEnd|)
(|htShowPage|)))
```

defun Create a variable string

— defun bcCreateVariableString —

```
(defun |bcCreateVariableString| (i)
  (format nil "x~a" i))
```

defun bcMakeUnknowns

— defun bcMakeUnknowns —

```
(defun |bcMakeUnknowns| (number)
  (format nil "~{~A~~}"
    (loop for i from 1 to number collect (format nil "x~a " i))))
```

defun bcMakeEquations

```
[strconc p??]
[bcCreateVariableString p1233]
[nreverse0 p??]
```

— defun bcMakeEquations —

```
(defun |bcMakeEquations| (i number)
  (if (eql number 1)
    (strconc (|bcCreateVariableString| 1) '|^2+1|))
    (progn
      (|bcCreateVariableString| i)
      (strconc
        (strconc (apply 'concat
          (let (t1)
            (do ((j 1 (1+ j))) ((> j number) (nreverse0 t1))
              (setq t1 (cons (strconc (|bcCreateVariableString| j) '+) t1))))))
          '|1|)
        (strconc '-2* (strconc (|bcCreateVariableString| i) '|^2|))))))
```

defun bcMakeLinearEquations

```
[bcCreateVariableString p1233]
[strconc p??]
[nreverse0 p??]
```

— defun bcMakeLinearEquations —

```
(defun |bcMakeLinearEquations| (i number)
  (cond
    ((eql number 1) (|bcCreateVariableString| 1))
    ((eql number 2)
      (cond
        ((eql i 1)
          (strconc (|bcCreateVariableString| 1)
            (strconc '+ (|bcCreateVariableString| 2))))
        (t
          (strconc (|bcCreateVariableString| 1)
            (strconc '- (|bcCreateVariableString| 2))))))
    (t
      (strconc
        (strconc
          (apply 'concat
            (let (t1)
```

```

      (do ((j 1 (1+ j))) (> j number) (nreverse0 t1))
      (setq t1 (cons (strconc (|bcCreateVariableString| j) '+) t1))))
    '|1|)
    (strconc '-2* (|bcCreateVariableString| i))))))

```

defun bcInputEquationsEnd

If `exitFunction` is set, call it. [systemError p??]

— defun bcInputEquationsEnd —

```

(defun |bcInputEquationsEnd| (htPage)
  (let (fun)
    (if (setq fun (|httpProperty| htPage '|exitFunction|))
        (funcall fun htPage)
        (|systemError| nil))))

```

defun bcSolveEquationsNumerically

```

[htInitPage p1262]
[htMakePage p1263]
[htMakeDoneButton p1284]
[htShowPage p1263]
[httpPropertyList p1253]

```

— defun bcSolveEquationsNumerically —

```

(defun |bcSolveEquationsNumerically| (htPage p)
  (declare (ignore p))
  (|htInitPage| "Solve Basic Command" (|httpPropertyList| htPage))
  (|htMakePage|
    '((|text| . "What would you like?")
      (|radioButtons| |choice|
        ("Real roots expressed as rational numbers" "" |rr|)
        ("Real roots expressed as floats" "" |rf|)
        ("Complex roots expressed as rational numbers" "" |cr|)
        ("Complex roots expressed as floats" "" |cf|))
      (|text| . "\\vspace{1}\\newline")
      (|inputStrings| ("Enter the number of desired {\\em digits} of accuracy"
        "" 5 20 |acc| PI))))
  (|htMakeDoneButton| "Continue" '|bcSolveNumerically1|)

```

```
(|htShowPage|))
```

defun bcSolveNumerically1

```
[bcSolveEquations p1236]
```

— defun bcSolveNumerically1 —

```
(defun |bcSolveNumerically1| (htPage)
  (|bcSolveEquations| htPage 'numeric))
```

defun bcSolveEquations

```
[htpLabelInputString p1254]
[htpButtonValue p1252]
[member p1048]
[strconc p??]
[htpProperty p1254]
[bcString2WordList p1246]
[bcwords2liststring p1246]
[bcGenEquations p1242]
[bcFinish p1243]
```

— defun bcSolveEquations —

```
(defun |bcSolveEquations| (htPage solutionMethod)
  (let (digits kind accString alist varpart r varlist varString eqnString name)
    (when (eq solutionMethod 'numeric)
      (setq digits (|htpLabelInputString| htPage 'acc))
      (setq kind (|htpButtonValue| htPage 'choice))
      (setq accString
        (if (|member| kind '(|rf| |cf|))
            (strconc "1.e-" digits)
            (strconc "1/10**" digits))))
      (setq alist (|htpProperty| htPage 'inputArea))
      (setq varpart (cadar alist))
      (setq r (cdr alist))
      (setq varlist (|bcString2WordList| varpart))
      (setq varString
        (if (cdr varlist)
```

```

(|bcwords2liststring| varlist)
(car varlist)))
(setq eqnString (|bcGenEquations| r))
(cond
((eq solutionMethod '|numeric|)
 (setq name (if (|member| kind '(|rf| |rr|)) "solve" "complexSolve"))
 (|bcFinish| name eqnString accString))
(t
 (setq name (if (eq solutionMethod '|radical|) "radicalSolve" "solve"))
 (|bcFinish| name eqnString varString accString))))

```

defun Linear Solve Basic Command trampoline

[[bcReadMatrix](#) p1182]

This routine is a trampoline. It calls **bcReadMatrix** passing the name of a call-back routine **bcLinearSolveMatrix1** to be called after the matrix has been read.

— defun bcLinearSolveMatrix —

```

(defun |bcLinearSolveMatrix| (htPage junk)
(declare (ignore htPage junk))
(|bcReadMatrix| '|bcLinearSolveMatrix1|))

```

defun Linear Solve Basic Command options

[[htInitPage](#) p1262]
[[htMakePage](#) p1263]
[[htShowPage](#) p1263]
[\$EmptyMode p??]

— defun bcLinearSolveMatrix1 —

```

(defun |bcLinearSolveMatrix1| (htPage)
(let (page)
 (setq page
 (|htInitPage| "Linear Solve Basic Command" (|httpPropertyList| htPage)))
 (|httpSetProperty| page '|matrix| (|bcLinearExtractMatrix| htPage))
 (|htMakePage|
 '(|text| . "The right side vector B is:"))

```

The right
Zero
Not

```
(|lispLinks|
  ("Zero:" "the system is homogeneous" |bcLinearSolveMatrixHomo| |homo|)
  ("Not zero:" "the system is not homogeneous"
    |bcLinearSolveMatrixInhomo| |nothomo|)))
(|htShowPage|)))
```

defun bcLinearExtractMatrix

[httpInputAreaAlist p[1253](#)]

— defun bcLinearExtractMatrix —

```
(defun |bcLinearExtractMatrix| (htPage)
  (reverse (|httpInputAreaAlist| htPage)))
```

defun Linear Solve Basic Command options

```
[strconc p??]
[stringimage p??]
[httpProperty p1254]
[htInitPage p1262]
[httpPropertyList p1253]
[httpSetProperty p1254]
[htMakePage p1263]
[htShowPage p1263]
[$EmptyMode p??]
```

— defun bcLinearSolveMatrixInhomo —

```
(defun |bcLinearSolveMatrixInhomo| (htPage junk)
  (declare (ignore junk))
  (labels (
```

```

(f (i)
  (let (spacer prefix name)
    (setq spacer (cond ((> i 99) 0) ((> i 9) 1) (t 2)))
    (setq prefix (strconc "{\\em Coefficient " (stringimage i) ":{}")
    (unless (eql spacer 0)
      (setq prefix (strconc prefix "\\space{" (stringimage spacer) "}")
      (setq name (intern (strconc "c" (stringimage i))))
      (list prefix '|| 30 0 name 'p ))))
  (let (nrows ncols labellist page)
    (declare (special |$EmptyMode|))
    (setq nrows (|httpProperty| htPage '|nrows|))
    (setq ncols (|httpProperty| htPage '|ncols|))
    (setq labellist (loop for i from 1 to ncols collect (f i)))
    (setq page
      (|htInitPage| "Linear Solve Basic Command" (|httpPropertyList| htPage)))
    (|httpSetProperty| page '|matrix| (|httpProperty| htPage '|matrix|))
    (|httpSetProperty| page '|nrows| nrows)
    (|httpSetProperty| page '|ncols| ncols)
    (|htMakePage|
      (list
        '(|domainConditions| (|isDomain| P (|Polynomial| |$EmptyMode|)))
        '(|text| . "Enter the right side vector B:")
        (cons '|inputStrings| labellist)
        (list
          '(|text| . "\\vspace{1}\\newline Do you want:")
          '(|lispLinks|
            ("All the solutions?" "" |bcLinearSolveMatrixInhomoGen| |all|)
            ("A particular solution?" ""
              |bcLinearSolveMatrixInhomoGen| |particular|))
          )))
    (|htShowPage|))))

```

defun bcLinearSolveMatrixInhomoGen

[bcLinearMatrixGen p1240]

— defun bcLinearSolveMatrixInhomoGen —

```

(defun |bcLinearSolveMatrixInhomoGen| (htPage key)
  (|bcLinearMatrixGen| htPage key))

```

defun bcLinearSolveMatrixHomo

[bcLinearMatrixGen p1240]

— defun bcLinearSolveMatrixHomo —

```
(defun |bcLinearSolveMatrixHomo| (htPage key)
  (declare (ignore key))
  (|bcLinearMatrixGen| htPage '|homo|))
```

—————

defun bcLinearMatrixGen

```
[bcMatrixGen p1188]
[bcFinish p1243]
[httpInputAreaAlist p1253]
[bcVectorGen p1246]
[bcMkFunction p1243]
[bcGen p1245]
[strconc p??]
```

— defun bcLinearMatrixGen —

```
(defun |bcLinearMatrixGen| (htPage key)
  (let (matform vector vecform form)
    (setq matform (|bcMatrixGen| htPage))
    (cond
      ((eq key '|homo|)
       (|bcFinish| "nullSpace" matform))
      (t
       (setq vector
              (loop for x in (reverse (|httpInputAreaAlist| htPage))
                    collect (elt x 1)))
       (setq vecform (|bcVectorGen| vector))
       (setq form (|bcMkFunction| "solve" matform (cons vecform nil)))
       (|bcGen| (if (eq key '|particular|)
                    (strconc form ".particular")
                    form))))))
```

—————

defun linearFinalRequest

```
[sayBrightly p??]
[bcQueryInteger p??]
[explainLinear p1241]
```

— defun linearFinalRequest —

```
(defun |linearFinalRequest| (nhh mat vect)
  (declare (ignore mat vect))
  (let (tt)
    (|sayBrightly| "Do you want more information on the meaning of the output")
    (|sayBrightly| " (1) no ")
    (|sayBrightly| " (2) yes ")
    (setq tt (|bcQueryInteger| 1 2 t))
    (cond
      ((eql tt 1) (|sayBrightly| "Bye Bye"))
      ((eql tt 2) (|explainLinear| nhh))))
```

—————

defun explainLinear

```
[systemError p??]
```

— defun explainLinear —

```
(defun |explainLinear| (flag)
  (cond
    ((eq flag '|notHomogeneous|)
      '("solve returns a particular solution and a basis for"
        "the vector space of solutions for the homogeneous part."
        "The particular solution is \"failed\" if one cannot be found.))
    ((eq flag '|homogeneous|)
      '("solve returns a basis for"
        "the vector space of solutions for the homogeneous part"))
    (t (|systemError| nil))))
```

—————

defun finalExactRequest

```
[bcQueryInteger p??]
[sayBrightly p??]
[moreExactSolution p??]
```

```
[explainExact p??]
```

— **defun finalExactRequest** —

```
(defun |finalExactRequest| (equations unknowns)
  (let (tt)
    (|sayBrightly| "Do you like:")
    (|sayBrightly| "  (1) the solutions how they are displayed")
    (|sayBrightly| "  (2) to get ????" )
    (|sayBrightly| "  (3) more information on the meaning of the output")
    (setq tt (|bcQueryInteger| 1 3 t))
    (cond
      ((eq1 tt 1) (|sayBrightly| "Bye Bye"))
      ((eq1 tt 2) (|moreExactSolution| equations unknowns))
      ((eq1 tt 3) (|explainExact| equations unknowns))))))
```

defun bcLinearSolveEqnsGen

```
[httpInputAreaAlist p1253]
[httpLabelInputString p1254]
[bcString2WordList p1246]
[bcwords2liststring p1246]
[bcGenEquations p1242]
[bcFinish p1243]
```

— **defun bcLinearSolveEqnsGen** —

```
(defun |bcLinearSolveEqnsGen| (htPage)
  (let (vars varlist varString alist eqnString)
    (setq alist (|httpInputAreaAlist| htPage))
    (when (setq vars (|httpLabelInputString| htPage '|unknowns|))
      (setq varlist (|bcString2WordList| vars))
      (setq varString
        (if (cdr varlist) (|bcwords2liststring| varlist) (car varlist)))
      (setq alist (cdr alist)))
    (setq eqnString (|bcGenEquations| alist))
    (|bcFinish| "solve" eqnString varString)))
```

defun bcGenEquations

```
[strconc p??]
[bcwords2liststring p1246]
```

— defun bcGenEquations —

```
(defun |bcGenEquations| (alist)
  (let (right left y eqnlist)
    (setq y alist)
    (loop while y do
      (setq right (elt (car y) 1))
      (setq y (cdr y))
      (setq left (elt (car y) 1))
      (setq y (cdr y))
      (setq eqnlist (cons (strconc left " = " right) eqnlist)))
    (if (cdr eqnlist)
      (|bcwords2liststring| eqnlist)
      (car eqnlist))))
```

—————

defun Output the final formula

— defun bcFinish —

```
(defun |bcFinish| (&rest t1 &aux args arg name)
  (dsetq (name arg . args) t1)
  (|bcGen| (|bcMkFunction| name arg args)))
```

—————

defun convert arguments into function call syntax

Convert verb—(bcMkFunction "test" "arg1" "(" "arg2" "arg3"))— to "test(arg1,arg2,arg3)"

— defun bcMkFunction —

```
(defun |bcMkFunction| (name arg args)
  (setq str
    (let ((result ""))
      (concatenate 'string arg
        (dolist (i args result)
          (when i
            (setq result (concatenate 'string result
              (concatenate 'string "," i)))))))
    (concatenate 'string name "(" str ")"))
```

—————

defun bcString2HyString2

— defun bcString2HyString2 —

```
(defun |bcString2HyString2| (s)
  (if (and (stringp s) (char= (elt s 0) #\"))
      (concatenate 'string "\\\" s "\\\"")
      s))
```

defun bcString2HyString

— defun bcString2HyString —

```
(defun |bcString2HyString| (s) s)
```

defun find a character position in a string

— defun bcFindString —

```
(defun |bcFindString| (s i n char)
  (position char s :start i :end n))
```

defun Basic Command result page

```
[strconc p??]
[htInitPage p1262]
[htMakePage p1263]
[htShowPage p1263]
```

— defun bcGen —

```
(defun |bcGen| (command)
  (let (string)
```

```
(|htInitPage| "Basic Command" nil)
(setq string
  (if (< (length command) 50)
    (strconc "{\\centerline{\\tt " command " }}")
    (strconc "{\\tt " command " }")))
(|htMakePage|
  (list
    '(|text|
      "{Here is the AXIOM command you could have issued to compute this result:}"
      "\\vspace{2}\\newline "
      (cons '(|text| string) ))
    (|htMakeDoitButton| "Do It" command)
    (|htShowPage|)))
```

defun Basic Command result page – NAG version

```
[strconc p??]
[htInitPage p1262]
[htMakePage p1263]
[htShowPage p1263]
```

Except for the banner the `bcGen` and `linkGen` functions are identical. We no longer care so we just call `bcGen`.

— defun linkGen —

```
(defun |linkGen| (command)
  (|bcGen| command))
```

defun bcOptional

— defun bcOptional —

```
(defun |bcOptional| (s)
  (if (string-equal s "") "2" s))
```

defun create a vertical space on a page

[bcHt p1260]

— defun bcvspace —

```
(defun |bcvspace| ()
  (|bcHt| "\\vspace{1}\\newline "))
```

—————

defun break a string into words

— defun bcString2WordList —

```
(defun |bcString2WordList| (string)
  (loop for i = 0 then (1+ j)
        as j = (position #\space string :start i)
        collect (subseq string i j)
        while j))
```

—————

defun format words into a string

[strconc p??]

— defun bcwords2liststring —

```
(defun |bcwords2liststring| (words)
  (format nil "[~{~A~^, ~}" words))
```

—————

defun format a vector

[bcwords2liststring p1246]

— defun bcVectorGen —

```
(defun |bcVectorGen| (vec)
  (|bcwords2liststring| vec))
```

defun format an error message

```
[sayBrightlyNT p??]
[sayBrightly p??]
```

— defun bcError —

```
(defun |bcError| (string)
  (|sayBrightlyNT| "NOTE: ")
  (|sayBrightly| string))
```

defun format intervals

```
[strconc p??]
```

— defun bcDrawIt —

```
(defun |bcDrawIt| (ind a b)
  (strconc ind "=" a ".." b))
```

defun Basic Command page not ready

```
[htInitPage p1262]
[htMakePage p1263]
[htShowPage p1263]
```

— defun bcNotReady —

```
(defun |bcNotReady| (htPage)
  (declare (ignore htPage))
  (|htInitPage| "Basic Command" NIL)
  (|htMakePage|
    '((|text| . "{\\centerline{\\em This facility will soon be available}}"))))
  (|htShowPage|))
```

defun pad a string with blanks

```
[strconc p??]
[stringimage p??]
```

— defun htStringPad —

```
(defun |htStringPad| (n w)
  (let (s ws)
    (setq s (stringimage n))
    (setq ws (|#| s))
    (strconc "\\space{" (stringimage (1+ (- w ws))) "}" s)))
```

defun construct a name string

Given ("one" "two" "three") generate "(one,two,three)"

— defun stringList2String —

```
(defun |stringList2String| (x)
  (cond
    ((null x) "()")
    (t
     (setq str
       (let ((result ""))
         (concatenate 'string (car x)
           (dolist (i (cdr x) result)
             (setq result (concatenate 'string result
               (concatenate 'string "," i))))))
       (concatenate 'string "(" str ")")))))
```

defun construct a name string

```
[strconc p??]
[stringimage p??]
```

— defun htMkName —

```
(defun |htMkName| (s n)
  (strconc s (stringimage n)))
```

```
;;; ht-util merge
```

```
defvar $bcParseOnly
```

```
— initvars —
```

```
(defvar |$bcParseOnly| t)
```

```
defvar $htLineList
```

```
— initvars —
```

```
(defvar |$htLineList| nil)
```

```
defvar $curpage
```

```
— initvars —
```

```
(defvar |$curPage| nil)
```

```
defvar $activePageList
```

```
— initvars —
```

```
(defvar |$activePageList| nil)
```

defun httpDestroyPage

— defun httpDestroyPage —

```
(defun |httpDestroyPage| (pageName)
  (declare (special |$activePageList|))
  (SEQ (cond
        ((|member| pageName |$activePageList|)
         (EXIT (progn
                  (set pageName nil)
                  (setq |$activePageList|
                        (NREMOVE |$activePageList| pageName)))))))
```

—————

defun httpName

— defun httpName —

```
(defun |httpName| (htPage) (elt htPage 0))
```

—————

defun httpSetName

— defun httpSetName —

```
(defun |httpSetName| (htPage val) (setelt htPage 0 val))
```

—————

defun httpDomainConditions

— defun httpDomainConditions —

```
(defun |httpDomainConditions| (htPage) (elt htPage 1))
```

—————

defun httpSetDomainConditions

— defun httpSetDomainConditions —

```
(defun |httpSetDomainConditions| (htPage val)
  (setelt htPage 1 val))
```

—————

defun httpDomainVariableAlist

— defun httpDomainVariableAlist —

```
(defun |httpDomainVariableAlist| (htPage) (elt htPage 2))
```

—————

defun httpSetDomainVariableAlist

— defun httpSetDomainVariableAlist —

```
(defun |httpSetDomainVariableAlist| (htPage val)
  (setelt htPage 2 val))
```

—————

defun httpDomainPvarSubstList

— defun httpDomainPvarSubstList —

```
(defun |httpDomainPvarSubstList| (htPage) (elt htPage 3))
```

—————

defun httpSetDomainPvarSubstList

— defun httpSetDomainPvarSubstList —

```
(defun |httpSetDomainPvarSubstList| (htPage val)
  (setelt htPage 3 val))
```

defun httpRadioButtonAlist

— defun httpRadioButtonAlist —

```
(defun |httpRadioButtonAlist| (htPage) (elt htPage 4))
```

defun httpButtonValue

— defun httpButtonValue —

```
(defun |httpButtonValue| (htPage groupName)
  (prog ()
    (return
      (SEQ (DO ((G166092
                  (LASSOC groupName
                        (|httpRadioButtonAlist| htPage))
                  (CDR G166092))
                (|buttonName| nil))
            ((OR (ATOM G166092)
                  (progn (setq |buttonName| (car G166092)) nil))
              NIL)
            (SEQ (EXIT (COND
                        ((BOOT-EQUAL
                          (|stripSpaces|
                           (|httpLabelInputString| htPage
                            |buttonName|))
                          "t")
                        (EXIT (RETURN |buttonName|))))))))))
```

defun httpSetRadioButtonAlist

— defun httpSetRadioButtonAlist —

```
(defun |httpSetRadioButtonAlist| (htPage val)
  (setelt htPage 4 val))
```

defun httpInputAreaAlist

```
— defun httpInputAreaAlist —

(defun |httpInputAreaAlist| (htPage) (elt htPage 5))
```

defun httpSetInputAreaAlist

```
— defun httpSetInputAreaAlist —

(defun |httpSetInputAreaAlist| (htPage val)
  (setelt htPage 5 val))
```

defun httpAddInputAreaProp

```
— defun httpAddInputAreaProp —

(defun |httpAddInputAreaProp| (htPage label prop)
  (setelt htPage 5
    (cons (cons label (cons nil (cons nil (cons nil prop))))
      (elt htPage 5))))
```

defun httpPropertyList

```
— defun httpPropertyList —
```

```
(defun |httpPropertyList| (htPage) (elt htPage 6))
```

defun httpProperty

— defun httpProperty —

```
(defun |httpProperty| (htPage propName)
  (LASSOC propName (elt htPage 6)))
```

defun httpSetProperty

— defun httpSetProperty —

```
(defun |httpSetProperty| (htPage propName val)
  (prog (pair)
    (return
      (progn
        (setq pair (|assoc| propName (elt htPage 6)))
        (cond
          (pair (rplacd pair val))
          (t
            (setelt htPage 6
              (cons (cons propName val) (elt htPage 6))))))))))
```

defun httpLabelInputString

— defun httpLabelInputString —

```
(defun |httpLabelInputString| (htPage label)
  (prog (props s)
    (return
      (progn
        (setq props
          (LASSOC label (|httpInputAreaAlist| htPage)))
        (cond
```

```
((and props (stringp (setq s (elt props 0))))
  (cond
    ((equal s "") s)
    (t (|trimString| s))))
(t nil))))))
```

defun httpLabelFilteredInputString

— defun httpLabelFilteredInputString —

```
(defun |httpLabelFilteredInputString| (htPage label)
  (prog (props)
    (return
      (progn
        (setq props
          (LASSOC label (|httpInputAreaAlist| htPage)))
        (cond
          (props (cond
            ((and (> (|#| props) 5) (elt props 6))
              (funcall (symbol-function (elt props 6))
                (elt props 0)))
            (t (|replacePercentByDollar| (elt props 0))))))
          (t nil))))))
```

defun replacePercentByDollar,fn

— defun replacePercentByDollar,fn —

```
(defun |replacePercentByDollar,fn| (s i n)
  (prog (m)
    (return
      (SEQ (if (> i n) (EXIT ""))
        (if (> (setq m (|charPosition| #\% s i))
          n)
          (EXIT (SUBSTRING s i nil)))
        (EXIT (STRCONC (SUBSTRING s i (- m i))
          "$"
          (|replacePercentByDollar,fn| s (1+ m)
            n))))))
```

defun replacePercentByDollar

— defun replacePercentByDollar —

```
(defun |replacePercentByDollar| (s)
  (|replacePercentByDollar,fn| s 0 (maxindex s)))
```

defun httpSetLabelInputString

— defun httpSetLabelInputString —

```
(defun |httpSetLabelInputString| (htPage label val)
  (prog (props)
    (return
      (progn
        (setq props
          (LASSOC label (|httpInputAreaAlist| htPage)))
        (cond
          (props (setelt props 0 (stringimage val)))
          (t nil))))))
```

defun httpLabelSpadValue

— defun httpLabelSpadValue —

```
(defun |httpLabelSpadValue| (htPage label)
  (prog (props)
    (return
      (progn
        (setq props
          (LASSOC label (|httpInputAreaAlist| htPage)))
        (cond (props (elt props 1)) (t nil))))))
```

defun httpSetLabelSpadValue

— defun httpSetLabelSpadValue —

```
(defun |httpSetLabelSpadValue| (htPage label val)
  (prog (props)
    (return
      (progn
        (setq props
          (LASSOC label (|httpInputAreaAlist| htPage)))
        (cond (props (setelt props 1 |val|)) (t nil))))))
```

defun httpLabelErrorMsg

— defun httpLabelErrorMsg —

```
(defun |httpLabelErrorMsg| (htPage label)
  (prog (props)
    (return
      (progn
        (setq props
          (LASSOC label (|httpInputAreaAlist| htPage)))
        (cond (props (elt props 2)) (t nil))))))
```

defun httpSetLabelErrorMsg

— defun httpSetLabelErrorMsg —

```
(defun |httpSetLabelErrorMsg| (htPage label val)
  (prog (props)
    (return
      (progn
        (setq props
          (LASSOC label (|httpInputAreaAlist| htPage)))
        (cond (props (setelt props 2 val)) (t nil))))))
```

defun httpLabelType

— defun httpLabelType —

```
(defun |httpLabelType| (htPage label)
  (prog (props)
    (return
      (progn
        (setq props
          (LASSOC label (|httpInputAreaAlist| htPage)))
        (cond (props (elt props 3)) (t nil))))))
```

defun httpLabelDefault

— defun httpLabelDefault —

```
(defun |httpLabelDefault| (htPage label)
  (prog (msg props)
    (return
      (cond
        ((setq msg (|httpLabelInputString| htPage label))
          (cond
            ((equal msg "t") 1)
            ((equal msg "nil") 0)
            (t msg)))
        (t
          (setq props
            (LASSOC label (|httpInputAreaAlist| htPage)))
          (cond (props (elt props 4)) (t nil))))))
```

defun httpLabelSpadType

— defun httpLabelSpadType —

```
(defun |httpLabelSpadType| (htPage label)
  (prog (props)
    (return
      (progn
```

```
(setq props
  (LASSOC label (|httpInputAreaAlist| htPage)))
(cond (props (elt props 5)) (t nil))))))
```

defun httpLabelFilter

— defun httpLabelFilter —

```
(defun |httpLabelFilter| (htPage label)
  (prog (props)
    (return
      (progn
        (setq props
          (LASSOC label (|httpInputAreaAlist| htPage)))
        (cond (props (elt props 6)) (t nil))))))
```

defun httpPageDescription

— defun httpPageDescription —

```
(defun |httpPageDescription| (htPage) (elt htPage 7))
```

defun httpSetPageDescription

— defun httpSetPageDescription —

```
(defun |httpSetPageDescription| (htPage pageDescription)
  (setelt htPage 7 pageDescription))
```

defun httpAddToPageDescription

— defun httpAddToPageDescription —

```
(defun |httpAddToPageDescription| (htPage pageDescrip)
  (setelt htPage 7
    (NCONC (NREVERSE (COPY-LIST pageDescrip)) (elt htPage 7))))
```

—————

defun issue a single hypertex line or group of lines

— defun iht —

```
(defun |iht| (line)
  (declare (special |$htLineList| |$newPage|))
  (cond
    (|$newPage| nil)
    ((consp line)
     (setq |$htLineList|
       (NCONC (NREVERSE (|mapStringize| (COPY-LIST line)))
         |$htLineList|)))
    (t
     (setq |$htLineList|
       (cons (|basicStringize| line) |$htLineList|))))
```

—————

defun bcHt

— defun bcHt —

```
(defun |bcHt| (line)
  (declare (special |$curPage| |$newPage|))
  (progn
    (|iht| line)
    (cond
      ((consp line)
       (cond
         (|$newPage|
          (|httpAddToPageDescription| |$curPage|
            (cons (cons '|text| line) nil))))
```

```

      (t nil)))
    (|$newPage|
      (|htpAddToPageDescription| |$curPage|
        (cons (cons '|text| (cons line nil)) nil)))
    (t nil)))

```

defun bcIssueHt

— defun bcIssueHt —

```

(defun |bcIssueHt| (line)
  (cond ((consp line) (|htMakePage1| line)) (t (|iht| line))))

```

defun mapStringize

— defun mapStringize —

```

(defun |mapStringize| (z)
  (cond
    ((atom z) z)
    (t (rplaca z (|basicStringize| (car z)))
      (rplacd z (|mapStringize| (cdr z)) z)))

```

defun basicStringize

— defun basicStringize —

```

(defun |basicStringize| (s)
  (cond
    ((stringp s)
      (cond
        ((equal s "\\$" ) "\\%")
        ((equal s "{\\em $}") "{\\em \\%}")
        (t s)))

```

```
((eq s '$) "\\%")
(t (princ-to-string s)))
```

defun stringize

— defun stringize —

```
(defun |stringize| (s)
  (cond ((stringp s) s) (t (princ-to-string s))))
```

defun htInitPage

— defun htInitPage —

```
(defun |htInitPage| (title propList)
  (declare (special |$curPage|))
  (progn
    (|htInitPageNoScroll| propList title)
    (|htSayStandard| "\\beginscroll ")
    |$curPage|))
```

defun htAddHeading

— defun htAddHeading —

```
(defun |htAddHeading| (title)
  (declare (special |$curPage|))
  (|htNewPage| title)
  |$curPage|)
```

defun htShowPage

```

— defun htShowPage —

(defun |htShowPage| ()
  (|htSayStandard| "\\endscroll")
  (|htShowPageNoScroll|))

```

defun show the page which has been computed

```

— defun htShowPageNoScroll —

(defun |htShowPageNoScroll| ()
  (prog (line)
    (declare (special |$htLineList| |$curPage| |$newPage|))
    (return
      (progn
        (|htSayStandard| "\\autobuttons")
        (|httpSetPageDescription| |$curPage|
          (NREVERSE (|httpPageDescription| |$curPage|)))
        (setq |$newPage| nil)
        (setq |$htLineList| nil)
        (|htMakePage| (|httpPageDescription| |$curPage|))
        (setq line (apply (|function| CONCAT) (NREVERSE |$htLineList|)))
        (|issueHT| line)
        (|endHTPage|))))))

```

defun make a page given the description in itemList

```

— defun htMakePage —

(defun |htMakePage| (itemList)
  (declare (special |$curPage| |$newPage|))
  (progn
    (cond
      (|$newPage| (|httpAddToPageDescription| |$curPage| itemList)))
    (|htMakePage1| itemList)))

```

defun htMakePage1

— defun htMakePage1 —

```

(defun |htMakePage1| (itemList)
  (prog (itemType items)
    (return
      (SEQ (DO ((G166261 itemList (CDR G166261)) (G166253 NIL))
        ((OR (ATOM G166261)
          (PROGN (SETQ G166253 (CAR G166261)) NIL)
          (PROGN
            (PROGN
              (setq itemType (CAR G166253))
              (setq items (CDR G166253))
              G166253)
            NIL))
          NIL)
        (SEQ (EXIT (COND
          ((eq itemType '|text|)
            (|ht| items))
          ((eq itemType '|lispLinks|)
            (|htLispLinks| items))
          ((eq itemType '|lispmemoLinks|)
            (|htLispMemoLinks| items))
          ((eq itemType '|bcLinks|)
            (|htBcLinks| items))
          ((eq itemType '|bcLinksNS|)
            (|htBcLinks| items t))
          ((eq itemType '|bcLispLinks|)
            (|htBcLispLinks| items))
          ((eq itemType '|radioButtons|)
            (|htRadioButtons| items))
          ((eq itemType '|bcRadioButtons|)
            (|htBcRadioButtons| items))
          ((eq itemType '|inputStrings|)
            (|htInputStrings| items))
          ((eq itemType '|domainConditions|)
            (|htProcessDomainConditions| items))
          ((eq itemType '|bcStrings|)
            (|htProcessBcStrings| items))
          ((eq itemType '|toggleButtons|)
            (|htProcessToggleButtons| items))
          ((eq itemType '|bcButtons|)
            (|htProcessBcButtons| items))
          ((eq itemType '|doneButton|)
            (|htProcessDoneButton| items))
          ((eq itemType '|doitButton|)
            (|htProcessDoitButton| items))
          (t

```

```
(|systemError|
  (cons "unknown itemType"
    (cons itemType nil)))))))))
```

defun htMakeErrorPage

— defun htMakeErrorPage —

```
(defun |htMakeErrorPage| (htPage)
  (prog (line)
    (declare (special |$curPage| |$htLineList| |$newPage|))
    (return
      (progn
        (setq |$newPage| nil)
        (setq |$htLineList| nil)
        (setq |$curPage| htPage)
        (|htMakePage| (|httpPageDescription| htPage))
        (setq line (apply (|function| CONCAT) (NREVERSE |$htLineList|)))
        (|issueHT| line)
        (|endHTPage|))))))
```

defun htQuote

— defun htQuote —

```
(defun |htQuote| (s)
  (progn
    (|iht| "\"")
    (|iht| s)
    (|iht| "\"")))
```

defun htProcessToggleButton

— defun htProcessToggleButton —


```

(defun |htProcessBcButtons| (buttons)
  (prog (defaultValue buttonName k)
    (declare (special |$curPage|))
    (return
      (SEQ (DO ((G166328 buttons (CDR G166328)) (G166317 nil))
        ((OR (ATOM G166328)
          (progn (setq G166317 (car G166328)) nil)
          (progn
            (progn
              (setq defaultValue (car G166317))
              (setq buttonName (CADR G166317))
              G166317)
            nil))
          nil)
        (SEQ (EXIT (progn
          (cond
            ((NULL (LASSOC buttonName
              (|httpInputAreaAlist| |$curPage|)))
              (|setUpDefault| buttonName
                (cons '|button|
                  (cons defaultValue nil))))))
            (setq k
              (|httpLabelDefault| |$curPage|
                buttonName))
            (cond
              ((EQL k 0)
                (|iht| (cons "\\off{"
                  (cons buttonName
                    (cons "}" nil))))))
              ((EQL k 1)
                (|iht| (cons "\\on{"
                  (cons buttonName
                    (cons "}" nil))))))
            (t
              (|iht| (cons "\\inputbox["
                (cons
                  (|httpLabelDefault| |$curPage|
                    buttonName)
                  (cons "]" {"
                    (cons buttonName
                      (cons
                        nil))))))))))))))))))

```

"}{\\htbmfile{pick}}{\\htbmfi.

defun htProcessBcStrings

— defun htProcessBcStrings —

```

(defun |htProcessBcStrings| (strings)
  (PROG (numChars default stringName spadType filter mess2)
    (declare (special |$curPage|))
    (return
      (SEQ (DO ((G166358 strings (CDR G166358)) (G166343 nil))
        ((or (atom G166358)
          (progn (setq G166343 (CAR G166358)) nil)
          (progn
            (progn
              (setq numChars (car G166343))
              (setq default (cadr G166343))
              (setq stringName (caddr G166343))
              (setq spadType (caddr G166343))
              (setq filter (caddr G166343))
              G166343)
            nil))
          nil)
        (SEQ (EXIT (progn
          (setq mess2 "")
          (cond
            ((null (LASSOC stringName
              (|httpInputAreaAlist| |$curPage|)))
              (|setUpDefault| stringName
                (cons '|string|
                  (cons default
                    (cons spadType
                      (cons filter nil)))))))
            (cond
              ((|httpLabelErrorMsg| |$curPage|
                stringName)
                (|iht| (cons
                  "\\centerline{\\em "
                  (cons
                    (|httpLabelErrorMsg| |$curPage|
                      stringName)
                    (cons "}" nil))))
                (setq mess2
                  (concat mess2 (|bcSadFaces|)))
                (|httpSetLabelErrorMsg| |$curPage|
                  stringName nil)))
              (|iht| (cons "\\inputstring{"
                (cons stringName
                  (cons "{"
                    (cons numChars
                      (cons "}"

```

```
(cons
  (|httpLabelDefault|
   |$curPage| stringName)
  (cons "}" "
    (cons mess2 nil))))))))))))))
```

defun bcSadFaces

— defun bcSadFaces —

```
(defun |bcSadFaces| ()
  "\\space{1}{\\em\\htbitmap{error}\\htbitmap{error}\\htbitmap{error}}")
```

defun htLispLinks

— defun htLispLinks —

```
(defun |htLispLinks| (&REST G166422 &AUX option links)
  (setq links (car G166422))
  (setq option (cdr G166422))
  (prog (t1 options indent message info func value call)
    (return
      (SEQ (progn
        (setq t1 (|beforeAfter| ' |options| links))
        (setq links (car t1))
        (setq options (cadr t1))
        (setq indent (or (LASSOC ' |indent| options) 5))
        (|iht| "\\newline\\indent{")
        (|iht| (|stringize| indent))
        (|iht| "}\\beginitems")
        (DO ((G166403 links (CDR G166403)) (G166387 nil))
          ((or (atom G166403)
              (progn (setq G166387 (car G166403)) nil)
              (progn
                (progn
                  (setq message (car G166387))
                  (setq info (cadr G166387))
                  (setq func (caddr G166387))
                  (setq value (cddddr G166387))
```

```

G166387)
  nil))
  nil)
  (SEQ (EXIT (progn
    (|iht| "\\item[")
    (setq call
      (cond
        ((IFCAR option)
         "\\lispmemolink")
        (t
         "\\lispldownlink"))))
    (|htMakeButton| call message
      (|mkCurryFun| func value))
    (|iht| (cons "]"\\space{" nil))
    (|bcIssueHt| info))))))
  (|iht| "\\enditems\\indent{0} "))))))

```

defun htLispMemoLinks

— defun htLispMemoLinks —

```
(defun |htLispMemoLinks| (links) (|htLispLinks| links t))
```

defun htBcLinks

— defun htBcLinks —

```

(defun |htBcLinks| (&REST G166465 &AUX options links)
  (setq links (car G166465))
  (setq options (cdr G166465))
  (prog (skipStateInfo? t1 message info func value)
    (return
      (SEQ (progn
        (setq |skipStateInfo?| (IFCAR options))
        (setq t1 (|beforeAfter| 'options| links))
        (setq links (car t1))
        (setq options (cadr t1))
        (DO ((G166447 links (CDR G166447)) (G166434 nil))
          ((or (atom G166447)

```

```

(progn (setq G166434 (car G166447)) nil)
(progn
  (progn
    (setq message (car G166434))
    (setq info (cadr G166434))
    (setq func (caddr G166434))
    (setq value (cdddd G166434))
    G166434)
  nil))
nil)
(SEQ (EXIT (progn
  (|htMakeButton|
    "\\lispdownlink" message
    (|mkCurryFun| func value)
    skipStateInfo?)
    (|bcIssueHt| info)))))))))

```

defun htBcLispLinks

— defun htBcLispLinks —

```

(defun |htBcLispLinks| (links)
  (prog (t1 options message info func value)
    (return
      (SEQ (progn
        (setq t1 (|beforeAfter| ' |options| links))
        (setq links (car t1))
        (setq options (cadr t1))
        (DO ((G166487 links (cdr G166487)) (G166474 nil))
          ((or (atom G166487)
            (progn (setq G166474 (car G166487)) nil)
            (progn
              (progn
                (setq message (car G166474))
                (setq info (cadr G166474))
                (setq func (caddr G166474))
                (setq value (cdddd G166474))
                G166474)
              nil))
            nil)
          (SEQ (EXIT (progn
            (|htMakeButton| "\\lisplink"
              message
              (|mkCurryFun| func value))
              (|bcIssueHt| info)))))))))

```

defun beforeAfter

— defun beforeAfter —

```
(defun |beforeAfter| (x u)
  (prog (y r)
    (return
      (SEQ (cons (prog (G166514)
                      (setq G166514 nil)
                      (return
                        (DO ((G166504 u (CDR G166504)))
                          ((or (atom G166504)
                              (progn
                                (progn
                                  (setq y (car G166504))
                                  (setq r (cdr G166504))
                                  G166504)
                                nil)
                              (null (NEQUAL x y))))
                        (NREVERSEO G166514))
                        (SEQ (EXIT (setq G166514 (cons y G166514))))))
                        (cons r nil)))))))
```

defun mkCurryFun

— defun mkCurryFun —

```
(defun |mkCurryFun| (fun val)
  (prog (name code)
    (return
      (progn
        (setq name (gentemp))
        (setq code
          (cons 'defun
            (cons name
              (cons '(arg)
                (cons
                  (cons 'apply
```

```

                                (cons (mkq fun)
                                (cons
                                  (cons 'cons
                                    (cons 'arg
                                      (cons (mkq val) nil)))
                                  nil)))
                                nil))))
(eval code)
name))))

```

defun htRadioButtons

— defun htRadioButtons —

```

(defun |htRadioButtons| (G166546)
  (prog (groupName buttons boxesName message info buttonName defaultValue)
    (declare (special |$curPage|))
    (return
      (SEQ (progn
        (setq groupName (car G166546))
        (setq buttons (cdr G166546))
        (|httpSetRadioButtonAlist| |$curPage|
          (cons (cons groupName (|buttonNames| buttons))
                (|httpRadioButtonAlist| |$curPage|)))
        (setq boxesName (gentemp))
        (|iht| (cons "\\newline\\indent{5}\\radioboxes{"
          (cons boxesName
            (cons
              "{\\htbmfile{pick}}{\\htbmfile{unpick}}\\beginitems "
              nil))))
        (setq defaultValue "1")
        (DO ((G166568 buttons (cdr G166568))
            (G166540 nil))
          ((or (atom G166568)
              (progn (setq G166540 (car G166568)) nil)
              (progn
                (progn
                  (setq message (car G166540))
                  (setq info (cadr G166540))
                  (setq buttonName (caddr G166540))
                  G166540)
                nil))
              nil)
          (SEQ (EXIT (progn
            (cond

```

```

((null (LASSOC buttonName
  (|httpInputAreaAlist| |$curPage|)))
(|setUpDefault| buttonName
  (cons '|button|
    (cons defaultValue nil)))
(setq defaultValue
  "0"))
(|iht| (cons "\\item{\\em\\radiobox["
  (cons
    (|httpLabelDefault| |$curPage|
      buttonName)
    (cons "]"{"
      (cons buttonName
        (cons "]"{"
          (cons boxesName
            (cons
              "\\space{"
              nil)))))))))
(|bcIssueHt| message)
(|iht| "\\space{ }")
(|bcIssueHt| info))))
(|iht| "\\enditems\\indent{0} ") ))))

```

defun htBcRadioButtons

— defun htBcRadioButtons —

```

(defun |htBcRadioButtons| (G166594)
  (prog (groupName buttons boxesName message info buttonName defaultValue)
    (declare (special |$curPage|))
    (return
      (SEQ (progn
        (setq groupName (car G166594))
        (setq buttons (cdr G166594))
        (|httpSetRadioButtonAlist| |$curPage|
          (cons (cons groupName (|buttonNames| buttons))
            (|httpRadioButtonAlist| |$curPage|)))
        (setq boxesName (gentemp))
        (|iht| (cons "\\radioboxes{"
          (cons boxesName
            (cons "]"{"\\htbfile{pick}}{\\htbfile{unpick}} "
              nil))))
        (setq defaultValue "1")
        (DO ((G166616 buttons (cdr G166616))
          (G166588 nil))

```

```

((or (atom G166616)
      (progn (setq G166588 (car G166616)) nil)
      (progn
        (progn
          (setq message (car G166588))
          (setq info (cadr G166588))
          (setq buttonName (caddr G166588))
          G166588)
        nil))
      nil)
  (SEQ (EXIT (progn
    (cond
      ((null (LASSOC buttonName
                    (|httpInputAreaAlist| |$curPage|)))
        (|setUpDefault| buttonName
          (cons '|button|
                (cons defaultValue nil)))
        (setq defaultValue
          "0")))
      (|iht| (cons
        "{\\em\\radiobox["
        (cons
          (|httpLabelDefault| |$curPage|
            buttonName)
          (cons "]" {"
            (cons buttonName
              (cons "}{"
                (cons boxesName
                  (cons "]" nil))))))))
        (|bcIssueHt| message)
        (|iht| "\\space{}}")
        (|bcIssueHt| info)))))))))

```

defun setUpDefault

— defun setUpDefault —

```

(defun |setUpDefault| (name props)
  (declare (special |$curPage|))
  (|httpAddInputAreaProp| |$curPage| name props))

```

defun buttonNames

— defun buttonNames —

```

(defun |buttonNames| (buttons)
  (prog (buttonName)
    (return
      (SEQ (prog (G166645)
        (setq G166645 nil)
        (return
          (DO ((G166651 buttons (cdr G166651))
            (G166637 nil))
            ((or (atom G166651)
              (progn (setq G166637 (car G166651)) nil)
              (progn
                (progn
                  (setq buttonName (caddr G166637))
                  G166637)
                nil))
              (NREVERSEO G166645))
            (SEQ (EXIT (setq G166645
              (cons buttonName G166645)))))))))))))

```

—————

defun htInputStrings

— defun htInputStrings —

```

(defun |htInputStrings| (strings)
  (prog (mess1 numChars default stringName spadType filter mess2)
    (declare (special |$curPage|))
    (return
      (SEQ (progn
        (|iht| "\\newline\\indent{5}\\beginitems ")
        (DO ((G166685 strings (cdr G166685))
          (G166665 nil))
          ((or (atom G166685)
            (progn (setq G166665 (car G166685)) nil)
            (progn
              (progn
                (setq mess1 (car G166665))
                (setq mess2 (cadr G166665))
                (setq numChars (caddr G166665))
                (setq default (caddr G166665))

```

```

      (setq stringName
        (car (cddddr G166665)))
      (setq spadType
        (cadr (cddddr G166665)))
      (setq filter (cddr (cddddr G166665)))
      G166665)
    nil))
  nil)
  (SEQ (EXIT (progn
    (cond
      ((null (LASSOC stringName
        (|httpInputAreaAlist| |$curPage|)))
        (|setUpDefault| stringName
          (cons '|string|
            (cons default
              (cons spadType
                (cons filter nil)))))))
      (cond
        ((|httpLabelErrorMsg| |$curPage|
          stringName)
          (|iht| (cons "\\centerline{\\em "
            (cons
              (|httpLabelErrorMsg| |$curPage|
                stringName)
              (cons "}" nil))))
            (setq mess2
              (CONCAT mess2 (|bcSadFaces|)))
            (|httpSetLabelErrorMsg| |$curPage|
              stringName nil)))
          (|iht| "\\item ")
          (|bcIssueHt| mess1)
          (|iht| (cons "\\inputstring{"
            (cons stringName
              (cons "{"
                (cons numChars
                  (cons "}"
                    (cons
                      (|httpLabelDefault| |$curPage|
                        stringName)
                      (cons "}" nil)))))))
            (|bcIssueHt| mess2))))
          (|iht| "\\enditems\\indent{0}\\newline "))))))

```

defun htProcessDomainConditions

— defun htProcessDomainConditions —

```
(defun |htProcessDomainConditions| (condList)
  (declare (special |$curPage|))
  (progn
    (|httpSetDomainConditions| |$curPage|
      (|renamePatternVariables| condList))
    (|httpSetDomainVariableAlist| |$curPage|
      (|computeDomainVariableAlist|))))
```

—————

defun renamePatternVariables

— defun renamePatternVariables —

```
(defun |renamePatternVariables| (condList)
  (declare (special |$curPage| |$PatternVariableList|))
  (progn
    (|httpSetDomainPvarSubstList| |$curPage|
      (|renamePatternVariables1| condList nil
        |$PatternVariableList|))
    (|substFromAlist| condList (|httpDomainPvarSubstList| |$curPage|))))
```

—————

defun renamePatternVariables1

— defun renamePatternVariables1 —

```
(defun |renamePatternVariables1| (condList substList patVars)
  (prog (restConds pattern t2 pv t3 cond nsubst)
    (declare (special |$EmptyMode|))
    (return
      (cond
        ((null condList) substList)
        (t (setq cond (car condList))
          (setq restConds (cdr condList))
          (cond
            ((or (and (consp cond) (eq (qcar cond) '|isDomain|)
              (progn
                (setq t2 (qcdr cond))
                (and (consp t2)
```

```

      (progn
        (setq pv (qcar t2))
        (setq t3 (qcdr t2))
        (and (consp t3)
          (eq (qcdr t3) nil)
          (progn
            (setq pattern
              (qcar t3))
            t))))))
    (and (consp cond) (eq (qcar cond) '|ofCategory|)
      (progn
        (setq t2 (qcdr cond))
        (and (consp t2)
          (progn
            (setq pv (qcar t2))
            (setq t3 (qcdr t2))
            (and (consp t3)
              (eq (qcdr t3) nil)
              (progn
                (setq pattern
                  (qcar t3))
                t))))))
        (and (consp cond) (eq (qcar cond) '|Satisfies|)
          (progn
            (setq t2 (qcdr cond))
            (and (consp t2)
              (progn
                (setq pv (qcar t2))
                (setq t3 (qcdr t2))
                (and (consp t3)
                  (eq (qcdr t3) nil)
                  (progn
                    (setq cond (qcar t3))
                    t))))))
            (cond
              ((equal pv |$EmptyMode|)
               (setq nsubst substList))
              (t
               (setq nsubst
                 (cons (cons pv (car patVars)) substList))))
            (|renamePatternVariables1| restConds nsubst
              (cdr patVars)))
      (t substList))))))

```

defun substFromAlist

— defun substFromAlist —

```
(defun |substFromAlist| (z substAlist)
  (prog (pvar replace)
    (return
      (SEQ (progn
        (DO ((G166792 substAlist (cdr G166792))
              (G166783 nil))
          ((or (atom G166792)
              (progn (setq G166783 (car G166792)) nil)
              (progn
                (progn
                  (setq pvar (car G166783))
                  (setq replace (cdr G166783))
                  G166783)
                nil))
              nil)
          (SEQ (EXIT (setq z (subst replace pvar z :test #'equal))))))
        z))))))
```

defun computeDomainVariableAlist

— defun computeDomainVariableAlist —

```
(defun |computeDomainVariableAlist| ()
  (prog (pvar)
    (declare (special |$curPage|))
    (return
      (SEQ (prog (G166813)
        (setq G166813 nil)
        (return
          (DO ((G166819 (|httpDomainPvarSubstList| |$curPage|)
                  (cdr G166819))
                (G166805 NIL))
              ((or (atom G166819)
                  (progn (setq G166805 (car G166819)) nil)
                  (progn
                    (progn
                      (setq pvar (cdr G166805))
                      G166805)
                    NIL))
                nil))
```



```

                                t))))
      (|member| pv pvarList))
    (|pvarCondList1|
      (NCONC pvarList (|pvarsOfPattern| pattern))
      (cons cond activeConds) restConds))
    (t (|pvarCondList1| pvarList activeConds restConds)))))))))

```

defun pvarsOfPattern

— defun pvarsOfPattern —

```

(defun |pvarsOfPattern| (pattern)
  (prog ()
    (declare (special |$PatternVariableList|))
    (return
      (SEQ (cond
        ((null (listp pattern)) nil)
        (t
          (prog (G166869)
            (setq G166869 nil)
            (return
              (DO ((G166875 (cdr pattern) (cdr G166875))
                (pvar nil))
                ((or (atom G166875)
                  (progn (setq pvar (car G166875)) nil))
                  (NREVERSEO G166869))
                (SEQ (EXIT (cond
                  ((|member| pvar
                    |$PatternVariableList|)
                    (setq G166869
                      (cons pvar G166869))))))))))))))

```

defun htMakeTemplates,substLabel

— defun htMakeTemplates,substLabel —

```

(defun |htMakeTemplates,substLabel| (i template)
  (SEQ (if (consp template)
    (EXIT (intern (CONCAT (car template) (princ-to-string i)

```

```

(cdr template))))
(EXIT template)))

```

defun htMakeTemplates

— defun htMakeTemplates —

```

(defun |htMakeTemplates| (templateList numLabels)
  (prog ()
    (return
      (SEQ (progn
        (setq templateList
          (prog (G166895)
            (setq G166895 nil)
            (return
              (DO ((G166900 templateList
                (CDR G166900))
                (template nil))
                ((or (atom G166900)
                  (progn
                    (setq template (car G166900))
                    nil))
                  (NREVERSE0 G166895))
                (SEQ (EXIT (setq G166895
                  (cons
                    (|templateParts| template)
                    G166895))))))))
          (prog (G166910)
            (setq G166910 nil)
            (return
              (DO ((i 1 (1+ i))
                ((qsgreaterp i numLabels)
                  (NREVERSE0 G166910))
                (SEQ (EXIT (setq G166910
                  (cons
                    (prog (G166922)
                      (setq G166922 nil)
                      (return
                        (DO
                          ((G166927 templateList
                            (CDR G166927))
                          (template nil))
                          ((or (atom G166927)
                            (progn
                              (setq template

```

```

(car G166927))
  nil))
(NREVERSEO G166922))
(SEQ
(EXIT
(setq G166922
(cons
(htMakeTemplates,substLabel|
i template)
G166922))))))
G166910)))))))))

```

defun templateParts

— defun templateParts —

```

(defun |templateParts| (template)
  (prog (i)
    (return
      (cond
        ((null (stringp template)) template)
        (t (setq i (SEARCH "%l" template))
          (cond
            ((null i) template)
            (t
              (cons (SUBSEQ template 0 i)
                    (SUBSEQ template (+ i 2))))))))))

```

defun htMakeDoneButton

— defun htMakeDoneButton —

```

(defun |htMakeDoneButton| (message func)
  (progn
    (|bcHt| "\\newline\\vspace{1}\\centerline{")
    (cond
      ((equal message "Continue")
        (|bchtMakeButton| "\\lispdownlink"
          '|\\ContinueBitmap| func))

```

```

(t
  (|bchtMakeButton| "\\lispdownlink"
    (CONCAT "\\box{" message "}")
    func)))
(|bcHt| "}" ")))

```

defun htProcessDoneButton

— defun htProcessDoneButton —

```

(defun |htProcessDoneButton| (G166950)
  (prog (label func)
    (return
      (progn
        (setq label (car G166950))
        (setq func (cadr G166950))
        (|iht| "\\newline\\vspace{1}\\centerline{"
          (cond
            ((equal label "Continue")
              (|htMakeButton| "\\lispdownlink"
                '|\\ContinueBitmap| func))
            ((equal label "Push to enter names")
              (|htMakeButton| "\\lispdownlink"
                "\\ControlBitmap{clicktoet}" func))
            (t
              (|htMakeButton| "\\lispdownlink"
                (CONCAT "\\box{" label "}")
                func)))
          (|iht| "}" "))))))

```

defun htMakeButton

— defun htMakeButton —

```

(defun |htMakeButton|
  (&REST G166990 &AUX options func message htCommand)
  (DSETQ (htCommand message func . options) G166990)
  (prog (skipStateInfo? id type)
    (declare (special |$curPage|))

```

```

(return
  (SEQ (progn
    (setq skipStateInfo? (IFCAR options))
    (|iht| (cons htCommand (cons "{" nil)))
    (|bcIssueHt| message)
    (cond
      (skipStateInfo?
        (|iht| (cons "}{(|htDoneButton| '|"
          (cons func
            (cons "| "
              (cons (|httpName| |$curPage|)
                (cons "}" nil)))))))
      (t
        (|iht| (cons "}{(|htDoneButton| '|"
          (cons func
            (cons "| (progn " nil))))
        (DO ((G166977 (|httpInputAreaAlist| |$curPage|)
          (CDR G166977))
          (G166965 nil))
          ((OR (ATOM G166977)
            (progn (setq G166965 (car G166977)) nil)
            (progn
              (setq id (car G166965))
              (setq type (car (cddddr G166965)))
              G166965)
            nil))
          nil)
        (SEQ (EXIT (progn
          (|iht| (cons "(|httpSetLabelInputString| "
            (cons (|httpName| |$curPage|)
              (cons "'|"
                (cons id
                  (cons "| " nil))))))
          (cond
            ((eq type '|string|)
              (|iht| (cons "\"\\stringvalue{"
                (cons id
                  (cons "}\""
                    nil))))))
            (t
              (|iht| (cons
                "\"\\boxvalue{"
                  (cons id
                    (cons "}\""
                      nil))))))
          (|iht| " ") )))))
        (|iht| (cons (|httpName| |$curPage|)
          (cons "}" nil)))))))))

```

defun bchtMakeButton

— defun bchtMakeButton —

```
(defun |bchtMakeButton| (htCommand message func)
  (prog (id type)
    (declare (special |$curPage|))
    (return
      (SEQ (progn
        (|bcHt| (cons htCommand
          (cons "{"
            (cons message
              (cons "}{"(|htDoneButton| '|"
                (cons func
                  (cons "| (progn "
                    nil)))))))
          (DO ((G167004 (|httpInputAreaAlist| |$curPage|)
            (cdr G167004))
              (G166992 nil))
            ((or (atom G167004)
              (progn (setq G166992 (car G167004)) nil)
              (progn
                (progn
                  (setq id (car G166992))
                  (setq type (car (cddddr G166992)))
                  G166992)
                nil))
              nil)
            (SEQ (EXIT (progn
              (|bcHt| (cons "(|httpSetLabelInputString| "
                (cons (|httpName| |$curPage|)
                  (cons "'|"
                    (cons id
                      (cons "| " nil))))))
              (cond
                ((eq type '|string|)
                  (|bcHt| (cons
                    "\"\\stringvalue{"
                    (cons id
                      (cons "}\\\"" nil))))
                  (t
                    (|bcHt| (cons
                      "\"\\boxvalue{"
                      (cons id
                        (cons "}\\\"" nil))))))
              (|bcHt| " ) "))))))
```



```
(|bcHt| (cons (|httpName| |$curPage|)
              (cons "))) " nil))))))
```

defun htProcessDoitButton

— defun htProcessDoitButton —

```
(defun |htProcessDoitButton| (G167017)
  (prog (label command func fun)
    (return
      (progn
        (setq label (car G167017))
        (setq command (cadr G167017))
        (setq func (caddr G167017))
        (setq fun (|mkCurryFun| func (cons command nil)))
        (|iht| "\\newline\\vspace{1}\\centerline{")
        (|htMakeButton| "\\lispcommand"
          (CONCAT "\\box{" label "}")
          fun)
        (|iht| "} ")
        (|iht| "\\vspace{2}{Select \\ \\UpButton{} \\ to go back one page.}")
        (|iht| "\\newline{Select \\ \\ExitButton{QuitPage} \\ to remove this window.}")))))
```

defun htMakeDoitButton

— defun htMakeDoitButton —

```
(defun |htMakeDoitButton| (label command)
  (declare (special |$curPage|))
  (progn
    (cond
      ((equal label "Do It")
        (|bcHt| "\\newline\\vspace{1}\\centerline{\\lispcommand{\\DoItBitmap}{(|doDoitButton| ")}")
        (t
          (|bcHt| (cons "\\newline\\vspace{1}\\centerline{\\lispcommand{\\box{"
            (cons label
              (cons "}{(|doDoitButton| "
                nil))))))
          (|bcHt| (|httpName| |$curPage|)))
```

```
(|bcHt| (cons " \""
              (cons (|htEscapeString| command)
                    (cons "\"" nil))))
(|bcHt| "}}}")
(|bcHt| "\\vspace{2}{Select \\ \\UpButton{} \\ to go back one page.}")
(|bcHt| "\\newline{Select \\ \\ExitButton{QuitPage} \\ to remove this window.}"))
```

defun doDoitButton

— defun doDoitButton —

```
(defun |doDoitButton| (htPage command)
  (declare (ignore htPage))
  (|executeInterpreterCommand| command))
```

defun executeInterpreterCommand

— defun executeInterpreterCommand —

```
(defun |executeInterpreterCommand| (command)
  (progn
    (princ command)
    (terpri)
    (|setCurrentLine| command)
    (catch 'spad_reader (|parseAndInterpret| command))
    (princ (mkprompt))
    (finish-output)))
```

defun htDoneButton

— defun htDoneButton —

```
(defun |htDoneButton| (func htPage)
  (cond
```

```
((|typeCheckInputAreas| htPage) (|htMakeErrorPage| htPage))
((null (fboundp func))
 (|systemError| (cons "unknown function" (cons func nil))))
(t (funcall (symbol-function func) htPage))))
```

defun typeCheckInputAreas

— defun typeCheckInputAreas —

```
(defun |typeCheckInputAreas| (htPage)
  (prog (inputAlist stringName t2 t3 t4 t5 t6 t7 spadType t8 filter
        condList string val errorCondition)
    (declare (special |$bcParseOnly|))
    (return
      (SEQ (progn
        (setq inputAlist nil)
        (setq errorCondition nil)
        (DO ((G167160 (|httpInputAreaAlist| htPage)
                    (cdr G167160))
            (entry nil))
          ((or (atom G167160)
              (progn (setq entry (car G167160)) nil))
           nil)
          (SEQ (EXIT (cond
            ((and (consp entry)
                  (progn
                    (setq stringName
                      (QCAR entry))
                    (setq t2 (QCDR entry))
                    (and (consp t2)
                        (progn
                          (setq t3
                            (QCDR t2))
                          (and (consp t3)
                              (progn
                                (setq t4
                                  (QCDR t3))
                                (and (consp t4)
                                    (progn
                                      (setq t5
                                        (QCDR t4))
                                      (and (consp t5)
                                          (eq (QCAR t5)
                                              '|string|)
                                          (progn
```

```

        (setq t6
          (QCDR t5))
        (and (consp t6)
          (progn
            (setq t7
              (QCDR t6))
            (and
              (consp t7)
              (progn
                (setq
                  spadType
                  (QCAR t7))
                (setq
                  t8
                  (QCDR t7))
                (and
                  (consp
                    t8)
                  (eq
                    (QCDR
                     t8)
                    nil)
                  (progn
                    (setq
                      filter
                      (QCAR
                       t8))
                    t))))))))))
      (progn
        (setq condList
          (LASSOC
            (LASSOC spadType
              (|httpDomainPvarSubstList|
               htPage))
            (|httpDomainVariableAlist|
             htPage)))
        (setq string
          (|httpLabelFilteredInputString|
           htPage stringName))
        (cond
          (|$bcParseOnly|
            (cond
              ((null
                (|ncParseFromString| string))
               (|httpSetLabelErrorMsg| htPage
                "Syntax Error"
                "Syntax Error"))
              (t nil)))
          (t
            (setq val

```

```

(|checkCondition|
(|httpLabelInputString|
  htPage stringName)
  string condList))
(cond
  ((stringp val)
   (setq errorCondition t)
   (|httpSetLabelErrorMsg| htPage
    stringName val))
  (t
   (|httpSetLabelSpadValue| htPage
    stringName val)))))))))
errorCondition))))))

```

defun checkCondition

— defun checkCondition —

```

(defun |checkCondition| (s1 string condList)
  (prog (pred t2 t3 pvar t4 pattern val type data newType)
    (return
      (cond
        ((and (consp condList) (eq (QCDR condList) nil)
          (progn
            (setq t2 (QCAR |condList|))
            (and (consp t2)
              (eq (QCAR t2) '|Satisfies|)
              (progn
                (setq t3 (QCDR t2))
                (and (consp t3)
                  (progn
                    (setq pvar (QCAR t3))
                    (setq t4 (QCDR t3))
                    (AND (consp t4)
                      (eq (QCDR t4) nil)
                      (progn
                        (setq pred (QCAR t4))
                        t))))))))))
          (setq val (funcall pred string))
          (cond
            ((stringp val) val)
            (t (cons '|String| (|wrap| s1))))))
        (null (and (consp condList) (eq (QCDR condList) nil)
          (progn
            (setq t2 (QCAR condList))

```

```

      (and (consp t2)
        (eq (QCAR t2) '|isDomain|)
        (progn
          (setq t3 (QCDR t2))
          (and (consp t3)
            (progn
              (setq pvar (QCAR t3))
              (setq t4
                (QCDR t3))
              (and (consp t4)
                (eq (QCDR t4) nil)
                (progn
                  (setq pattern
                    (QCAR t4))
                  t))))))))))
    (|systemError|
      "currently invalid domain condition"))
  ((equal |pattern| '|(String|)')
    (cons '|(String|)' (|wrap| s1)))
  (t (setq val (|parseAndEval| string))
    (cond
      ((stringp val)
        (cond
          ((equal val "Syntax Error ")
            "Error: Syntax Error ")
          (t (|condErrorMsg| pattern))))
      (t (setq type (car val))
        (setq data (cdr val))
        (setq newType
          (catch 'spad_reader
            (|resolveTM| type pattern)))
        (cond
          ((null newType) (|condErrorMsg| pattern))
          (t (|coerceInt| val newType))))))))))

```

defun condErrorMsg

— defun condErrorMsg —

```

(defun |condErrorMsg| (type)
  (prog (typeString)
    (return
      (progn
        (setq typeString (|form2String| type))
        (cond

```

```

      ((consp typeString)
       (setq typeString
              (apply (|function| CONCAT) typeString))))
(CONCAT "Error: Could not make your input into a "
       typeString))))

```

defun parseAndEval

— defun parseAndEval —

```

(defun |parseAndEval| (string)
  (prog (|$InteractiveMode| $boot $spad |$e| |$QuietCommand|)
    (declare (special |$InteractiveMode| $boot $spad |$e|
                     |$QuietCommand|))
    (return
     (progn
      (setq |$InteractiveMode| t)
      (setq $boot nil)
      (setq $spad t)
      (setq |$e| |$InteractiveFrame|)
      (setq |$QuietCommand| t)
      (|parseAndEval1| string)))))

```

defun parseAndEval1

— defun parseAndEval1 —

```

(defun |parseAndEval1| (string)
  (let (v syntaxError pform val)
    (setq syntaxError nil)
    (setq pform
      (progn
       (setq v
              (|applyWithOutputToString| '|ncParseFromString| (cons string nil)))
       (cond
        ((car v) (car v))
        (t (setq syntaxError t) (cdr v)))))
    (cond
     (syntaxError "Syntax Error ")

```

```

(pform
  (setq val
    (|applyWithOutputToString| '|processInteractive|
      (cons pform (list nil))))
  (cond
    ((car val) (car val))
    (t "Type Analysis Error")))
(t nil)))

```

defun oldParseString

— defun oldParseString —

```

(defun |oldParseString| (string)
  (prog (tree)
    (return
      (progn
        (setq tree
          (|applyWithOutputToString| '|string2SpadTree|
            (cons string nil)))
        (cond
          ((car tree)
            (|parseTransform| (postTransform (car tree))))
          (t (cdr tree)))))))

```

defun makeSpadCommand

— defun makeSpadCommand —

```

(defun |makeSpadCommand| (&REST G167322 &AUX z)
  (setq z G167322)
  (prog (opForm lastArg argList)
    (return
      (SEQ (progn
        (setq opForm (CONCAT (car z) "("))
        (setq lastArg (|last| z))
        (setq z (cdr z))
        (setq argList nil)
        (DO ((G167306 1 (cdr G167306)) (arg nil))

```



```

      ((or (atom G167306)
            (progn (setq arg (car G167306)) nil)
            (null (NEQUAL arg lastArg))))
      nil)
    (SEQ (EXIT (setq argList
                    (cons
                     (CONCAT arg ", ")
                     argList))))))
  (setq argList (NREVERSE (cons lastArg argList)))
  (CONCAT opForm (apply (|function| CONCAT) argList)
    ")"))))

```

defun htMakeInputList

— defun htMakeInputList —

```

(defun |htMakeInputList| (stringList)
  (prog (lastArg argList)
    (return
      (SEQ (progn
              (setq lastArg (|last| stringList))
              (setq argList nil)
              (DO ((G167328 stringList (cdr G167328)) (arg nil))
                  ((or (atom G167328)
                        (progn (setq arg (car G167328)) nil)
                        (null (NEQUAL arg lastArg))))
                nil)
            (SEQ (EXIT (setq argList
                            (cons
                             (CONCAT arg ", ")
                             argList))))))
            (setq argList (NREVERSE (cons lastArg argList)))
            (|bracketString| (apply (|function| CONCAT) argList))))))

```

defun bracketString

— defun bracketString —

```

(defun |bracketString| (string)

```

```
(CONCAT "[" string "]"))
```

defun quoteString

— defun quoteString —

```
(defun |quoteString| (string)
  (CONCAT "\"" string "\""))
```

defvar \$funnyQuote

— initvars —

```
(defvar |$funnyQuote| #\Rubout)
```

defvar \$funnyBacks

— initvars —

```
(defvar |$funnyBacks| #\\200)
```

defun htEscapeString

— defun htEscapeString —

```
(defun |htEscapeString| (str)
  (declare (special |$funnyBacks| |$funnyQuote|))
  (progn
```

```
(setq str (SUBSTITUTE |$funnyQuote| #" str))
(SUBSTITUTE |$funnyBacks| #\\ str)))
```

defun htsv

— defun htsv —

```
(defun |htsv| ()
  (|startHTPage| 50)
  (|htSetVars|)))
```

defun htSetVars

— defun htSetVars —

```
(defun |htSetVars| ()
  (declare (special |$setOptions| |$lastTree| |$path|))
  (progn
    (setq |$path| nil)
    (setq |$lastTree| nil)
    (cond
      ((NEQUAL 0 (LASTATOM |$setOptions|))
       (|htMarkTree| |$setOptions| 0))
      (|htShowSetTree| |$setOptions|)))
```

defun htShowSetTree

— defun htShowSetTree —

```
(defun |htShowSetTree| (setTree)
  (prog (page okList maxWidth1 maxWidth2 tabset1 tabset2 label links)
    (declare (special |$path|))
    (return
      (SEQ (progn
```

```

(setq |$path|
  (TAKE (SPADDIFFERENCE (LASTATOM setTree))
    |$path|))
(setq page (|htInitPage| (|mkSetTitle|) nil))
(|httpSetProperty| page '|setTree| setTree)
(setq links nil)
(setq maxWidth1 (setq maxWidth2 0))
(SEQ (DO ((G167379 setTree (cdr G167379))
  (setData nil))
  ((or (atom G167379)
    (progn
      (setq setData (car G167379))
      nil))
    nil)
  (SEQ (EXIT (cond
    ((|satisfiesUserLevel|
      (elt setData 2))
      (EXIT (progn
        (setq okList
          (cons setData okList))
        (setq maxWidth1
          (max
            (|#|
              (PNAME (elt setData 0)))
            maxWidth1))
        (setq maxWidth2
          (max
            (|htShowCount|
              (STRINGIMAGE
                (elt setData 1)))
            |maxWidth2|))))))))))
  (setq maxWidth1 (max 9 maxWidth1))
  (setq maxWidth2 (max 41 maxWidth2))
  (setq tabset1 (STRINGIMAGE maxWidth1))
  (setq tabset2
    (STRINGIMAGE
      (SPADDIFFERENCE
        (+ maxWidth2 maxWidth1) 1)))
  (|htSay| "\\tab{2}\\newline Variable\\tab{"
    (STRINGIMAGE
      (+ maxWidth1
        (quotient maxWidth2 3)))
    "}Description\\tab{"
    (STRINGIMAGE
      (+ (+ maxWidth2 maxWidth1) 2))
    "}Value\\newline\\beginitems ")
  (DO ((G167392 (reverse okList) (CDR G167392))
    (setData nil))
    ((or (atom G167392)
      (progn

```

```

        (setq setData (car G167392))
        nil))
    nil)
  (SEQ (EXIT (progn
    (|htSay| "\\item")
    (setq label
      (STRCONC "\\menuitemstyle{"
        (elt setData 0)
        "}"))
    (setq links
      (cons label
        (cons
          (cons
            (cons '|text|
              (cons
                "\\tab{"
                (cons tabset1
                  (cons "}"
                    (cons
                      (elt setData 1)
                      (cons "\\tab{"
                        (cons tabset2
                          (cons "}{\\em "
                            (cons
                              (|htShowSetTreeValue|
                                setData)
                                (cons
                                  "}"
                                  nil))))))))))
            nil)
            (cons '|htShowSetPage|
              (cons (elt setData 0)
                nil))))))
    (|htMakePage|
      (cons
        (cons '|bcLispLinks|
          (cons links
            (cons '|options|
              (cons '(|indent| . 0) nil))))
          nil))))))
    (|htSay| "\\enditems") (|htShowPage|))))))

```

defun htShowCount

— defun htShowCount —

```

(defun |htShowCount| (s)
  (prog (m i count)
    (return
      (SEQ (progn
        (setq m (|#| s))
        (cond
          ((> 8 m) (- m 1))
          (t (setq i 0) (setq count 0)
            (DO () ((NULL (> (- m 7) i)) nil)
              (SEQ (EXIT (cond
                ((and (equal (elt s i) #\{)
                  (equal (elt s (1+ i)) #\))
                  (equal (elt s (+ i 2)) #\e)
                  (equal (elt s (+ i 3)) #\m))
                (setq i (+ i 6)))
              (t (setq i (1+ i))
                (setq count (1+ count))))))))
          (+ count (- m i))))))))))

```

defun htShowSetTreeValue

— defun htShowSetTreeValue —

```

(defun |htShowSetTreeValue| (setData)
  (prog (st)
    (return
      (progn
        (setq st (elt setData 3))
        (cond
          ((eq st 'function)
            (|object2String| (FUNCALL (elt setData 4) '%display%|)))
          ((eq st 'integer)
            (|object2String| (|eval| (elt setData 4))))
          ((eq st 'string)
            (|object2String| (|eval| (elt setData 4))))
          ((eq st 'literals)
            (|object2String|
              (|translateTrueFalse2YesNo| (|eval| (elt setData 4)))))
          ((eq st 'tree) "...")
          (t (|systemError|))))))

```

defun mkSetTitle

— defun mkSetTitle —

```
(defun |mkSetTitle| ()
  (declare (special |$path|))
  (STRCONC "Command {\em }set "
    (|listOfStrings2String| |$path|) "}")
```

—————

defun listOfStrings2String

— defun listOfStrings2String —

```
(defun |listOfStrings2String| (u)
  (cond
    ((null u) "")
    (t
     (STRCONC (|listOfStrings2String| (cdr u)) " "
              (|stringize| (car u))))))
```

—————

defun htShowSetPage

— defun htShowSetPage —

```
(defun |htShowSetPage| (htPage branch)
  (prog (setTree setData st)
    (declare (special |$path|))
    (return
     (progn
      (setq setTree (|httpProperty| htPage '|setTree|))
      (setq |$path|
              (cons branch
                    (TAKE (- (LASTATOM setTree))
                          |$path|)))
      (setq setData (|assoc| branch setTree))
      (cond
        ((null setData) (|systemError| "No Set Data"))
        (t (setq st (elt setData 3))
```

```
(cond
  ((eq st 'function)
   (|htShowFunctionPage| htPage setData))
  ((eq st 'integer)
   (|htShowIntegerPage| htPage setData))
  ((eq st 'literals)
   (|htShowLiteralsPage| htPage setData))
  ((eq st 'tree)
   (|htShowSetTree| (elt setData 5)))
  ((eq st 'string)
   (|htSetNotAvailable| htPage
    "set compiler"))
  (t (|systemError| "Unknown data type")))))))
```

defun htShowLiteralsPage

— defun htShowLiteralsPage —

```
(defun |htShowLiteralsPage| (htPage setData)
  (|htSetLiterals| htPage (elt setData 0) (elt setData 1)
   (elt setData 4) (elt setData 5) '|htSetLiteral|))
```

defun htSetLiterals

— defun htSetLiterals —

```
(defun |htSetLiterals| (htPage name message variable values functionToCall)
  (prog (page links)
    (return
      (SEQ (progn
              (setq page
                (|htInitPage| "Set Command"
                  (|httpPropertyList| htPage)))
              (|httpSetProperty| page '|variable| variable)
              (|bcHt| (cons "\\centerline{Set {\\em "
                (cons name
                  (cons "}}\\newline" nil))))
              (|bcHt| (cons "{\\em Description: } "
                (cons message
```



```

      (cons "\\newline\\vspace{1} "
            nil)))
(|bcHt| "Select one of the following: \\newline\\tab{3} ")
(setq links
  (prog (G167460)
    (setq G167460 nil)
    (return
      (DO ((G167465 values (cdr G167465))
          (opt nil))
        ((or (atom G167465)
              (progn
                (setq opt (car G167465))
                nil))
              (NREVERSE0 G167460))
          (SEQ (EXIT (setq G167460
            (cons
              (cons
                (STRCONC ""
                  (STRINGIMAGE opt))
                (cons "\\newline\\tab{3}"
                  (cons functionToCall
                    (cons opt nil))))
                G167460))))))))))
(|htMakePage| (cons (cons ' |bcLispLinks| links) nil))
(|bcHt|
  (cons
    '|\\indent{0}\\newline\\vspace{1} The current setting is: {\\em |
      (cons (|translateTrueFalse2YesNo|
        (eval variable))
        (cons "}" " nil))))
(|htShowPage|))))

```

defun htSetLiteral

— defun htSetLiteral —

```

(defun |htSetLiteral| (htPage val)
  (progn
    (|htInitPage| "Set Command" nil)
    (set (|httpProperty| htPage '|variable|)
      (|translateYesNo2TrueFalse| val))
    (|htKill| htPage val)))

```

defun htShowIntegerPage

— defun htShowIntegerPage —

```
(defun |htShowIntegerPage| (htPage setData)
  (prog (page message t1)
    (declare (special |$htFinal| |$htInitial|))
    (return
      (progn
        (setq page
          (|htInitPage| (|mkSetTitle|)
            (|httpPropertyList| htPage)))
        (|httpSetProperty| page '|variable| (elt setData 4))
        (|bcHt| (cons "\\centerline{Set {\\em "
          (cons (elt setData 0)
            (cons "}}\\newline" nil))))
        (setq message (elt setData 1))
        (|bcHt| (cons "{\\em Description: } "
          (cons message
            (cons "\\newline\\vspace{1} "
              nil))))
        (setq t1 (elt setData 5))
        (setq |$htInitial| (car t1))
        (setq |$htFinal| (cadr t1))
        (cond
          ((equal |$htFinal| (+ |$htInitial| 1))
            (|bcHt| "Enter the integer {\\em ")
            (|bcHt| (|stringize| |$htInitial|))
            (|bcHt| "} or {\\em ")
            (|bcHt| (|stringize| |$htFinal|))
            (|bcHt| "}:"))
          ((null |$htFinal|)
            (|bcHt| "Enter an integer greater than {\\em ")
            (|bcHt| (|stringize| (- |$htInitial| 1)))
            (|bcHt| "}:"))
          (t (|bcHt| "Enter an integer between {\\em ")
            (|bcHt| (|stringize| |$htInitial|))
            (|bcHt| "} and {\\em ")
            (|bcHt| (|stringize| |$htFinal|))
            (|bcHt| "}:")))
        (|htMakePage|
          (cons '(|domainConditions| (|Satisfies| S chkRange))
            (cons (cons '|bcStrings|
              (cons (cons 5
                (cons (|eval| (elt setData 4))
                  (cons '|value| (cons 'S nil))))
                nil))
              nil)))
          nil)))
        (|htSetvarDoneButton| "Select to Set Value"
```

```
      '|htSetInteger|)
(|htShowPage|))))))
```

defun htSetInteger

— defun htSetInteger —

```
(defun |htSetInteger| (htPage)
  (prog (val)
    (return
      (progn
        (|htInitPage| (|mkSetTitle|) nil)
        (setq val
          (|chkRange| (|htInputLabelString| htPage '|value|)))
        (cond
          ((null (integerp val))
           (|errorPage| htPage
            (cons "Value Error"
                  (cons nil
                        (cons "\vspace{3}\centerline{\em "
                              (cons val
                                    (cons
                                      (cons
                                        "}}\vspace{2}\newline\centerline{Click on \UpBitmap{} to re-enter value}"
                                        nil))))))))
          (t (set (|htProperty| htPage '|variable|) val)
              (|htKill| htPage val)))))))
```

defun htShowFunctionPage

— defun htShowFunctionPage —

```
(defun |htShowFunctionPage| (htPage setData)
  (prog (fn)
    (return
      (cond
        ((setq fn (elt setData 6)) (funcall fn htPage))
        (t (|htSetProperty| htPage '|setData| setData)
          (|htSetProperty| htPage '|parts| (elt setData 5))
          (|htShowFunctionPageContinued| htPage))))))
```

defun htShowFunctionPageContinued

— defun htShowFunctionPageContinued —

```
(defun |htShowFunctionPageContinued| (htPage)
  (prog (parts setData phrase kind variable checker
        initValue restParts page currentValue)
    (return
      (progn
        (setq parts (|httpProperty| htPage '|parts|))
        (setq setData (|httpProperty| htPage '|setData|))
        (setq phrase (caar parts))
        (setq kind (cadar parts))
        (setq variable (caddar parts))
        (setq checker (car (cdddar parts)))
        (setq initValue (cadr (cdddar parts)))
        (setq restParts (cdr parts))
        (|httpSetProperty| htPage '|variable| variable)
        (|httpSetProperty| htPage '|checker| checker)
        (|httpSetProperty| htPage '|parts| restParts)
        (cond
          ((eq kind 'literals)
           (|htSetLiterals| htPage (elt setData 0) phrase
            variable checker '|htFunctionSetLiteral|))
          (t
           (setq page
             (|htInitPage| (|mkSetTitle|
                           (|httpPropertyList| htPage)))
             (|bcHt| (cons "\\centerline{Set {\\em "
                           (cons (elt setData 0)
                                (cons "}}\\newline" nil))))
             (|bcHt| (cons "{\\em Description: } "
                           (cons (elt setData 1)
                                (cons "\\newline\\vspace{1} "
                                     nil))))
             (setq currentValue (eval variable))
             (|htMakePage|
              (cons (cons '|domainConditions|
                           (cons (cons '|Satisfies|
                                         (cons 'S (cons checker nil)))
                                     nil))
                    (cons (cons '|text| phrase)
                           (cons (cons '|inputStrings|
                                         (cons
                                          (cons ""
                                           (cons ""
```

```

                                (cons 60
                                  (cons currentValue
                                    (cons '|value|
                                      (cons 'S nil))))))
                                nil))
                                nil))))
(|htSetvarDoneButton| "Select To Set Value" '|htSetFunCommand|)
(|htShowPage|))))))

```

defun htSetvarDoneButton

— defun htSetvarDoneButton —

```

(defun |htSetvarDoneButton| (message func)
  (progn
    (|bcHt| "\\newline\\vspace{1}\\centerline{")
    (cond
      ((OR (equal message "Select to Set Value")
            (equal message "Select to Set Values")))
      (|bchtMakeButton| "\\lisplink"
        "\\ControlBitmap{clicktose}" func))
    (t
      (|bchtMakeButton| "\\lisplink"
        (CONCAT "\\fbox{" message "}")
        func)))
    (|bcHt| "} ")))

```

defun htFunctionSetLiteral

— defun htFunctionSetLiteral —

```

(defun |htFunctionSetLiteral| (htPage val)
  (progn
    (|htInitPage| "Set Command" nil)
    (set (|httpProperty| htPage '|variable|)
      (|translateYesNo2TrueFalse| val))
    (|htSetFunCommandContinue| htPage val)))

```

defun htSetFunCommand

— defun htSetFunCommand —

```
(defun |htSetFunCommand| (htPage)
  (prog (variable checker value)
    (return
      (progn
        (setq variable (|httpProperty| htPage '|variable|))
        (setq checker (|httpProperty| htPage '|checker|))
        (setq value
          (|htCheck| checker
            (|httpLabelInputString| htPage '|value|)))
        (set variable value)
        (|htSetFunCommandContinue| htPage value))))))
```

defun htSetFunCommandContinue

— defun htSetFunCommandContinue —

```
(defun |htSetFunCommandContinue| (htPage value)
  (prog (parts t2 t3 predicate restParts continue)
    (return
      (progn
        (setq parts (|httpProperty| htPage '|parts|))
        (setq continue
          (cond
            ((null parts) nil)
            ((and (consp parts)
              (progn
                (setq t2 (QCAR parts))
                (and (consp t2)
                  (eq (QCAR t2) '|break|)
                  (progn
                    (setq t3 (QCDR t2))
                    (AND (consp t3)
                      (eq (QCDR t3) nil)
                      (progn
                        (setq predicate
                          (QCAR t3))
                        t))))))
            (progn
              (setq restParts (QCDR parts))))))
```

```

        t))
      (|eval| predicate))
    (t t)))
  (cond
    (|continue| (|htSetProperty| htPage '|parts| restParts)
      (|htShowFunctionPageContinued| htPage))
    (t (|htKill| htPage value))))))

```

defun htKill

— defun htKill —

```

(defun |htKill| (htPage value)
  (declare (ignore htPage))
  (prog (string)
    (declare (special |$path|))
    (return
      (progn
        (|htInitPage| "System Command" nil)
        (setq string
          (STRCONC "{\\em }set "
            (|listOfStrings2String|
              (cons value |$path|))
            "}"))
        (|htMakePage|
          (cons '(|text| "{Here is the AXIOM system command you could have issued:}"
            "\\vspace{2}\\newline\\centerline{\\tt}"
            (cons (cons '|text| string) nil)))
          (|htMakePage| '(|text| . "}\\vspace{1}\\newline\\rm"))
          (|htSay| "\\vspace{2}{Select \\ \\UpButton{} \\ to go back.}")
          (|htSay| "\\newline{Select \\ \\ExitButton{QuitPage} \\ to remove this window.}")
          (|htProcessDoitButton|
            (cons "Press to Remove Page"
              (cons "" (cons '|htDoNothing| nil))))
          (|htShowPage|))))))

```

defun htSetNotAvailable

— defun htSetNotAvailable —

```

(defun |htSetNotAvailable| (htPage whatToType)
  (prog (page string)
    (return
      (progn
        (setq page
          (|htInitPage| "Unavailable Set Command"
            (|httpPropertyList| htPage)))
        (|htInitPage| "Unavailable System Command" nil)
        (setq |string|
          (STRCONC "{\\em " whatToType
            "}")
          (|htMakePage|
            (cons '(|text| "\\vspace{1}\\newline"
              "{Sorry, but this system command is not available through HyperDoc. Please directly issue this command in a
                "\\vspace{2}\\newline\\centerline{\\tt"
                  (cons (cons '(|text| string) nil)))
              (|htMakePage| '(|text| . "}"\\vspace{1}\\newline"))
              (|htProcessDoitButton|
                (cons "Press to Remove Page"
                  (cons "" (cons '|htDoNothing| nil))))
              (|htShowPage|))))))

```

defun htDoNothing

— defun htDoNothing —

```

(defun |htDoNothing| (htPage command)
  (declare (ignore htPage command))
  nil)

```

defun htCheck

— defun htCheck —

```

(defun |htCheck| (checker value)
  (cond
    ((consp checker) (|htCheckList| checker (|parseWord| value)))
    (t (funcall checker value))))

```

defun parseWord

— defun parseWord —

```

(defun |parseWord| (x)
  (prog ()
    (return
      (SEQ (cond
        ((stringp x)
          (cond
            ((prog (G167588)
              (setq G167588 t)
              (return
                (DO ((G167594 nil (null G167588))
                  (G167595 (maxindex x))
                  (i 0 (1+ i)))
                  ((OR G167594 (QSGREATERP i G167595))
                   G167588)
                (SEQ (EXIT (setq G167588
                              (AND G167588
                                (digitp (elt x i))))))))))
              (parse-integer x))
            (t (intern x))))
          (t x))))))

```

—————

defun htCheckList

— defun htCheckList —

```

(defun |htCheckList| (checker value)
  (prog (n t2 m)
    (return
      (progn
        (cond
          ((|member| value '(|y| |ye| |yes| Y YE YES))
            (setq value '|yes|)))
        (cond
          ((|member| value '(|n| |no| N NO)) (setq value '|no|)))
        (cond
          ((and (consp checker)
              (progn
                (setq n (qcar checker))
                (setq t2 (qcdr checker))

```

```

      (and (consp t2) (eq (QCDR t2) nil)
        (progn (setq m (QCAR t2)) t)))
    (integerp n))
  (cond
    ((eql m (1+ n))
     (cond ((|member| value checker) value) (t n)))
    ((null m)
     (cond
       ((and (integerp value) (>= value n)) value)
       (t n)))
    ((integerp m)
     (cond
       ((and (integerp value) (>= value n)
              (<= value m))
        value)
       (t n))))))
  ((|member| value checker) value)
  (t (car checker))))))

```

defun translateYesNoToTrueFalse

— defun translateYesNoToTrueFalse —

```

(defun |translateYesNoToTrueFalse| (x)
  (cond
    ((eq x '|yes|) t)
    ((eq x '|no|) nil)
    (t x)))

```

defun chkNameList

— defun chkNameList —

```

(defun |chkNameList| (x)
  (prog (u parsedNames)
    (return
      (SEQ (progn
              (setq u (|bcString2ListWords| x))
              (setq parsedNames

```

```

(prog (G167635)
  (setq G167635 nil)
  (return
    (DO ((G167640 u (CDR G167640))
        (x nil))
      ((or (atom G167640)
        (progn
          (setq x (car G167640))
          nil))
        (NREVERSEO G167635))
      (SEQ (EXIT (setq G167635
        (cons (|ncParseFromString| x)
          G167635)))))))
(cond
  ((prog (G167646)
    (setq G167646 t)
    (return
      (DO ((G167652 nil (NULL G167646))
          (G167653 parsedNames (CDR G167653))
          (x nil))
        ((OR G167652 (ATOM G167653)
          (progn (setq x (car G167653)) nil))
          G167646)
        (SEQ (EXIT (setq G167646
          (AND G167646 (identp x)))))))
      parsedNames)
    (t
      "Please enter a list of identifiers separated by blanks")))))

```

defun chkPosInteger

— defun chkPosInteger —

```

(defun |chkPosInteger| (s)
  (prog (u)
    (return
      (cond
        ((and (setq u (|parseOnly| s)) (integerp u) (> u 0))
          u)
        (t "Please enter a positive integer")))))

```

defun chkOutputFileName

— defun chkOutputFileName —

```
(defun |chkOutputFileName| (s)
  (cond
    ((|member| (|bcString2WordList| s) '(CONSOLE |console|))
      '|console|)
    (t (|chkDirectory| s))))
```

—————

defun chkDirectory

— defun chkDirectory —

```
(defun |chkDirectory| (s) s)
```

—————

defun chkNonNegativeInteger

— defun chkNonNegativeInteger —

```
(defun |chkNonNegativeInteger| (s)
  (prog (u)
    (return
      (cond
        ((and (setq u (|ncParseFromString| s)) (integerp u)
              (>= u 0))
          u)
        (t "Please enter a non-negative integer")))))
```

—————

defun chkRange

— defun chkRange —

```
(defun |chkRange| (s)
  (prog (u)
    (declare (special |$htFinal| |$htInitial|))
    (return
      (cond
        ((and (setq u (|ncParseFromString| s)) (integerp u)
              (>= u |$htInitial|)
              (or (null |$htFinal|) (<= u |$htFinal|)))
          u)
        ((null |$htFinal|)
         (STRCONC "Please enter an integer greater than "
                   (|stringize| (- |$htInitial| 1))))
        (t
         (STRCONC "Please enter an integer between "
                   (|stringize| |$htInitial|) " and "
                   (|stringize| |$htFinal|)))))))
```

defun chkAllNonNegativeInteger

— defun chkAllNonNegativeInteger —

```
(defun |chkAllNonNegativeInteger| (s)
  (prog (u)
    (return
      (or (and (setq u (|ncParseFromString| s))
                (|member| u '(|a| |al| |all| A AL ALL)) 'ALL)
          (|chkNonNegativeInteger| s)
          "Please enter {\em all} or a non-negative integer"))))
```

defun htMakePathKey,fn

— defun htMakePathKey,fn —

```
(defun |htMakePathKey,fn| (a b)
  (SEQ (if (null b) (EXIT a))
        (EXIT (|htMakePathKey,fn|
                  (STRCONC a "." (PNAME (car b)))
                  (cdr b)))))
```

defun htMakePathKey

— defun htMakePathKey —

```
(defun |htMakePathKey| (path)
  (cond
    ((null path) (|systemError| "path is not set"))
    (t
     (intern (|htMakePathKey,fnl| (PNAME (car path)) (cdr path))))))
```

defun htMarkTree

— defun htMarkTree —

```
(defun |htMarkTree| (tree n)
  (SEQ (progn
        (rplacd (LASTTAIL tree) n)
        (SEQ (DO ((G167706 tree (cdr G167706)) (branch nil))
                  ((OR (ATOM G167706)
                       (progn (setq branch (car G167706)) nil))
                   nil)
         (SEQ (EXIT (cond
                      ((eq (elt branch 3) 'tree)
                       (EXIT (|htMarkTree| (elt branch 5)
                                             (1+ n))))))))))))))
```

defun htSetHistory

— defun htSetHistory —

```
(defun |htSetHistory| (htPage)
  (prog (msg data)
    (return
     (progn
      (setq msg
        '|when the history facility is on (yes), results of computations are saved in memory|)
      (setq data
        (cons '|history|
```

```

      (cons msg
        (cons '|history|
          (cons 'literals
            (cons '|$HiFiAccess|
              (cons '(|on| |off| |yes| |no|)
                nil))))))
    (|htShowLiteralsPage| htPage data))))

```

defun htSetOutputLibrary

— defun htSetOutputLibrary —

```

(defun |htSetOutputLibrary| (htPage)
  (|htSetNotAvailable| htPage ")set compiler output"))

```

defun htSetInputLibrary

— defun htSetInputLibrary —

```

(defun |htSetInputLibrary| (htPage)
  (|htSetNotAvailable| htPage ")set compiler input"))

```

defun htSetExpose

— defun htSetExpose —

```

(defun |htSetExpose| (htPage)
  (|htSetNotAvailable| htPage ")set expose"))

```

defun htSetOutputCharacters

— defun htSetOutputCharacters —

```
(defun |htSetOutputCharacters| (htPage)
  (|htSetNotAvailable| htPage ")set output characters"))
```

—————

defun htSetLinkerArgs

— defun htSetLinkerArgs —

```
(defun |htSetLinkerArgs| (htPage)
  (|htSetNotAvailable| htPage ")set fortran calling linker"))
```

—————

defun htSetCache

— defun htSetCache —

```
(defun |htSetCache| (&REST G167749 &AUX options htPage)
  (declare (special |$valueList| |$path|))
  (setq htPage (car G167749))
  (setq options (cdr G167749))
  (progn
    (setq |$path| '(|functions| |cache|))
    (setq htPage (|htInitPage| (|mkSetTitle|) nil))
    (setq |$valueList| nil)
    (|htMakePage|
      '(|text|
        "Use this system command to cause the AXIOM interpreter to 'remember' "
        "past values of interpreter functions. "
        "To remember a past value of a function, the interpreter "
        "sets up a {\\em cache} for that function based on argument values. "
        "When a value is cached for a given argument value, its value is gotten "
        "from the cache and not recomputed. Caching can often save much "
        "computing time, particularly with recursive functions or functions that "
        "are expensive to compute and that are called repeatedly "
        "with the same argument." "\\vspace{1}\\newline ")
      (|domainConditions| (|Satisfies| S chkNameList)))
```



```
(|text|
"Enter below a list of interpreter functions you would like specially cached. "
      "Use the name {\em all} to give a default setting for all "
      "interpreter functions. " "\vspace{1}\newline "
      "Enter {\em all} or a list of names (separate names by blanks):")
(|inputStrings| (" " " 60 "all" names S))
(|doneButton| "Push to enter names" |htCacheAddChoice|))
(|htShowPage|))
```

defun htCacheAddChoice

— defun htCacheAddChoice —

```
(defun |htCacheAddChoice| (htPage)
  (prog (names page)
    (declare (special |$valueList|))
    (return
      (SEQ (progn
        (setq names
          (|bcString2WordList|
            (|httpLabelInputString| htPage '|names|)))
        (setq |$valueList|
          (cons (|listOfStrings2String| names)
            |$valueList|))
        (cond
          ((null names) (|htCacheAddQuery|))
          ((null (cdr names)) (|htCacheOne| names))
          (t (setq page (|htInitPage| (|mkSetTitle|) nil))
            (|httpSetProperty| page '|names| names)
            (|htMakePage|
              '((|domainConditions|
                (|Satisfies| ALLPI chkAllPositiveInteger))
              (|text|
                "For each function, enter below a {\em cache length}, a positive integer. "
                "This number tells how many past values will "
                "be cached. "
                "A cache length of {\em 0} means the function won't be cached. "
                "To cache all past values, "
                "enter {\em all}."
                "\vspace{1}\newline "
                "For each function name, enter {\em all} or a positive integer:"))
              (DO ((i 1 (QSADD1 i))
                (G167755 names (CDR G167755)) (name nil))
                ((or (atom G167755)
                  (progn (setq name (car G167755)) nil))
```

```

        nil)
      (SEQ (EXIT (|htMakePage|
                  (cons (cons '|inputStrings|
                              (cons
                                (cons
                                  (STRCONC "Function {\\em "
                                    name
                                    "} will cache")
                                  (cons "values"
                                    (cons 5
                                      (cons 10
                                        (cons
                                          (|htMakeLabel|
                                            "c" i)
                                          (cons 'ALLPI nil))))))
                                nil))
                              nil))))
        (|htSetvarDoneButton| "Select to Set Values" '|htCacheSet|)
        (|htShowPage|))))))

```

defun htMakeLabel

— defun htMakeLabel —

```

(defun |htMakeLabel| (prefix i)
  (intern (strconc prefix (|stringize| i))))

```

defun htCacheSet

— defun htCacheSet —

```

(defun |htCacheSet| (htPage)
  (prog (names num n name val)
    (declare (special |$cacheCount| |$cacheAlist|))
    (return
      (SEQ (progn
              (setq names (|htpProperty| htPage '|names|))
              (DO ((i 1 (QSADD1 i))
                  (G167785 names (CDR G167785)) (name nil))

```

```

((or (atom G167785)
      (progn (setq name (car G167785)) nil))
      nil)
(SEQ (EXIT (progn
              (setq num
                    (|chkAllNonNegativeInteger|
                     (|htLabelInputString| htPage
                      (|htMakeLabel| "c"
                       i))))
              (setq |$cacheAlist|
                    (ADDASSOC (intern name) num
                              |$cacheAlist|))))))
(cond
  ((setq n (LASSOC 'all |$cacheAlist|))
   (setq |$cacheCount| n)
   (setq |$cacheAlist|
         (deleteAssoc 'all |$cacheAlist|))))
(|htInitPage| "Cache Summary" nil)
(|bcHt| "In general, interpreter functions ")
(|bcHt| (cond
          ((EQL |$cacheCount| 0)
           '|will {\em not} be cached.|)
          (t (|bcHt| "cache "
                    (|htAllOrNum| |$cacheCount|)
                    "} values.")))
(|bcHt| "\\vspace{1}\\newline ")
(cond
  (|$cacheAlist|
   (DO ((G167801 |$cacheAlist| (cdr G167801))
        (G167774 nil))
        ((or (atom G167801)
              (progn
                (setq G167774 (car G167801))
                nil)
              (progn
                (setq name (car G167774))
                (setq val (CDR G167774))
                G167774)
              nil))
        nil)
   (SEQ (EXIT (cond
              ((NEQUAL val |$cacheCount|)
               (progn
                (|bcHt| "\\newline function {\em "
                 (|bcHt| (|stringize| name))
                 (|bcHt| "} will cache "
                 (|htAllOrNum| val)
                 (|bcHt| "} values"))))))))
(|htProcessDoitButton|

```

```

      (cons "Press to Remove Page"
        (cons "" (cons '|htDoNothing| nil))))
    (|htShowPage|))))))

```

defun htAllOrNum

— defun htAllOrNum —

```

(defun |htAllOrNum| (val)
  (|bcHt| (cond
    ((eq val '|all|) "{\\em all}")
    ((eq val 0) "{\\em no}")
    (t
     (STRCONC "the last {\\em "
              (|stringize| val))))))

```

defun htCacheOne

— defun htCacheOne —

```

(defun |htCacheOne| (names)
  (prog (page)
    (return
      (progn
        (setq page (|htInitPage| (|mkSetTitle|) nil))
        (|htpSetProperty| page '|names| names)
        (|htMakePage|
          '((|domainConditions|
            (|Satisfies| ALLPI |chkAllPositiveInteger|))
            (|text| "Enter below a {\\em cache length}, a positive integer. "
              "This number tells how many past values will "
              "be cached. To cache all past values, "
              "enter {\\em all}." "\\vspace{1}\\newline ")
            (|inputStrings|
              ("Enter {\\em all} or a positive integer:" "" 5 10
               |c1| ALLPI))))
          (|htSetvarDoneButton| "Select to Set Value"
            '|htCacheSet|)
          (|htShowPage|))))))

```

defvar \$historyDisplayWidth

— initvars —

```
(defvar |$historyDisplayWidth| 120)
```

defvar \$newline

— initvars —

```
(defvar |$newline| #\Newline)
```

defun downlink

— defun downlink —

```
(defun |downlink| (page)
  (declare (special |$saturn|))
  (cond
    (|$saturn| (|downlinkSaturn| page))
    (t (|htInitPage| "Bridge" nil)
      (|htSay| "\\replacepage{" page "}")
      (|htShowPage|))))
```

defun downlinkSaturn

— defun downlinkSaturn —

```
(defun |downlinkSaturn| (fn)
  (prog (line u n lines)
```

```

(return
  (SEQ (progn
    (setq u (|dbReadLines| fn))
    (setq lines "")
    (DO ()
      ((null (and (consp u)
        (progn
          (setq line (QCAR u))
          (setq u (QCDR u))
          t)))
        nil)
      (SEQ (EXIT (progn
        (setq n (MAXINDEX line))
        (cond
          ((> 1 n) nil)
          ((equal (elt line 0) #\%)
            nil)
          (t
            (setq lines
              (STRCONC lines line))))))))
    (|issueHTSaturn| lines))))))

```

defun dbNonEmptyPattern

— defun dbNonEmptyPattern —

```

(defun |dbNonEmptyPattern| (pattern)
  (cond
    ((null pattern) "")
    (t (setq pattern (STRINGIMAGE pattern))
      (cond ((> (|#| pattern) 0) pattern) (t "")))))

```

defun htSystemVariables,gn

— defun htSystemVariables,gn —

```

(defun |htSystemVariables,gn| (t1 al)
  (prog (class key options)
    (declare (special |$heading| |$levels|)))

```

```

(return
  (SEQ (progn
    (setq class (caddr t1))
    (setq key (caddr t1))
    (setq options (cadr (cddddr t1)))
    t1)
    (if (null (member class |$levels|)) (EXIT al))
    (if (or (or (eq key 'literals)
      (eq key 'integer))
      (eq key 'string))
      (EXIT (cons (cons |$heading| t1) al)))
    (if (eq key 'tree)
      (EXIT (|htSystemVariables,fn| options al nil)))
    (if (eq key 'function)
      (EXIT (cons (cons |$heading| t1) al)))
    (EXIT (|systemError| key))))))

```

defun htSystemVariables,fn

— defun htSystemVariables,fn —

```

(defun |htSystemVariables,fn| (t1 al firstTime)
  (declare (special |$heading|))
  (SEQ (if (atom t1) (EXIT al))
    (if firstTime (setq |$heading| (|opOf| (car t1))) nil)
    (EXIT (|htSystemVariables,fn| (cdr t1)
      (|htSystemVariables,gn| (car t1) al) firstTime))))

```

defun htSystemVariables,displayOptions

— defun htSystemVariables,displayOptions —

```

(defun |htSystemVariables,displayOptions| (name class variable val options)
  (SEQ (if (eq class 'integer)
    (EXIT (SEQ (|htMakePage|
      (cons (cons '|bcLispLinks|
        (cons
          (cons
            (cons

```

```

        (cons '|text|
          (cons (elt options 0)
            (cons "-"
              (cons
                (or (elt options 1)
                  "")
                nil))))
        nil)
      (cons ""
        (cons
          '|htSetSystemVariableKind|
          (cons
            (cons variable
              (cons name
                (cons 'parse-integer nil))))
            nil))))
      nil))
    nil))
  (|htMakePage|
    '((|domainConditions|
      (|isDomain| INT (|Integer|))))
    (EXIT (|htMakePage|
      (cons (cons '|bcStrings|
        (cons
          (cons 5
            (cons (STRINGIMAGE val)
              (cons name (cons 'INT nil))))
          nil))
        nil))))))
    (if (eq class 'string)
      (EXIT (|htSay| "{\\em " val
        "\\space{1}")
      (EXIT (DO ((G167913 options (cdr G167913)) (x nil))
        ((or (atom G167913)
          (progn (setq x (car G167913)) nil))
        nil)
        (SEQ (if (or (or (equal val x)
          (and (eq val t)
            (eq x '|on|)))
            (and (null val) (eq x '|off|)))
          (EXIT (|htSay| "{\\em " x
            "\\space{1}")
          (EXIT (|htMakePage|
            (cons (cons '|bcLispLinks|
              (cons
                (cons x
                  (cons " "
                    (cons '|htSetSystemVariable|
                      (cons
                        (cons variable

```



```

        (cons x nil))
      nil))))
    nil))
  nil))))))

```

defun htSystemVariables,functionTail

— defun htSystemVariables,functionTail —

```

(defun |htSystemVariables,functionTail| (name class var valuesOrFunction)
  (prog (val)
    (return
      (SEQ (setq val (|eval| var))
        (if (atom valuesOrFunction)
          (EXIT (SEQ (|htMakePage|
            '((|domainConditions|
              (|isDomain| STR (|String|))))
            (|htMakePage|
              (cons (cons '|bcLinks|
                (cons
                  (cons "reset"
                    (cons ""
                      (cons
                        '|htSetSystemVariableKind|
                        (cons
                          (cons var
                            (cons name (cons nil nil)))
                            nil))))
                  nil))
                nil))
            (EXIT (|htMakePage|
              (cons
                (cons '|bcStrings|
                  (cons
                    (cons 30
                      (cons (STRINGIMAGE val)
                        (cons name
                          (cons valuesOrFunction nil))))
                    nil))
                  nil))))))
            (EXIT (|htSystemVariables,displayOptions| name class
              var val valuesOrFunction))))))

```

defun htSystemVariables

— defun htSystemVariables —

```
(defun |htSystemVariables| ()
  (prog (|$levels| |$heading| classlevel table heading name
        message key variable options func lastHeading
        t1 msg class var valuesOrFunction val)
    (DECLARE (SPECIAL |$levels| |$heading| |$setOptions| |$UserLevel|
                    |$fullScreenSysVars|))
    (return
      (SEQ (cond
        ((null |$fullScreenSysVars|) (|htSetVars|))
        (t (setq classlevel |$UserLevel|)
          (setq |$levels| '(|compiler| |development| |interpreter|))
          (setq |$heading| nil)
          (DO () ((NULL (NEQUAL classlevel (car |$levels|))) nil)
            (SEQ (EXIT (setq |$levels| (cdr |$levels|))))))
          (setq table
            (NREVERSE
              (|htSystemVariables,fn| |$setOptions| nil
                t)))
          (|htInitPage| "System Variables" nil)
          (|htSay| "\\beginmenu")
          (setq lastHeading nil)
          (DO ((G167961 table (cdr G167961)) (G167879 nil))
            ((or (atom G167961)
              (progn (setq G167879 (car G167961)) nil)
              (progn
                (progn
                  (setq heading (car G167879))
                  (setq name (cadr G167879))
                  (setq message (caddr G167879))
                  (setq key (car (cddddr G167879)))
                  (setq variable (cadr (cddddr G167879)))
                  (setq options (caddr (cddddr G167879)))
                  (setq func (caddrr (cddddr G167879)))
                  G167879)
                nil))
              nil)
            (SEQ (EXIT (progn
              (|htSay| "\\newline\\item ")
              (cond
                ((equal heading lastHeading)
                  (|htSay| "\\tab{8}"))
                (t
                  (|htSay| heading
                    "\\tab{8}")
                  (setq lastHeading heading))))
              ))
          ))
      ))
  )
```

```

(|htSay| "{\\em " name
  '|}\\tab{22}| message)
(|htSay| "\\tab{80}")
(cond
  ((eq key 'function)
    (cond
      ((null options)
        (|htMakePage|
          (cons
            (cons '|bcLinks|
              (cons
                (cons "reset"
                  (cons ""
                    (cons func (cons nil nil))))
                nil))
            nil)))
      (t
        (setq t1 (car options))
        (setq msg (car t1))
        (setq class (cadr t1))
        (setq var (caddr t1))
        (setq valuesOrFunction (caddr t1))
        (|htSystemVariables,functionTail|
          name class var valuesOrFunction)
        (DO
          ((G167971 (cdr options)
            (cdr G167971))
            (option nil))
          ((or (atom G167971)
            (progn
              (setq option (car G167971))
              nil))
            nil)
          (SEQ
            (EXIT
              (cond
                ((and (consp option)
                  (eq (QCAR option)
                    '|break|))
                '|break|)
                '|skip|)
              (t
                (setq msg (car option))
                (setq class (cadr option))
                (setq var (caddr option))
                (setq valuesOrFunction
                  (caddr option))
                (|htSay| "\\newline\\tab{22}"
                  msg
                    "\\tab{80}")
                (|htSystemVariables,functionTail|

```

```

                                name class var
                                valuesOrFunction)))))))))
      (t (setq val (|eval| variable))
        (|htSystemVariables,displayOptions|
          name key variable val options))))))
      (|htSay| "\\endmenu") (|htShowPage|))))))

```

defun htSetSystemVariableKind

— defun htSetSystemVariableKind —

```

(defun |htSetSystemVariableKind| (htPage G168009)
  (prog (variable name fun value)
    (return
      (progn
        (setq variable (car G168009))
        (setq name (cadr G168009))
        (setq fun (caddr G168009))
        (setq value (|htpLabelInputString| htPage name))
        (cond
          ((and (stringp value) fun)
            (setq value (funcall fun value))))
        (set variable value)
        (|htSystemVariables|))))))

```

defun htSetSystemVariable

— defun htSetSystemVariable —

```

(defun |htSetSystemVariable| (htPage G168030)
  (declare (ignore htPage))
  (prog (name value)
    (return
      (progn
        (setq name (car G168030))
        (setq value (cadr G168030))
        (setq value
          (cond
            ((eq value '|on|) t)

```

```

      ((eq value '|off|) nil)
      (t value)))
  (set name value)
  (|htSystemVariables|))))

```

defun htGloss

— defun htGloss —

```

(defun |htGloss| (pattern)
  (|htGlossPage| nil
    (or (|dbNonEmptyPattern| pattern) "*" t)))

```

defun htGlossPage

— defun htGlossPage —

```

(defun |htGlossPage| (htPage pattern tryAgain?)
  (prog (|$wildCard| |$key| filter grepForm results defstream
        lines heading k tick)
    (declare (special |$wildCard| |$key| |$tick|))
    (return
      (SEQ (progn
        (setq |$wildCard| #\*)
        (cond
          ((equal pattern "*")
           (|downlink| '|GlossaryPage|))
          (t (setq filter (|pmTransFilter| pattern))
              (setq grepForm (|mkGrepPattern| filter '|none|))
              (setq |$key| '|none|)
              (setq results (|applyGrep| grepForm '|gloss|))
              (setq defstream
                (make-instream
                  (STRCONC (|getEnv| "AXIOM")
                           "/algebra/glossdef.text"))))
              (setq lines
                (|gatherGlossLines| results defstream))
              (setq heading
                (cond

```

```

      ((equal pattern "")
       "Glossary")
      ((null lines)
       (cons "No glossary items match {\em "
             (cons pattern
                   (cons "}" nil))))
      (t
       (cons "Glossary items matching {\em "
             (cons pattern
                   (cons "}" nil))))))
(cond
  ((null lines)
   (cond
    ((and tryAgain? (> (|#| pattern) 0))
     (cond
      ((equal
        (elt pattern
          (setq k (MAXINDEX pattern)))
        #\s)
       (|htGlossPage| htPage
        (SUBSTRING pattern 0 k) t))
      ((upper-case-p (elt pattern 0))
       (|htGlossPage| htPage (downcase pattern)
        nil))
      (t
       (|errorPage| htPage
        (cons "Sorry"
              (cons nil
                    (cons
                     (cons "\\centerline{"
                       (append heading
                             (cons "}" nil)))
                     nil))))))
      (t
       (|errorPage| htPage
        (cons "Sorry"
              (cons nil
                    (cons
                     (cons "\\centerline{"
                       (append heading
                             (cons "}" nil)))
                     nil))))))
      (t (|htInitPageNoScroll| nil heading)
       (|htSay| "\\beginscroll\\beginmenu")
       (DO ((G168058 lines (cdr G168058))
            (line nil))
          ((or (atom G168058)
               (progn (setq line (car G168058)) nil))
           nil)

```

```

(SEQ (EXIT (progn
  (setq tick
    (|charPosition| |$tick|
    line 1))
  (|htSay|
    "\\item{\\em \\menuitemstyle{}}\\tab{0}{\\em "
    (|escapeString|
      (SUBSTRING line 0 tick))
    "} "
    (SUBSTRING line
      (1+ tick) nil))))))
(|htSay| "\\endmenu ")
(|htSay| "\\endscroll\\newline ")
(|htMakePage|
  (cons (cons ' |bcLinks|
    (cons
      (cons "Search"
        (cons ""
          (cons ' |htGlossSearch|
            (cons nil nil))))
      nil))
    nil))
(|htSay| " for glossary entry matching ")
(|htMakePage|
  (cons (cons ' |bcStrings|
    (cons
      (cons 24
        (cons "*"
          (cons ' |filter| (cons 'em nil))))
      nil))
    nil))
(|htShowPageNoScroll|)))))))))

```

defun gatherGlossLines

— defun gatherGlossLines —

```

(defun |gatherGlossLines| (results defstream)
  (prog (n keyAndTick byteAddress line k pointer def x
    j nextPointer xtralines acc)
    (declare (special |$tick|))
    (return
      (SEQ (progn
        (setq acc nil)
        (DO ((G168098 results (cdr G168098))

```

```

(keyline nil))
((or (atom G168098)
      (progn (setq keyline (car G168098)) nil))
 nil)
(SEQ (EXIT (progn
  (setq n
    (|charPosition| |$tick| keyline
      0))
  (setq keyAndTick
    (SUBSTRING keyline 0
      (1+ n)))
  (setq byteAddress
    (|string2Integer|
      (SUBSTRING keyline (1+ n)
        nil)))
  (file-position defstream byteAddress)
  (setq line (readline defstream))
  (setq k
    (|charPosition| |$tick| line 1))
  (setq pointer
    (SUBSTRING line 0 k))
  (setq def
    (SUBSTRING line (1+ k)
      nil))
  (setq xtralines nil)
  (DO ()
    ((null (and (null (eofp defstream))
      (setq x
        (readline defstream))
      (setq j
        (|charPosition| |$tick| x 1))
      (setq nextPointer
        (SUBSTRING x 0 j))
      (equal nextPointer
        pointer))))
    nil)
  (SEQ (EXIT
    (setq xtralines
      (cons
        (SUBSTRING x (1+ j) nil)
        xtralines)))))
  (setq acc
    (cons
      (STRCONC keyAndTick def
        (prog (G168110)
          (setq G168110 "")
          (return
            (DO
              ((G168115
                (NREVERSE xtralines)

```



```

(CDR G168115))
(G168081 nil))
((OR (ATOM G168115)
      (progn
        (setq G168081
              (car G168115))
        nil))
      G168110)
      (SEQ
        (EXIT
          (setq G168110
                (STRCONC G168110
                        G168081))))))
      acc))))))
(reverse acc))))))

```

defun htGlossSearch

— defun htGlossSearch —

```

(defun |htGlossSearch| (htPage junk)
  (declare (ignore junk))
  (|htGloss| (|httpLabelInputString| htPage '|filter|)))

```

defun htGreekSearch

— defun htGreekSearch —

```

(defun |htGreekSearch| (filter)
  (prog (ss s names matches nonmatches)
    (return
      (SEQ (progn
        (setq ss (|dbNonEmptyPattern| filter))
        (setq s (|pmTransFilter| ss))
        (cond
          ((and (consp s) (eq (QCAR s) '|error|))
            (|bcErrorPage| s))
          ((null s)
            (|errorPage| nil)

```

```

      (cons (cons "Missing search string"
                  nil)
            (cons nil
                  (cons
                    "\\vspace{2}\\centerline{To select one of the greek letters:}\\newline "
                    (cons
                      "\\centerline{\\em first} enter a search key into the input area}\\newline "
                      (cons
                        "\\centerline{\\em then } move the mouse cursor to the work {\\em search} and click}"
                        nil))))))
    (t (setq filter (|patternCheck| s))
      (setq names
        '(|alpha| |beta| |gamma| |delta| |epsilon|
          |zeta| |eta| |theta| |iota| |kappa|
          |lambda| |mu| |nu| |pi|))
      (DO ((G168149 names (CDR G168149)) (x nil))
          ((or (atom G168149)
               (progn (setq x (car G168149)) nil))
           nil)
        (SEQ (EXIT (cond
                     ((|superMatch?| filter (PNAME x))
                      (setq matches
                        (cons x matches)))
                     (t
                      (setq nonmatches
                        (cons x nonmatches))))))
              (setq matches (NREVERSE matches))
              (setq nonmatches (NREVERSE nonmatches))
              (|htInitPage| "Greek Names" nil)
              (cond
                ((null matches)
                 (|htInitPage|
                  (cons "Greek names matching search string {\\em "
                        (cons ss (cons "}" nil)))
                  nil)
                 (|htSay| ' |\\vspace{2}\\centerline{Sorry, but no greek letters match your search string}\\centerline{\\em
                  ss
                  ' |}\\centerline{Click on the up-arrow to try again}|)
                 (|htShowPage|))
                (t
                 (|htInitPage|
                  (cons "Greek letters matching search string {\\em "
                        (cons ss (cons "}" nil)))
                  nil)
                 (cond
                   (|nonmatches|
                    (|htSay|
                     "The greek letters that {\\em match} your search string {\\em "
                     ss "}:"))
                   (t

```

```

(|htSay| "Your search string {\em "
  ss
  '}| matches all of the greek letters:|))
(|htSay| "{\em \table{")
(DO ((G168158 matches (CDR G168158))
  (x nil))
  ((or (atom G168158)
    (progn (setq x (car G168158)) nil))
  nil)
  (SEQ (EXIT (|htSay| "{" x
    "}"))))
(|htSay| "}}\vspace{1}")
(cond
  (|nonmatches|
    (|htSay|
      "The greek letters that {\em do not match} your search string:{\em \table{")
      (DO ((G168167 nonmatches (CDR G168167))
        (x nil))
        ((or (atom G168167)
          (progn
            (setq x (car G168167))
            nil))
          nil)
        (SEQ (EXIT (|htSay| "{" x
          "}"))))
      (|htSay| "}}"))
    (|htShowPage|))))))

```

defun htTextSearch

— defun htTextSearch —

```

(defun |htTextSearch| (filter)
  (prog (s lines matches nonmatches)
    (return
      (SEQ (progn
        (setq s
          (|pmTransFilter| (|dbNonEmptyPattern| filter)))
        (cond
          ((and (consp s) (eq (QCAR s) '|error|))
            (|bcErrorPage| s))
          ((null s)
            (|errorPage| nil
              (cons (cons "Missing search string"
                nil)

```

```

      (cons nil
        (cons
          "\\vspace{2}\\centerline{To select one of the lines of text:}\\newline "
          (cons
            "\\centerline{\\em first} enter a search key into the input area}\\newline "
            (cons
              "\\centerline{\\em then } move the mouse cursor to the work {\\em search} and click}"
              nil))))))
      (t (setq filter s)
        (setq lines
          (cons
            "{\\em Fruit flies} *like* a {\\em banana and califlower ears.}"
            (cons
              "{\\em Sneak Sears Silas with Savings Snatch}"
              nil)))
        (DO ((G168191 lines (cdr G168191)) (x nil))
          ((or (atom G168191)
              (progn (setq x (car G168191)) nil))
           nil)
          (SEQ (EXIT (cond
            ((|superMatch?| filter x)
              (setq matches
                (cons x matches)))
            (t
              (setq nonmatches
                (cons x nonmatches))))))
          (setq matches (NREVERSE matches))
          (setq nonmatches (NREVERSE nonmatches))
          (|htInitPage| "Text Matches" nil)
          (cond
            ((null matches)
              (|htInitPage|
                (cons "Lines matching search string {\\em "
                  (cons s (cons ")" nil)))
                nil)
              (|htSay|
                '\\vspace{2}\\centerline{Sorry, but no lines match your search string}\\centerline{\\em |
                  s
                  '|}\\centerline{Click on the up-arrow to try again}|)
                (|htShowPage|))
              (t
                (|htInitPage|
                  (cons "Lines matching search string {\\em "
                    (cons s (cons ")" nil)))
                  nil)
                (cond
                  (nonmatches
                    (|htSay| "The lines that {\\em match} your search string {\\em "
                      s "}:"))
                  (t

```

```

(|htSay| "Your search string {\em "
          s '} matches both lines:|))
(|htSay| "{\em \table{")
(DO ((G168200 matches (CDR G168200))
     (x nil))
     ((or (atom G168200)
           (progn (setq x (car G168200)) nil))
      nil)
     (SEQ (EXIT (|htSay| "{" x
                          "}"))))
(|htSay| "}}\\vspace{1}")
(cond
 (nonmatches
  (|htSay|
   "The line that {\em does not match} your search string:{\em \table{")
   (DO ((G168209 nonmatches (cdr G168209))
        (x nil))
        ((or (atom G168209)
              (progn
               (setq x (car G168209))
               nil))
         nil)
        (SEQ (EXIT (|htSay| "{" x
                              "}"))))
   (|htSay| "}}"))
 (|htShowPage|))))))

```

defun htTutorialSearch

— defun htTutorialSearch —

```

(defun |htTutorialSearch| (pattern)
  (prog (s source target lines t1 name title)
    (return
     (SEQ (progn
           (setq s
                 (or (|dbNonEmptyPattern| pattern)
                     (return
                      (|errorPage| nil
                       (cons "Empty search key"
                            (cons nil
                                 (cons
                                  "\\vspace{3}\\centerline{You must enter some search string"
                                  nil))))))
           (setq s (|mkUnixPattern| s))

```

— defun mkUnixPattern —

```
(defun |mkUnixPattern| (s)
  (prog (starPositions k u)
    (declare (special |$wild|))
    (return
      (SEQ (progn
              (setq u (|mkUpDownPattern| s))
              (setq starPositions
                    (reverse (prog (G168264)
                                   (setq G168264 nil)
                                   (return
                                     (DO
                                       ((G168270
                                        (+ (- 1)
                                           (MAXINDEX u))))
                                       (i 1 (QSADD1 i))))
                                     ))
                                ))
            ))))
```

```

((QSGREATERP i G168270)
 (NREVERSEO G168264))
(SEQ
 (EXIT
  (cond
   ((equal (elt u i)
    |$wild|)
    (setq G168264
     (cons i G168264)))))))))
(DO ((G168277 starPositions (cdr G168277))
 (i nil))
 ((or (atom G168277)
  (progn (setq i (car G168277)) nil))
  nil)
 (SEQ (EXIT (setq u
  (STRCONC (SUBSTRING u 0 i)
   ".*"
   (SUBSTRING u (1+ i) nil))))))
(cond
 ((NEQUAL (elt u 0) |$wild|)
  (setq u (STRCONC "[^a-zA-Z]" u)))
 (t (setq u (SUBSTRING u 1 nil))))
(cond
 ((NEQUAL (elt u (setq k (MAXINDEX u))) |$wild|)
  (setq u (STRCONC u "[^a-zA-Z]")))
 (t (setq u (SUBSTRING u 0 k)))
 u))))

```

Chapter 75

Browser Support Code

75.1 Pages Initiated from HyperDoc Pages

defun conPage

```
[form2HtString p??]  
[downcase p??]  
[lassq p??]  
[downlink p1324]  
[conPageFastPath p1344]  
[kPage p??]  
[ySearch p??]  
[$conArgstrings p??]
```

— defun conPage —

```
(defun |conPage| (&rest arglist)  
  (let (|$conArgstrings| form da pageName line a b)  
    (declare (special |$conArgstrings|))  
    (setq a (car arglist))  
    (setq b (cdr arglist))  
    (setq form (cond ((atom a) (cons a b)) (t a)))  
    (setq |$conArgstrings| (loop for x in (cdr a) collect (|form2HtString| x)))  
    (cond ((null (atom a)) (setq a (car a))))  
    (setq da (downcase a))  
    (cond  
      ((setq pageName  
        (lassq da  
          '(|type| . |CategoryType|)  
          (|union| . |DomainUnion|)  
          (|record| . |DomainRecord|)  
          (|mapping| . |DomainMapping|)
```



```

(|enumeration| . |DomainEnumeration|))))
(|downlink| |pageName|)
((setq line (|conPageFastPath| da)) (|kPage| line form))
((setq line (|conPageFastPath| (upcase a))) (|kPage| line form))
(t (|ySearch| a))))

```

defun gets line quickly for constructor name or abbreviation

```

[length p??]
[stringimage p??]
[charPosition p??]
[lassq p??]
[dbRead p??]
[conPageConEntry p1344]
[$lowerCaseConTb p??]

```

— defun conPageFastPath —

```

(defun |conPageFastPath| (x)
  (let (s name entry lineNumber)
    (declare (special |$lowerCaseConTb|))
    (setq s (stringimage x))
    (unless (> (|#| s) (|charPosition| #\* s 0)) ; quit if name has * in it
      (setq name (cond ((stringp x) (intern x)) (t x)))
      (setq entry (hget |$lowerCaseConTb| name))
      (when entry
        ;'dbLineNumbers property is set by function dbAugmentConstructorDataTable
        (if (setq lineNumber (lassq '|dbLineNumber| (cddr entry)))
            (|dbRead| lineNumber)
            (|conPageConEntry| (car entry)))))))

```

defun conPageConEntry

```

[buildLIbdbConEntry p??]
[$conname p??]
[$conform p??]
[$exposed? p??]
[$doc p??]
[$kind p??]

```

— defun conPageConEntry —

```
(defun |conPageConEntry| (entry)
  (let (|$conname| |$conform| |$exposed?| |$doc| |$kind|)
    (declare (special |$conname| |$conform| |$exposed?| |$doc| |$kind|))
    (setq |$conname| nil)
    (setq |$conform| nil)
    (setq |$exposed?| nil)
    (setq |$doc| nil)
    (setq |$kind| nil)
    (|buildLibdbConEntry| entry))))
```

defun kdPageInfo

```
[htSay p??]
[nequal p??]
[bcHt p1260]
[stringimage p??]
[htSaturnBreak p??]
[htSayStandard p??]
[kPageArgs p??]
[length p??]
[extractFileNameFromPath p??]
[subseq p??]
[getdatabase p1010]
[htSay p??]
[htMakePage p1263]
```

— defun kdPageInfo —

```
(defun |kdPageInfo| (name abbrev nargs conform signature file?)
  (let (sourceFileName filename)
    (|htSay| '|{\sf | name "|)
    (when (nequal abbrev name) (|bcHt| (list '| has abbreviation | abbrev)))
    (when file? (|bcHt| (list " is a source file.")))
    (cond
      ((eq1 nargs 0)
       (when (nequal abbrev name) (|bcHt| ".")))
      (t
       (when (nequal abbrev name) (|bcHt| " and"))
       (|bcHt|
        (if (eq1 nargs 1)
            " takes one argument:"
            (list '| takes | (stringimage nargs) '| arguments:|))))))
    (|htSaturnBreak|)
    (|htSayStandard| "\\indentrel{2}"))
```

```

(when (> nargs 0) (|kPageArgs| conform signature))
(|htSayStandard| "\\indentrel{-2}")
(when (char= (elt name (1- (|#| name)))) #\&)
  (setq name (subseq name 0 (1- (|#| name)))))
(setq sourceFileName (getdatabase (intern name) 'sourcefile))
(setq filename (|extractFileNameFromPath| sourceFileName))
(when (nequal filename "")
  (|htSayStandard| "\\newline{ }")
  (|htSay| "The source code for the constructor is found in ")
  (|htMakePage|
    (list (list ' |text| "\\unixcommand{ " filename " }{\\$AXIOM/lib/SPADEDIT "
      sourceFileName " " name " }"))))
(when (nequal nargs 0) (|htSay| "."))
(|htSaturnBreak|))

```

defun kArgPage

```

[httpProperty p1254]
[getConstructorModemap p??]
[position p??]
[sublisFormal p??]
[mkDomTypeForm p1348]
[domainDescendantsOf p1349]
[httpSetProperty p1254]
[dbShowCons p1387]

```

— defun kArgPage —

```

(defun |kArgPage| (htPage arg)
  (let (conform op args domname source n typeForm domTypeForm descendants rank)
    (setq conform (|httpProperty| htPage ' |conform|))
    (setq op (car conform))
    (setq args (cdr conform))
    (setq domname (|httpProperty| htPage ' |domname|))
    (setq source (cddar (|getConstructorModemap| op)))
    (setq n (|position| arg args))
    (setq typeForm (|sublisFormal| args (elt source n)))
    (setq domTypeForm (|mkDomTypeForm| typeForm conform domname))
    (setq descendants (|domainDescendantsOf| typeForm domTypeForm))
    (|httpSetProperty| htPage ' |cAlist| descendants)
    (setq rank
      (unless (> n 4) (elt ' (|First| |Second| |Third| |Fourth| |Fifth|) n)))
    (|httpSetProperty| htPage ' |rank| rank)
    (|httpSetProperty| htPage ' |thing| "argument")
    (|dbShowCons| htPage ' |names|)))

```

defun reportCategory

```
[htSay p??]
[categoryParts p??]
[bcConform p??]
[bcPred p??]
[bcConPredTable p??]
[reportAO p1348]
```

— defun reportCategory —

```
(defun |reportCategory| (conform typeForm arg)
  (let (lt1 conlist attrlist oplist)
    (|htSay| "Argument {\em " arg "}")
    (setq lt1 (|categoryParts| conform typeForm t))
    (setq conlist (car lt1))
    (setq attrlist (cadr lt1))
    (setq oplist (cddr lt1))
    (|htSay| " must ")
    (cond
      (conlist
        (|htSay| "belong to ")
        (cond
          ((and (consp conlist) (eq (qcdr conlist) nil))
            (|htSay| "category ")
            (|bcConform| (caar conlist))
            (|bcPred| (cdar conlist)))
          (t
            (|htSay| "categories:")
            (|bcConPredTable| conlist (lopOf| conform))
            (|htSay| "\\newline "))))))
    (cond
      (attrlist
        (when conlist (|htSay| " and "))
        (|reportAO| "attribute" attrlist)
        (|htSay| "\\newline ")))
    (cond
      (oplist
        (when (or conlist attrlist) (|htSay| " and "))
        (|reportAO| "operation" oplist))))))
```

defun reportAO

```
[htSay p??]
[satDownLink p??]
[escapeSpecialChars p??]
[form2HtString p??]
[bcConform p??]
```

— defun reportAO —

```
(defun |reportAO| (kind oplist)
  (let (op sig pred attr ops sigs)
    (|htSay| "have " kind ":")
    (dolist (item oplist)
      (setq op (car item))
      (setq sig (cadr item))
      (setq pred (caddr item))
      (|htSay| "\\newline ")
      (when (eql (|#| oplist) 1) (|htSay| "\\centerline{")
      (cond
        ((string= kind "attribute")
         (setq attr (|form2HtString| (cons op sig)))
         (|satDownLink| attr (list "(|attrPage| '|" attr "|)" )))
        (t
         (setq ops (|escapeSpecialChars| (stringimage op)))
         (setq sigs (|form2HtString| (cons '|Mapping| sig)))
         (|satDownLink| ops (list "(|opPage| '|" ops "|" |" sigs "|)"))
         (|htSay| ": ")
         (|bcConform| (cons '|Mapping| sig))))
      (when (eql (|#| oplist) 1) (|htSay| "}"))
      (|htSay| "\\newline ")))
```

—————

defun mkDomTypeForm

```
[sublislis p??]
[mkDomTypeForm p1348]
[hasIndent p??]
```

— defun mkDomTypeForm —

```
(defun |mkDomTypeForm| (typeForm conform domname)
  (cond
    (domname (sublislis (cdr domname) (cdr conform) typeForm))
    ((and (consp typeForm) (eq (qcar typeForm) '|Join|))
     (cons '|Join|
```

```
(loop for t1 in (qcdr typeForm) collect
  (|mkDomTypeForm| t1 conform domname)))
((null (|hasIdent| typeForm)) typeForm))
```

defun domainDescendantsOf

```
[systemError p??]
[simpHasPred p??]
[quickAnd p??]
[domainsOf p??]
[ifcdr p??]
[qcar p??]
[qcdr p??]
[assoc p??]
[listSort p??]
[function p??]
[delete p??]
```

— defun domainDescendantsOf —

```
(defun |domainDescendantsOf| (conform domform)
  (labels (
    (catScreen (r alist)
      (let (t1 item pred pred1 npred)
        (dolist (x r)
          (unless (and (consp x) (member (qcar x) '(attribute signature)))
            (|systemError| x))
          (setq alist
            (dolist (anitem alist (nreverse0 t1))
              (setq item (car anitem))
              (setq pred (cdr anitem))
              (when (and
                (setq pred1 (|simpHasPred| (list '|has| item x)))
                (setq npred (|quickAnd| pred1 pred)))
                (setq t1 (cons (cons item npred) t1))))))
            alist))
    ; keep only those domains that appear in ALL parts of Join
    (jfn (arg domlist)
      (let (y r item pred u keepList alist)
        (setq y (car arg))
        (setq r (cdr arg))
        (setq alist (|domainsOf| y (ifcar domlist)))
        (dolist (x r)
          (setq domlist (ifcdr domlist))
          (when (and (consp x) (eq (qcar x) 'category) (consp (qcdr x)))
```

```

      (setq alist (catScreen (cddr x) alist)))
    (setq keepList nil)
    (dolist (dom (|domainsOf| x (ifcar domlist)))
      (setq item (car dom))
      (setq pred (cdr dom))
      (when (setq u (|assoc| item alist))
        (setq keepList
          (cons (cons item (|quickAnd| (cdr u) pred)) keepList))))
    (setq alist keepList))
  (dolist (pair alist)
    (rplacd pair (|simpHasPred| (cdr pair))))
  (|listSort| (|function| glesseqp) alist)))
(if (consp conform)
  (cond
    ((eq (qcar conform) '|Join|)
     (jfn
      (|delete| '(|Type| |Object|) (qcdr conform))
      (|delete| '(|Type| |Object|) (ifcdr domform))))
    ((eq (qcar conform) 'category) nil)
    (t (|domainsOf| conform domform)))
  (|domainsOf| conform domform)))

```

There are 8 parts of an htPage:

1. kind
2. name
3. nargs
4. xflag
5. sig
6. args
7. abbrev
8. comments

75.2 Branches of Constructor Page

defun kiPage

[htpProperty p1254]
 [mkConform p1374]

```
[kDomainName p1370]
[errorPage p??]
[capitalize p??]
[htInitPage p1262]
[htCopyProplist p??]
[dbShowConsDoc1 p1393]
[htShowPage p1263]
[$conformsAreDomains p??]
```

— defun kiPage —

```
(defun |kiPage| (htPage junk)
  (declare (ignore junk))
  (let (lt1 kind name nargs args conform domname heading page)
    (declare (special |$conformsAreDomains|))
    (setq lt1 (|httpProperty| htPage '|parts|))
    (setq kind (first lt1))
    (setq name (second lt1))
    (setq nargs (third lt1))
    (setq args (sixth lt1))
    (setq conform (|mkConform| kind name args))
    (setq domname (|kDomainName| htPage kind name nargs))
    (cond
      ((and (consp domname) (eq (qcar domname) '|error|))
        (|errorPage| htPage domname))
      (t
        (setq heading
          (list "Description of " (|capitalize| kind) " {\sf " name args "}"))
        (setq page (|htInitPage| heading (|htCopyProplist| htPage)))
        (setq |$conformsAreDomains| domname)
        (|dbShowConsDoc1| htPage conform nil)
        (|htShowPage|))))))
```

—————

defun kePage

```
[httpProperty p1254]
[concat p1047]
[kDomainName p1370]
[errorPage p??]
[httpSetProperty p1254]
[mkConform p1374]
[opOf p??]
[capitalize p??]
[form2HtString p??]
```



```

[sublisFormal p??]
[ifcdr p??]
[getConstructorExports p??]
[simpHasPred p??]
[pluralSay p??]
[length p??]
[htInitPage p1262]
[htCopyProplist p??]
[htSayStandard p??]
[httpSetProperty p1254]
[htMakePage p1263]
[menuButton p??]
[htSay p??]
[bcConPredTable p??]
[htBigSkip p??]
[kePageDisplay p1354]
[kePageOpAlist p1353]
[htSowPage p??]
[$conformsAreDomains p??]

```

— defun kePage —

```

(defun |kePage| (htPage junk)
  (declare (ignore junk))
  (let (|$conformsAreDomains| lt1 kind name nargs args constring domname
        conform conname heading data conlist attrlist oplist prefix page)
    (declare (special |$conformsAreDomains|))
    (setq lt1 (|httpProperty| htPage '|parts|))
    (setq kind (first lt1))
    (setq name (second lt1))
    (setq nargs (third lt1))
    (setq args (sixth lt1))
    (setq constring (concat name args))
    (setq domname (|kDomainName| htPage kind name nargs))
    (cond
      ((and (consp domname) (eq (qcar domname) '|error|))
        (|errorPage| htPage domname))
      (t
        (|httpSetProperty| htPage '|domname| domname)
        (setq |$conformsAreDomains| domname)
        (setq conform (|mkConform| kind name args))
        (setq conname (|opOf| conform))
        (setq heading
          (list (|capitalize| kind) " {\sf "
            (if domname (|form2HtString| domname nil t) constring) "}" ))
        (setq data
          (|sublisFormal|
            (or (ifcdr domname) (cdr conform))

```

```

(|getConstructorExports| (or domname conform) t)))
(setq conlist (car data))
(setq attrlist (cadr data))
(setq oplist (cddr data))
(when domname
  (dolist (x conlist) (rplac (cdr x) (|simpHasPred| (cdr x))))
  (dolist (x attrlist) (rplac (cddr x) (|simpHasPred| (cddr x))))
  (dolist (x oplist) (rplac (cddr x) (|simpHasPred| (cddr x))))
(setq prefix
  (|pluralSay| (+ (+ (|#| conlist) (|#| attrlist)) (|#| oplist))
    "Export" "Exports"))
(setq page
  (|htInitPage| (append prefix (cons " of " heading))
    (|htCopyPropList| htPage)))
(|htSayStandard| "\\beginmenu ")
(|htpSetProperty| page '|data| data)
(when conlist
  (|htMakePage|
    (list
      (list '|bcLinks|
        (list (|menuButton|) "" '|dbShowCons1| conlist '|names|))))
    (|htSayStandard| "\\tab{2}")
    (|htSay| "All attributes and operations from:")
    (|bcConPredTable| conlist (|opOf| conform) (cdr conform)))
  (when attrlist
    (when conlist (|htBigSkip|))
    (|kePageDisplay| page "attribute" (|kePageOpAlist| attrlist)))
  (when oplist
    (when (or conlist attrlist) (|htBigSkip|))
    (|kePageDisplay| page "operation" (|kePageOpAlist| oplist)))
  (|htSayStandard| " \\endmenu ")
  (|htShowPage|))))

```

defun kePageOpAlist

```

[lassoc p??]
[insertAlist p??]
[zeroOneConvert p??]

```

— defun kePageOpAlist —

```

(defun |kePageOpAlist| (oplist)
  (let (op sig pred u opAlist)
    (dolist (item oplist)
      (setq op (car item))

```

```

(setq sig (cadr item))
(setq pred (cddr item))
(setq u (lassoc op opAlist))
(setq opAlist
  (|insertAlist| (|zeroOneConvert| op)
    (cons (list sig pred) u)
    opAlist)))
opAlist))

```

defun kePageDisplay

```

[length p??]
[htpSetProperty p1254]
[htMakePage p1263]
[menuButton p??]
[htSayStandard p??]
[htSay p??]
[stringimage p??]
[pluralize p??]
[htSaySaturn p??]
[dbGatherData p??]
[dbSowOpItems p??]

```

— defun kePageDisplay —

```

(defun |kePageDisplay| (htPage which opAlist)
  (let (count total expandProperty data)
    (setq count (|#| opAlist))
    (cond
      ((eql count 0) nil)
      (t
       (setq total
         (apply #' + (loop for entry in opAlist collect (|#| (cdr entry)))))
       (if (string= which "operation")
         (|htpSetProperty| htPage '|opAlist| opAlist)
         (|htpSetProperty| htPage '|attrAlist| opAlist))
       (setq expandProperty
         (if (string= which "operation")
           '|expandOperations|
           '|expandAttributes|))
       (|htpSetProperty| htPage expandProperty '|lists|)
       (|htMakePage|
        (list
         (list '|bcLinks| (list (|menuButton|) "" '|dbShowOps| which '|names|))))
         (|htSayStandard| "\\tab{2}"))

```

```

(unless (= count total)
  (if (eql count 1)
    (|htSay| "1 name for ")
    (|htSay| (stringimage count) " names for ")))
(if (> total 1)
  (|htSay| (stringimage total) " " (|pluralize| which)
    " are explicitly exported:")
  (|htSay| "1 " which " is explicitly exported:"))
(|htSaySaturn| "\\")
(setq data (|dbGatherData| htPage opAlist which '|names|))
(|dbShowOpItems| which data nil))))

```

defun ksPage

```

[httpProperty p1254]
[kDomainName p1370]
[errorPage p??]
[form2HtString p??]
[httpSetProperty p1254]
[htInitPageNoScroll p??]
[htCopyProplist p??]
[htSay p??]
[htSayStandard p??]
[dbSearchOrder p1356]
[dbShowCons p1387]

```

— defun ksPage —

```

(defun |ksPage| (htPage junk)
  (declare (ignore junk))
  (let (lt1 kind name nargs domname heading domain conform page u)
    (setq lt1 (|httpProperty| htPage '|parts|))
    (setq kind (first lt1))
    (setq name (second lt1))
    (setq nargs (third lt1))
    (setq domname (|kDomainName| htPage kind name nargs))
    (cond
      ((and (consp domname) (eq (qcar domname) '|error|))
        (|errorPage| htPage domname))
      (t
        (setq heading
          (if (null domname)
            (|httpProperty| htPage '|heading|)
            (list "{\sf " (|form2HtString| domname nil t) "}"))))
        (when domname

```

```

      (|httpSetProperty| htPage '|domname| domname)
      (|httpSetProperty| htPage '|heading| heading))
    (setq domain (unless (string= kind "category") (eval domname)))
    (setq conform (|httpProperty| htPage '|conform|))
    (setq page
      (|htInitPageNoScroll| (|htCopyPropList| htPage)
        (cons "Search order for " heading)))
    (|htSay| (concat
      "When an operation is not defined by the domain, the following "
      "domains are searched in order for a \"default definition\"))
    (|htSayStandard| "\\beginscroll ")
    (setq u (|dbSearchOrder| conform domname domain))
    (|httpSetProperty| htPage '|cAlist| u)
    (|httpSetProperty| htPage '|thing| "constructor")
    (|dbShowCons| htPage '|names|))))

```

defun dbSearchOrder

```

[opOf p??]
[dbInfovec p??]
[getdatabase p1010]
[simpCatPredicate p??]
[sublislis p??]
[kTestPred p1386]
[devaluate p??]
[kFormatSlotDomain p??]
[dbSubConform p1386]
[dbAddChain p1387]
[$domain p??]
[$infovec p??]
[$predvec p??]

```

— defun dbSearchOrder —

```

(defun |dbSearchOrder| (conform domname |$domain|)
  (declare (special |$domain|))
  (let (|$infovec| name u catpredvec catinfo catvec p pred pak catform res
        catforms t1)
    (declare (special |$infovec| |$predvec|))
    (setq conform (or domname conform))
    (setq name (|opOf| conform))
    (setq |$infovec| (|dbInfovec| name))
    (when |$infovec|
      (setq u (elt |$infovec| 3))

```

```

(setq |$predvec|
  (if |$domain| (elt |$domain| 3) (getdatabase name 'predicates)))
(setq catpredvec (car u))
(setq catinfo (cadr u))
(setq catvec (caddr u))
(setq catforms
  (dotimes (i (maxindex catvec) (nreverse0 t1))
    (cond
      ((progn
        (setq pred
          (|simpCatPredicate|
            (progn
              (setq p
                (sublislis (cdr conform) |$FormalMapVariableList|
                  (|kTestPred| (elt catpredvec i)))))
              (if |$domain| (eval p) p))))
          (when (and domname (contained '$ pred))
            (setq pred (subst domname '$ pred :test #'equal)))
            (and (setq pak (elt catinfo i)) pred))
        (setq t1
          (cons
            (cons
              (cond
                ((and pak (null (identp pak)))
                  (|devaluate| pak))
                (t
                  (setq catform (|kFormatSlotDomain| (elt catvec i)))
                  (setq res (|dbSubConform| (cdr conform)
                    (cons pak (cons '$ (cdr catform)))))
                  (when domname (setq res (subst domname '$ res :test #'equal))
                    res))
                  pred)
              t1))))))
      (append (|dbAddChain| conform) catforms))))

```

defun kcPage

```

[httpProperty p1254]
[kDomainName p1370]
[qcar p??]
[errorPage p??]
[opOf p??]
[form2HtString p??]
[htInitPage p1262]
[htCopyProplist p??]

```

```

[htpSetProperty p1254]
[dbpHasDefaultCategory? p??]
[htSay p??]
[brCon p??]
[htSayStandard p??]
[htBeginMenu p??]
[htMakePage p1263]
[satBreak p??]
[asharpConstructorName? p??]
[nequal p??]
[hget p1044]
[hasNewInfoAlist p??]
[htEndMenu p??]
[htShowPage p1263]
[$defaultPackageNamesHT p??]

```

— defun kcPage —

```

(defun |kcPage| (htPage junk)
  (declare (ignore junk))
  (let (lt1 kind name nargs xpart domname conform conname heading page message)
    (declare (special |$defaultPackageNamesHT|))
    (setq lt1 (|httpProperty| htPage '|parts|))
    (setq kind (first lt1))
    (setq name (second lt1))
    (setq nargs (third lt1))
    (setq xpart (fourth lt1))
    (setq domname (|kDomainName| htPage kind name nargs))
    (cond
      ((and (consp domname) (eq (qcar domname) '|error|))
        (|errorPage| htPage domname))
      (t
        (setq conform (|httpProperty| htPage '|conform|))
        (setq conname (|opOf| conform))
        (setq heading
          (if (null domname)
              (|httpProperty| htPage '|heading|)
              (list "{\sf " (|form2HtString| domname nil t) "}"))))
        (setq page
          (|htInitPage| (cons "Cross Reference for " heading)
            (|htCopyProplist| htPage)))
        (when domname
          (|httpSetProperty| htPage '|domname| domname)
          (|httpSetProperty| htPage '|heading| heading))
        (when (and (string= kind "category")
          (|dbpHasDefaultCategory?| xpart))
          (|htSay| "This category has default package ")
          (|bcCon| (concat name (|char| '&)) ""))

```

```

(|htSayStandard| "\\newline")
(|htBeginMenu| 3)
(|htSayStandard| "\\item ")
(setq message
  (if (string= kind "category")
    (list "Categories it directly extends")
    (list "Categories the "
      (if (string= kind "default package") "package" kind)
      " belongs to by assertion"))))
(|htMakePage|
  (list
    (list '|bcLinks|
      (list "\\menuitemstyle{Parents}"
        (list (list '|text| "\\tab{12}" message)) '|kcpPage| nil))))
(|satBreak|)
(setq message
  (if (string= kind "category")
    (list "All categories it is an extension of")
    (list "All categories the " kind " belongs to")))
(|htMakePage|
  (list
    (list '|bcLinks|
      (list "\\menuitemstyle{Ancestors}"
        (list (list '|text| "\\tab{12}" message)) '|kcaPage| nil))))
(when (string= kind "category")
  (|satBreak|)
  (|htMakePage|
    (list
      (list '|bcLinks|
        (list "\\menuitemstyle{Children}"
          (list (list '|text| "\\tab{12}"
            "Categories which directly extend this category"))))))
  (|satBreak|)
  (|htMakePage|
    (list
      (list '|bcLinks|
        (list "\\menuitemstyle{Descendants}"
          (list (list '|text| "\\tab{12}"
            "All categories which extend this category"))))))
  (unless (|asharpConstructorName?| conname)
    (|satBreak|)
    (setq message "Constructors mentioning this as an argument type")
    (|htMakePage|
      (list
        (list '|bcLinks|
          (list "\\menuitemstyle{Dependents}"
            (list (list '|text| "\\tab{12}" message)) '|kcdePage| nil))))
    (when (and (null (|asharpConstructorName?| conname))
      (nequal kind "category"))
      (|satBreak|)

```



```

(|htMakePage|
  (list
    (list '|bcLinks|
      (list "\\menuitemstyle{Lineage}"
        "\\tab{12}Constructor hierarchy used for operation lookup"
        '|ksPage| nil))))))
(unless (|asharpConstructorName?| conname)
  (when (string= kind "category")
    (|satBreak|)
    (|htMakePage|
      (list
        (list '|bcLinks|
          (list "\\menuitemstyle{Domains}"
            (list (list '|text| "\\tab{12}"
              "All domains which are of this category")
              '|kcdPage| nil))))))
    (unless (string= kind "category")
      (|satBreak|)
      (|htMakePage|
        (list
          (list '|bcLinks|
            (list "\\menuitemstyle{Clients}" "\\tab{12}Constructors"
              '|kcuPage| nil))))
          (if (hget |$defaultPackageNamesHT| conname)
            (|htSay| " which {\\em may use} this default package")
            (|htSay| " which {\\em use} this " kind)))
          (when (or (nequal kind "category") (|dbpHasDefaultCategory?| xpart))
            (|satBreak|)
            (setq message
              (if (string= kind "category")
                (list "Constructors {\\em used by} its default package")
                (list "Constructors {\\em used by} the " kind)))
            (|htMakePage|
              (list
                (list '|bcLinks|
                  (list "\\menuitemstyle{Benefactors}"
                    (list (list '|text| "\\tab{12}" message) '|kcnPage| nil))))))
            (when (and (null (|asharpConstructorName?| conname))
              (|hasNewInfoAlist| conname))
              (|satBreak|)
              (setq message (list "Cross reference for capsule implementation"))
              (|htMakePage|
                (list
                  (list '|bcLinks|
                    (list "\\menuitemstyle{CapsuleInfo}"
                      (list (list '|text| "\\tab{12}" message) '|kciPage| nil))))))
                (|htEndMenu| 3)
                (|htShowPage|))))))

```

defun kcpPage

```
[httpProperty p1254]
[kDomainName p1370]
[errorPage p??]
[qcar p??]
[form2HtString p??]
[httpSetProperty p1254]
[opOf p??]
[htInitPage p1262]
[htCopyProplist p??]
[parentsOf p??]
[sublislis p??]
[dbShowCons p1387]
```

— defun kcpPage —

```
(defun |kcpPage| (htPage junk)
  (declare (ignore junk))
  (let (lt1 kind name nargs domname heading conform conname page parents choice)
    (setq lt1 (|httpProperty| htPage '|parts|))
    (setq kind (first lt1))
    (setq name (second lt1))
    (setq nargs (third lt1))
    (setq domname (|kDomainName| htPage kind name nargs))
    (cond
      ((and (consp domname) (eq (qcar domname) '|error|))
        (|errorPage| htPage domname))
      (t
        (setq heading
          (if (null domname)
            (|httpProperty| htPage '|heading|)
            (list "{\\sf " (|form2HtString| domname nil t) "}"))))
        (when domname
          (|httpSetProperty| htPage '|domname| domname)
          (|httpSetProperty| htPage '|heading| heading))
        (setq conform (|httpProperty| htPage '|conform|))
        (setq conname (|opOf| conform))
        (setq page
          (|htInitPage| (cons "Parents of " heading) (|htCopyProplist| htPage)))
        (setq parents (|parentsOf| conname))
        (when domname
          (setq parents (sublislis (cdr domname) (cdr conform) parents)))
        (|httpSetProperty| htPage '|cAlist| parents)
        (|httpSetProperty| htPage '|thing| "parent")
        (setq choice (if domname '|parameters| '|names|))
```

```
(|dbShowCons| htPage choice))))))
```

defun reduceAlistForDomain

```
[sublislis p??]
[simpHasPred p??]
[nreverse0 p??]
```

— defun reduceAlistForDomain —

```
(defun |reduceAlistForDomain| (alist domform conform)
  (let (pred result)
    (setq alist (sublislis (cdr domform) (cdr conform) alist))
    (dolist (pair alist)
      (rplacd pair (|simpHasPred| (cdr pair) domform)))
    (dolist (pair alist (nreverse0 result))
      (setq pred (cdr pair))
      (when pred (setq result (cons pair result))))))
```

defun kcaPage

```
[kcaPage1 p1363]
[ancestorsOf p??]
```

— defun kcaPage —

```
(defun |kcaPage| (htPage junk)
  (declare (ignore junk))
  (|kcaPage1| htPage "category" " an "
    "ancestor" (|function| |ancestorsOf|) nil))
```

defun kcdPage

```
[kcaPage1 p1363]
[descendantsOf p??]
```

— defun kcdPage —

```
(defun |kcdPage| (htPage junk)
  (declare (ignore junk))
  (|kcaPage1| htPage "category" " a "
    "descendant" (|function| |descendantsOf|) t))
```

defun kcdoPage

```
[kcdoPage p1363]
[domainsOf p??]
```

— defun kcdoPage —

```
(defun |kcdoPage| (htPage junk)
  (declare (ignore junk))
  (|kcaPage1| htPage "domain" " a "
    "descendant" (|function| |domainsOf|) nil))
```

defun kcaPage1

```
[httpProperty p1254]
[kDomainName p1370]
[errorPage p??]
[form2HtString p??]
[httpSetProperty p1254]
[opOf p??]
[augmentHasArgs p1365]
[listSort p??]
[function p??]
[dbShowCons p1387]
```

— defun kcaPage1 —

```
(defun |kcaPage1| (htPage kind article whichever fn isCatDescendants?)
  (declare (ignore article))
  (let (lt1 name nargs domname heading conform conname ancestors choice)
    (setq lt1 (|httpProperty| htPage '|parts|))
    (setq kind (first lt1))
    (setq name (second lt1))
    (setq nargs (third lt1))
    (setq domname (|kDomainName| htPage kind name nargs)))
```

```

(cond
  ((and (consp domname) (eq (qcar domname) '|error|))
    (|errorPage| htPage domname))
  (t
    (setq heading
      (if (null domname)
        (|httpProperty| htPage '|heading|)
        (list "{\sf " (|form2HtString| domname nil t) "}"))))
    (when (and domname (null isCatDescendants?))
      (|httpSetProperty| htPage '|domname| domname)
      (|httpSetProperty| htPage '|heading| heading))
    (setq conform (|httpProperty| htPage '|conform|))
    (setq conname (|opOf| conform))
    (setq ancestors (FUNCALL fn conform domname))
    (unless (string= whichever "ancestor")
      (setq ancestors (|augmentHasArgs| ancestors conform)))
    (setq ancestors (|listSort| (|function| glesseq) ancestors))
    (|httpSetProperty| htPage '|cAlist| ancestors)
    (|httpSetProperty| htPage '|thing| whichever)
    (setq choice '|names|)
    (|dbShowCons| htPage choice))))

```

defun kccPage

```

[|httpProperty| p1254]
[kDomainName p1370]
[qcar p??]
[errorPage p??]
[form2HtString p??]
[|httpSetProperty| p1254]
[opOf p??]
[|htInitPage| p1262]
[|htCopyProplist| p??]
[|augmentHasArgs| p1365]
[|childrenOf| p??]
[|reduceAlistForDomain| p1362]
[|dbShowCons| p1387]

```

— defun kccPage —

```

(defun |kccPage| (htPage junk)
  (declare (ignore junk))
  (let (lt1 kind name nargs domname heading conform conname page children)
    (setq lt1 (|httpProperty| htPage '|parts|))

```

```

(setq kind (first lt1))
(setq name (second lt1))
(setq nargs (third lt1))
(setq domname (|kDomainName| htPage kind name nargs))
(cond
  ((and (consp domname) (eq (qcar domname) '|error|))
    (|errorPage| htPage domname))
  (t
    (setq heading
      (if (null domname)
        (|httpProperty| htPage '|heading|)
        (list "{\\sf " (|form2HtString| domname nil t) "}"))))
    (when domname
      (|httpSetProperty| htPage '|domname| domname)
      (|httpSetProperty| htPage '|heading| heading))
      (setq conform (|httpProperty| htPage '|conform|))
      (setq conname (|opOf| conform))
      (setq page
        (|htInitPage| (cons "Children of " heading) (|htCopyProplist| htPage)))
      (setq children (|augmentHasArgs| (|childrenOf| conform) conform))
      (when domname
        (setq children (|reduceAlistForDomain| children domname conform)))
      (|httpSetProperty| htPage '|cAlist| children)
      (|httpSetProperty| htPage '|thing| "child")
      (|dbShowCons| htPage '|names|))))

```

defun augmentHasArgs

```

[opOf p??]
[kdr p??]
[length p??]
[nreverse0 p??]
[extractHasArgs p??]
[getConstructorForm p??]

```

— defun augmentHasArgs —

```

(defun |augmentHasArgs| (alist conform)
  (let (conname args n name p result pred)
    (setq conname (|opOf| conform))
    (setq args (kdr conform))
    (cond
      (args
        (setq n (|#| args))
        (dolist (item alist (nreverse0 result))

```

```

(setq name (car item))
(setq p (cdr item))
(setq pred
  (if (consp (|extractHasArgs| p))
      p
      (|quickAnd| p
        (cons '|hasArgs|
          (take n (kdr (|getConstructorForm| (|opOf| name))))))))
(setq result (cons (cons name pred) result)))
(t alist)))

```

defun kcdePage

```

[httpProperty p1254]
[concat p1047]
[nequal p??]
[ncParseFromString p1067]
[opOf p??]
[getDependentsOfConstructor p1367]
[getConstructorForm p??]
[httpSetProperty p1254]
[dbShowCons p1387]

```

— defun kcdePage —

```

(defun |kcdePage| (htPage junk)
  (declare (ignore junk))
  (let (lt1 kind name args conname constring conform pakname domlist cAlist)
    (setq lt1 (|httpProperty| htPage '|parts|))
    (setq kind (first lt1))
    (setq name (second lt1))
    (setq args (sixth lt1))
    (setq conname (intern name))
    (setq constring (concat name args))
    (setq conform
      (if (nequal kind "default package")
          (|ncParseFromString| constring)
          (cons (intern name) (cdr (|ncParseFromString| (concat #\d args))))))
    (setq pakname (|opOf| conform))
    (setq domlist (|getDependentsOfConstructor| pakname))
    (setq cAlist
      (loop for x in domList collect (cons (|getConstructorForm| x) t)))
    (|httpSetProperty| htPage '|cAlist| cAlist)
    (|httpSetProperty| htPage '|thing| "dependent")
    (|dbShowCons| htPage '|names|)))

```

defun getDependentsOfConstructor

```
[readLibPathFast p??]
[pathname p1042]
[rread p605]
[rshut p??]
```

— defun getDependentsOfConstructor —

```
(defun |getDependentsOfConstructor| (con)
  (let (stream val)
    (setq stream
      (|readLibPathFast| (|pathname| (list ' |dependents| 'database ' |a|))))
    (setq val (|rread| con stream nil))
    (rshut stream)
    val))
```

defun kcuPage

```
[httpProperty p1254]
[concat p1047]
[nequal p??]
[ncParseFromString p1067]
[opOf p??]
[getUsersOfConstructor p1368]
[getConstructorForm p??]
[httpSetProperty p1254]
[dbShowCons p1387]
```

— defun kcuPage —

```
(defun |kcuPage| (htPage junk)
  (declare (ignore junk))
  (let (lt1 kind name args conname constring conform pakname domlist cAlist)
    (setq lt1 (|httpProperty| htPage '|parts|))
    (setq kind (first lt1))
    (setq name (second lt1))
    (setq args (sixth lt1))
    (setq conname (intern name))
```



```

(setq constring (concat name args))
(setq conform
  (if (nequal kind "default package")
      (|ncParseFromString| constring)
      (cons (intern name)
            (cdr (|ncParseFromString| (concat #\d args))))))
(setq pakname
  (if (string= kind "category")
      (intern (concat name #\&))
      (|opOf| conform)))
(setq domlist (|getUsersOfConstructor| pakname))
(setq cAlist
  (loop for x in domlist collect (cons (|getConstructorForm| x) t)))
(|httpSetProperty| htPage '|cAlist| cAlist)
(|httpSetProperty| htPage '|thing| "user")
(|dbShowCons| htPage '|names|)))

```

defun getUsersOfConstructor

```

[readLibPathFast p??]
[pathname p1042]
[rread p605]
[rshut p??]

```

— defun getUsersOfConstructor —

```

(defun |getUsersOfConstructor| (con)
  (let (stream val)
    (setq stream (|readLibPathFast| (|pathname| (list '|users| 'database '|a|))))
    (setq val (|rread| con stream nil))
    (rshut stream)
    val))

```

defun kcnPage

```

[kDomainName p1370]
[qcar p??]
[errorPage p??]
[httpProperty p1254]
[form2HtString p??]
[httpSetProperty p1254]

```

```
[concat p1047]
[pname p1045]
[opOf p??]
[getImports p??]
[sublislis p??]
[dbShowCons p1387]
```

— defun kcnPage —

```
(defun |kcnPage| (htPage junk)
  (declare (ignore junk))
  (let (lt1 kind name nargs domname heading conform pakname domlist cAlist)
    (setq lt1 (|httpProperty| htPage '|parts|))
    (setq kind (first lt1))
    (setq name (second lt1))
    (setq nargs (third lt1))
    (setq domname (|kDomainName| htPage kind name nargs))
    (cond
      ((and (consp domname) (eq (qcar domname) '|error|))
        (|errorPage| htPage domname))
      (t
        (setq heading
          (if (null domname)
            (|httpProperty| htPage '|heading|)
            (list "{\\sf " (|form2HtString| domname nil t) "}"))))
        (if domname
          (|httpSetProperty| htPage '|domname| domname)
          (|httpSetProperty| htPage '|heading| heading))
        (setq conform (|httpProperty| htPage '|conform|))
        (setq pakname
          (if (string= kind "category")
            (intern (concat (pname conname) #\&))
            (|opOf| conform)))
        (setq domlist (|getImports| pakname))
        (when domname
          (setq domlist
            (sublislis (cons domname (cdr domname))
              (cons '$ (cdr conform)) domlist)))
        (setq cAlist (loop for x in domList collect (cons x t)))
        (|httpSetProperty| htPage '|cAlist| cAlist)
        (|httpSetProperty| htPage '|thing| "benefactor")
        (|dbShowCons| htPage '|names|))))))
```

defun koPageInputAreaUnchanged?

```
[httpLabelInputString p1254]
[concat p1047]
[stringimage p??]
[httpProperty p1254]
```

— defun koPageInputAreaUnchanged? —

```
(defun |koPageInputAreaUnchanged?| (htPage nargs)
  (equal
    (loop for i from 1 to nargs
      collect
        (|httpLabelInputString| htPage (intern (concat "*" (stringimage i)))))
    (|httpProperty| htPage 'inputAreaList)))
```

—————

defun kDomainName

```
[httpSetProperty p1254]
[httpLabelInputString p1254]
[getdatabase p1010]
[kArgumentCheck p1371]
[kdr p??]
[concat p1047]
[unabbrev p??]
[mkConform p1374]
[kisValidType p1372]
[dbMkEvalable p1372]
[spad-reader p??]
[$PatternVariableList p??]
```

— defun kDomainName —

```
(defun |kDomainName| (htPage kind name nargs)
  (let (inputAreaList conname args n argTailPart argString typeForm
        evaluatedTypeForm)
    (|httpSetProperty| htPage '|domname| nil)
    (setq inputAreaList
      (loop for i from 1 to nargs for var in |$PatternVariableList| do
        collect (|httpLabelInputString| htPage var)))
    (|httpSetProperty| htPage '|inputAreaList| inputAreaList)
    (setq conname (intern name))
    (setq args
      (loop for x in inputAreaList
```

```

      for domain? in (cdr (getdatabase conname 'cosig))
    collect (or (|kArgumentCheck| domain? x) nil)))
(when (some #'identity (loop for x in args collect (null x)))
  (cond
    ((> (setq n (apply #'(loop for x in args collect (if x 1 0)))) 0)
     (list 'error| nil "\\centerline{You gave values for only {\em "
       n " } of the {\em " (|#| args) "}} "
       "\\centerline{parameters of {\sf " name
       "}}\\vspace{1}\\centerline{Please enter either {\em all} or "
       "{\\em none} of the type parameters}")
      nil)
    (t
     (t
      (setq argString
        (cond
          ((null args) "()")
          (t
           (setq argTailPart
             (apply #'concat
              (loop for x in (kdr args) collect (concat (cons ", " x))))
            (apply #'concat (list "(" (car args) argTailPart ")")))))
      (setq typeForm
        (or (catch 'spad_reader (|unabbrev| (|mkConform| kind name argString)))
          (list 'error| 'invalidType| (concat name argString))))
      (if (null (setq evaluatedTypeForm (|isValidType| typeForm)))
          (list 'error| 'invalidType| (concat name argString))
          (|dbMkEvalable| evaluatedTypeForm))))))

```

defun kArgumentCheck

```

[conSpecialString? p??]
[kdr p??]
[stringimage p??]
[opOf p??]
[form2String p??]

```

— defun kArgumentCheck —

```

(defun |kArgumentCheck| (domain? s)
  (let (form)
    (cond
      ((string= s "") nil)
      ((and domain? (setq form (|conSpecialString?| s)))
       (if (null (kdr form))
           (list (stringimage (|opOf| form)))
           (|form2String| form)))
    )

```

```
(t (list s))))
```

defun dbMkEvalable

[getdatabase p1010]
[mkEvalable p913]

— defun dbMkEvalable —

```
(defun |dbMkEvalable| (form)
  (let (op kind)
    (setq op (car form))
    (setq kind (getdatabase op 'constructorkind))
    (if (eq kind 'category|)
        form
        (|mkEvalable| form))))
```

defun topLevelInterpEval

[processInteractive p48]
[\$ProcessInteractiveValue p50]
[\$noEvalTypeMsg p919]

— defun topLevelInterpEval —

```
(defun |topLevelInterpEval| (x)
  (let (|$ProcessInteractiveValue| |$noEvalTypeMsg|)
    (declare (special |$ProcessInteractiveValue| |$noEvalTypeMsg|))
    (setq |$ProcessInteractiveValue| t)
    (setq |$noEvalTypeMsg| t)
    (|processInteractive| x nil)))
```

defun kisValidType

[processInteractive p48]
[member p1048]

```
[kCheckArgumentNumbers p1373]
[$ProcessInteractiveValue p50]
[$noEvalTypeMsg p919]
[spad-reader p??]
```

— defun kisValidType —

```
(defun |kisValidType| (typeForm)
  (let (|$ProcessInteractiveValue| |$noEvalTypeMsg| it1)
    (declare (special |$ProcessInteractiveValue| |$noEvalTypeMsg|))
    (setq |$ProcessInteractiveValue| t)
    (setq |$noEvalTypeMsg| t)
    (setq it1 (catch 'spad_reader (|processInteractive| typeForm nil)))
    (when (and (consp it1) (consp (qcar it1)))
      (|member| (caar it1) '(domain |SubDomain|)))
    (and (|kCheckArgumentNumbers| (qcdr it1)) (qcdr it1))))
```

—————

defun kCheckArgumentNumbers

```
[kdr p??]
[getdatabase p1010]
[kCheckArgumentNumber p??]
```

— defun kCheckArgumentNumbers —

```
(defun |kCheckArgumentNumbers| (tt)
  (let (conname args cosig)
    (setq conname (car tt))
    (setq args (cdr tt))
    (setq cosig (kdr (getdatabase conname 'cosig)))
    (every #'identity
      (loop for domain? in cosig for x in args
        collect (if domain? (|kCheckArgumentNumbers| x) t)))))
```

—————

defun parseNoMacroFromString

```
[next p36]
[function p??]
[ncloopParse p36]
[lineoftoks p111]
```

```
[incString p37]
[StreamNull p333]
[pf2Sex p299]
```

— defun parseNoMacroFromString —

```
(defun |parseNoMacroFromString| (s)
  (setq s
    (|next| (|function| |ncloopParse|)
      (|next| (|function| |lineoftoks|)
        (|incString| s))))
  (if (|StreamNull| s)
    nil
    (|pf2Sex| (cadar s))))
```

—————

defun mkConform

```
[nequal p??]
[parseNoMacroFromString p1373]
[sayBrightlyNT p??]
[pp p??]
[systemError p??]
[ncParseFromString p1067]
[concat p1047]
```

— defun mkConform —

```
(defun |mkConform| (kind name argString)
  (let (form parse)
    (cond
      ((nequal kind "default package")
        (setq form (concat name argString))
        (setq parse (|parseNoMacroFromString| form))
        (cond
          ((null parse)
            (|sayBrightlyNT| "Won't parse: ")
            (|pp| form)
            (|systemError| "Keywords in argument list?"))
          ((atom parse) (cons parse nil))
          (t parse))))
    (t
      (cons (intern name) (cdr (|ncParseFromString| (concat #\d argString))))))))
```

—————

75.3 Operation Page for a Domain Form from Scratch

defun conOpPage

```
[dbCompositeWithMap p1377]
[httpProperty p1254]
[conOpPage1 p1375]
[dbExtractUnderlyingDomain p1377]

— defun conOpPage —

(defun |conOpPage| (htPage conform)
  (declare (ignore conform))
  (let (updown domname)
    (setq updown (|dbCompositeWithMap| htPage))
    (cond
      ((string= updown "DOWN")
       (setq domname (|httpProperty| htPage '|domname|))
       (|conOpPage1| (|dbExtractUnderlyingDomain| domname)
                     (list (cons '|updomain| domname)))))
      (t
       (setq domname (|httpProperty| htPage '|updomain|))
       (|conOpPage1| domname nil))))))
```

defun conOpPage1

```
[ifcar p??]
[opOf p??]
[dbSpecialOperations p1398]
[conPageFastPath p1344]
[dbXParts p??]
[concat p1047]
[mkConform p1374]
[capitalize p??]
[ncParseFromString p1067]
[dbSourceFile p??]
[isExposedConstructor p820]
[htInitPage p1262]
[httpSetProperty p1254]
[lassoc p??]
[ifcdr p??]
[koPage p1377]
[$Primitives p??]
```


— defun conOpPage1 —

```

(defun |conOpPage1| (&rest args)
  (let (bindingsAlist conname domname line parts name sig args isFile kind
        constring capitalKind signature sourceFileName emString heading page
        selectedOperation a b options conform)
    (declare (special |$Primitives|))
    (setq conform (car args))
    (setq options (cdr args))
    (setq bindingsAlist (ifcar options))
    (setq conname (|opOf| conform))
    (cond
      ((member conname |$Primitives|) (|dbSpecialOperations| conname))
      (t
       (setq domname (unless (atom conform) conform))
       (setq line (|conPageFastPath| conname))
       (setq parts (|dbXParts| line 7 1))
       (setq kind (first parts))
       (setq name (second parts))
       (setq sig (fifth parts))
       (setq args (sixth parts))
       (setq isFile (null kind))
       (setq kind (or kind "package"))
       (rplaca parts kind)
       (setq constring (concat name args))
       (setq conform (|mkConform| kind name args))
       (setq capitalKind (|capitalize| kind))
       (setq signature (|ncParseFromString| sig))
       (setq sourceFileName (|dbSourceFile| (intern name)))
       (setq emString (list "{\\sf " constring "}"))
       (setq heading (cons capitalKind (cons " " emString)))
       (unless (|isExposedConstructor| conname)
         (setq heading (cons "Unexposed " heading)))
       (setq page (|htInitPage| heading nil))
       (|httpSetProperty| page '|isFile| t)
       (|httpSetProperty| page '|fromConOpPage1| t)
       (|httpSetProperty| page '|parts| parts)
       (|httpSetProperty| page '|heading| heading)
       (|httpSetProperty| page '|kind| kind)
       (|httpSetProperty| page '|domname| domname)
       (|httpSetProperty| page '|conform| conform)
       (|httpSetProperty| page '|signature| signature)
       (when
        (setq selectedOperation (lassoc '|selectedOperation| (ifcdr options)))
        (|httpSetProperty| page '|selectedOperation| selectedOperation))
       (loop for item in bindingsAlist
         collect (|httpSetProperty| page (car item) (cdr item)))
       (|koPage| page "operation")))))

```

defun dbCompositeWithMap

[[httpProperty](#) [p1254](#)]
 [[dbExtractUnderlyingDomain](#) [p1377](#)]

— **defun dbCompositeWithMap** —

```
(defun |dbCompositeWithMap| (htPage)
  (let (domain opAlist)
    (cond
      ((|httpProperty| htPage '|updomain|) "UP")
      (t
       (setq domain (|httpProperty| htPage '|domname|))
       (cond
         ((null domain) nil)
         (t
          (setq opAlist (|httpProperty| htPage '|opAlist|))
          (when
            (|dbExtractUnderlyingDomain| (|httpProperty| htPage '|domname|))
            "DOWN"))))))))
```

defun dbExtractUnderlyingDomain

[[kdr](#) [p??](#)]
 [[isValidType](#) [p??](#)]

— **defun dbExtractUnderlyingDomain** —

```
(defun |dbExtractUnderlyingDomain| (domain)
  (some #'identity
    (loop for x in (kdr domain) when (|isValidType| x) collect x)))
```

75.4 Operation Page from Main Page**defun koPage**

[[httpProperty](#) [p1254](#)]
 [[concat](#) [p1047](#)]

```
[koPageInputAreaUnchanged? p1370]
[kDomainName p1370]
[errorPage p??]
[form2HtString p??]
[capitalize p??]
[httpSetProperty p1254]
[koPageAux p1379]
```

— defun koPage —

```
(defun |koPage| (htPage which)
  (let (lt1 kind name nargs args constring conname u IT1 domname headingString
        heading)
    (setq lt1 (|httpProperty| htPage '|parts|))
    (setq kind (first lt1))
    (setq name (second lt1))
    (setq nargs (third lt1))
    (setq args (sixth lt1))
    (setq constring (concat name args))
    (setq conname (intern name))
    (setq IT1 (setq u (|httpProperty| htPage '|domname|)))
    (setq domname
      (cond
        ((and (consp IT1) (equal (qcar IT1) conname)
              (or (eq (|httpProperty| htPage '|fromConOpPage1|) t)
                  (|koPageInputAreaUnchanged?| htPage nargs)))
         u)
        (t (|kDomainName| htPage kind name nargs))))
    (cond
      ((and (consp domname) (eq (qcar domname) '|error|))
       (|errorPage| htPage domname))
      (t
       (|httpSetProperty| htPage '|domname| domname)
       (setq headingString (if domname (|form2HtString| domname nil t) constring))
       (setq heading (list (|capitalize| kind) " {\sf " headingString "}" ))
       (|httpSetProperty| htPage '|which| which)
       (|httpSetProperty| htPage '|heading| heading)
       (|koPageAux| htPage which domname heading))))))
```

—————

defun koPageFromKKPage

```
[koPageAux p1379]
[httpProperty p1254]
```

— defun koPageFromKKPage —

```
(defun |koPageFromKKPage| (htPage ao)
  (|koPageAux| htPage ao (|httpProperty| htPage '|domname|)
    (|httpProperty| htPage '|heading|)))
```

defun koPageAux

```
[httpSetProperty p1254]
[koAttrs p??]
[koOps p??]
[assoc p??]
[systemError p??]
[dbShowOperationsFromConform p??]
```

— defun koPageAux —

```
(defun |koPageAux| (htPage which domname heading)
  (let (conform selectedOperation opAlist)
    (|httpSetProperty| htPage '|which| which)
    (setq domname (|httpProperty| htPage '|domname|))
    (setq conform (|httpProperty| htPage '|conform|))
    (setq heading (|httpProperty| htPage '|heading|))
    (setq opAlist
      (cond
        ((string= which "attribute") (|koAttrs| conform domname))
        ((string= which "general operation") (|koOps| conform domname t))
        (t (|koOps| conform domname))))))
  (cond
    ((setq selectedOperation (|httpProperty| htPage '|selectedOperation|))
     (setq opAlist
       (list (or (|assoc| selectedOperation opAlist) (|systemError|))))))
    (|dbShowOperationsFromConform| htPage which opAlist)))
```

defun koPageAux1

```
[httpProperty p1254]
[dbShowOperationsFromConform p??]
```

— defun koPageAux1 —

```
(defun |koPageAux1| (htPage opAlist)
  (let (which)
```

```
(setq which (|httpProperty| htPage '|which|))
(|dbShowOperationsFromConform| htPage which opAlist)))
```

defun koaPageFilterByName

```
[httpLabelInputString p1254]
[koaPageFilterByCategory p??]
[pmTransFilter p??]
[httpProperty p1254]
[dbGetInputString p??]
[superMatch? p??]
[downcase p??]
[stringimage p??]
[httpSetProperty p1254]
```

— defun koaPageFilterByName —

```
(defun |koaPageFilterByName| (htPage functionToCall)
  (let (filter which opAlist)
    (cond
      ((string= (|httpLabelInputString| htPage '|filter|) "")
        (|koaPageFilterByCategory| htPage functionToCall))
      (t
        (setq filter (|pmTransFilter| (|dbGetInputString| htPage)))
        (setq which (|httpProperty| htPage '|which|))
        (setq opAlist
          (loop for x in (|httpProperty| htPage '|opAlist|)
            when (|superMatch?| filter (downcase (stringimage (car x))))
            collect x))
        (|httpSetProperty| htPage '|opAlist| opAlist)
        (funcall functionToCall htPage nil))))))
```

75.5 Get Constructor Documentation

defun dbConstructorDoc,hn

```
[length p??]
[sublis p??]
[$FormalMapVariableList p??]
```

[*\$sig* *p??*]
 [*\$args* *p??*]

— **defun dbConstructorDoc,hn** —

```
(defun |dbConstructorDoc,hn| (sig)
  (declare (special |$sig| |$args|))
  (and (equal (|#| |$sig|) (|#| sig))
    (equal |$sig| (sublislis |$args| |$FormalMapVariableList| sig))))
```

defun dbConstructorDoc,gn

[dbConstructorDoc,hn [p1380](#)]
 [*\$op* *p??*]

— **defun dbConstructorDoc,gn** —

```
(defun |dbConstructorDoc,gn| (arg)
  (let (op alist sig doc)
    (declare (special |$op|))
    (setq op (car arg))
    (setq alist (cdr arg))
    (and |$op|
      (some #'identity
        (loop for item in alist when (|dbConstructorDoc,hn| (car item))
          collect (or (cdr item) '(""))))))))
```

defun dbConstructorDoc

[dbConstructorDoc,fn *p??*]
 [*\$sig* *p??*]
 [*\$op* *p??*]

— **defun dbConstructorDoc** —

```
(defun |dbConstructorDoc| (conform |$op| |$sig|)
  (declare (special |$op| |$sig|))
  (|dbConstructorDoc,fn| conform))
```

defun dbDocTable

[hget p1044]
 [make-hashtable p??]
 [originsInOrder p1382]
 [dbAddDocTable p1383]
 [\$docTable p??]
 [\$docTableHash p??]

— defun dbDocTable —

```
(defun |dbDocTable| (conform)
  (let (|$docTable| table)
    (declare (special |$docTable| |$docTableHash|))
    (cond
      ((setq table (hget |$docTableHash| conform))
       table)
      (t
       (setq |$docTable| (make-hashtable 'id))
       (loop for x in (|originsInOrder| conform) do (|dbAddDocTable| x))
       (|dbAddDocTable| conform)
       (hput |$docTableHash| conform |$docTable|)
       |$docTable|))))
```

—————→

defun originsInOrder

[getdatabase p1010]
 [assocleft p??]
 [ancestorsOf p??]
 [parentsOf p??]
 [originsInOrder p1382]
 [insert p??]

— defun originsInOrder —

```
(defun |originsInOrder| (conform)
  (let (con argl acc)
    (setq con (car conform))
    (setq argl (cdr conform))
    (cond
      ((eq (getdatabase con 'constructorkind) '|category|)
       (assocleft (|ancestorsOf| conform nil)))
      (t
       (setq acc (assocleft (|parentsOf| con))
```

```
(loop for x in acc do
  (loop for y in (|originsInOrder| x) do
    (setq acc (|insert| y acc))))
acc)))
```

```
[opOf p??]
[getConstructorForm p??]
[sublislis p??]
[getdatabase p1010]
[hput p1044]
[hget p1044]
[$docTable p??]
```

— defun dbAddDocTable —

[illegible]

defun dbGetDocTable,hn

```
[sublislis p??]
[kdr p??]
[qcdr p??]
[qcar p??]
[$which p??]
[$conform p??]
[$sig p??]
[$FormalMapVariableList p??]
```

— **defun dbGetDocTable,hn** —

```
(defun |dbGetDocTable,hn| (arg)
  (let (sig doc alteredSig pred r)
    (declare (special |$which| |$conform| |$sig| |$FormalMapVariableList|))
    (setq sig (car arg))
    (setq doc (cdr arg))
    (if (string= |$which| "attribute")
        (and (consp sig) (eq (qcar sig) '|attribute|) (equal (qcdr sig) |$sig|)
              doc)
        (progn
          (setq pred
            (and
              (eql (|#| |$sig|) (|#| sig))
              (setq alteredSig
                (sublislis (kdr |$conform|) |$FormalMapVariableList| sig))
              (equal alteredSig |$sig|)))
          (when (and pred doc
                    (and (consp doc) (eq (qcar doc) '|constant|)) (qcdr doc) doc)
            '("))))))
```

—————

defun dbGetDocTable,gn

```
[lastatom p??]
[dbGetDocTable,hn p1384]
[$conform p??]
```

— **defun dbGetDocTable,gn** —

```
(defun |dbGetDocTable,gn| (u)
  (let (code p comments)
    (declare (special |$conform|))
    (setq |$conform| (car u))
```

```
(when (atom |$conform|) (setq |$conform| (list |$conform|)))
(setq code (lastatom u))
(setq comments
  (some #'identity
    (loop for entry in (cdr u)
      when (setq p (|dbGetDocTable,hn| entry))
        collect p)))
(when comments (cons |$conform| (cons (car comments) code))))
```

defun dbGetDocTable

```
[stringimage p??]
[string2Integer p??]
[dbConstructorDoc p1381]
[qcdr p??]
[hget p1044]
[dbGetDocTable,gn p1384]
[$sig p??]
[$which p??]
[$conform p??]
[$op p??]
```

— defun dbGetDocTable —

```
(defun |dbGetDocTable| (op |$sig| docTable |$which| aux)
  (declare (special |$sig| |$which|))
  (let (doc origin)
    (declare (special |$conform| |$op|))
    (when (and (null (integerp op)) (digitp (elt (setq s (stringimage op)) 0)))
      (setq op (|string2Integer| s)))
    (cond
      ((and (consp aux) (consp (qcar aux)))
        (setq doc (|dbConstructorDoc| (car aux) |$op| |$sig|))
        (setq origin (if (qcdr aux) (cons '|ifp| aux) (car aux)))
        (cons origin doc))
      (t
        (some #'identity
          (loop for x in (hget docTable op)
            collect (|dbGetDocTable,gn| x)))))))
```

defun kTestPred

```

[testBitVector p??]
[simpHasPred p??]
[$predvec p??]
[$domain p??]

— defun kTestPred —

(defun |kTestPred| (n)
  (declare (special |$predvec| |$domain|))
  (cond
    ((eq1 n 0) t)
    (|$domain| (|testBitVector| |$predvec| n))
    (t (|simpHasPred| (elt |$predvec| (1- n))))))

```

defun dbAddChainDomain

```

[dbInfovec p??]
[dbSubConform p1386]
[kFormatSlotDomain p??]
[devaluate p??]
[$infovec p??]

— defun dbAddChainDomain —

(defun |dbAddChainDomain| (conform)
  (let (name args template form)
    (declare (special |$infovec|))
    (setq name (car conform))
    (setq args (cdr conform))
    (setq |$infovec| (|dbInfovec| name))
    (when |$infovec|
      (setq template (elt |$infovec| 0))
      (when (setq form (elt template 5))
        (|dbSubConform| args (|kFormatSlotDomain| (|devaluate| form)))))))

```

defun dbSubConform

```

[position p??]
[dbSubConform p1386]

```

[[\\$FormalMapVariableList p??](#)]

— **defun dbSubConform** —

```
(defun |dbSubConform| (args u)
  (let (n y)
    (declare (special |$FormalMapVariableList|))
    (cond
      ((atom u)
        (if (>= (setq n (|position| u |$FormalMapVariableList|)) 0)
          (elt args n)
          u))
      ((and (consp u) (eq (car u) '|local|) (consp (cdr u)) (eq (cddr u) nil))
        (setq y (cadr u))
        (|dbSubConform| args y))
      (t
        (loop for x in u collect (|dbSubConform| args x))))))
```

—————

defun dbAddChain

[[dbAddChainDomain p1386](#)]

[[dbAddChain p1387](#)]

— **defun dbAddChain** —

```
(defun |dbAddChain| (conform)
  (let (u)
    (when (setq u (|dbAddChainDomain| conform))
      (unless (atom u)
        (cons (cons u t) (|dbAddChain| u))))))
```

—————

75.6 Constructor Page Menu

defun dbShowCons

[[httpProperty p1254](#)]

[[pmTransFilter p??](#)]

[[ifcar p??](#)]

[[dbGetInputString p??](#)]

[[bcErrorPage p??](#)]

```

[constructor? p??]
[superMatch? p??]
[downcase p??]
[stringimage p??]
[emptySearchPage p??]
[htInitPageNoScroll p??]
[htCopyProplist p??]
[httpSetProperty p1254]
[dbShowCons p1387]
[member p1048]
[dbShowCons1 p1389]
[$exposedOnlyIfTrue p??]

```

— defun dbShowCons —

```

(defun |dbShowCons| (&rest args &AUX options key htPage)
  (let (cAlist filter abbrev? conname subject u htPage key options)
    (declare (special |$exposedOnlyIfTrue|))
    (setq htPage (first args))
    (setq key (second args))
    (setq options (cddr args))
    (setq cAlist (|httpProperty| htPage '|cAlist|))
    (cond
      ((eq key '|filter|)
        (setq filter
          (|pmTransFilter| (or (ifcar options) (|dbGetInputString| htPage))))
        (cond
          ((and (consp filter) (eq (car filter) '|error|))
            (|bcErrorPage| filter))
          (t
            (setq abbrev? (eq (|httpProperty| htPage '|exclusion|) '|abbrs|))
            (setq u
              (loop for x in cAlist
                when (progn
                  (setq conname (caar x))
                  (setq subject (if abbrev? (|constructor?| conname) conname))
                  (|superMatch?| filter (downcase (stringimage subject)))))
                collect x))
            (cond
              ((null u)
                (|emptySearchPage| "constructor" filter))
              (t
                (setq htPage (|htInitPageNoScroll| (|htCopyProplist| htPage)))
                (|httpSetProperty| htPage '|cAlist| u)
                (|dbShowCons| htPage (|httpProperty| htPage '|exclusion|))))))
      (when (member key '(|exposureOn| |exposureOff|))
        (setq |$exposedOnlyIfTrue| (eq key '|exposureOn|))
        (setq key (|httpProperty| htPage '|exclusion|)))

```

```
(|dbShowCons1| htPage cAlist key))))))
```

defun conPageChoose

```
[getConstructorForm p??]  
[dbShowCons1 p1389]
```

— defun conPageChoose —

```
(defun |conPageChoose| (conname)  
  (let (cAlist)  
    (setq cAlist (list (cons (|getConstructorForm| conname) t)))  
    (|dbShowCons1| nil cAlist '|names|)))
```

defun dbShowCons1

```
[remdup p??]  
[isExposedConstructor p820]  
[opOf p??]  
[conPage p1343]  
[htpProperty p1254]  
[union p??]  
[dbConstructorKind p??]  
[htCopyProplist p??]  
[htInitPageNoScroll p??]  
[dbConsHeading p1395]  
[htSayStandard p??]  
[htpSetProperty p1254]  
[bcNameConTable p??]  
[bcAbbTable p??]  
[getCDTEntry p??]  
[getdatabase p1010]  
[bcUnixTable p1397]  
[listSort p??]  
[function p??]  
[qlesseqp p??]  
[dbShowConsDoc p1392]  
[isExposedConstructor p820]  
[dbShowConditions p1394]
```

```

[bcConTable p??]
[assocleft p??]
[dbShowConsKinds p??]
[dbConsExposureMessage p1391]
[dbPresentCons p??]
[htShowPageNoScroll p1263]
[$conformsAreDomains p??]
[$exposedOnlyIfTrue p??]

```

— defun dbShowCons1 —

```

(defun |dbShowCons1| (htPage cAlist key)
  (let (|$conformsAreDomains| item conlist kinds a kind
        proplist page u fn y flist result)
    (declare (special |$conformsAreDomains| |$exposedOnlyIfTrue|))
    (setq conlist
      (remdup
        (dolist (x cAlist result)
          (push
            (if |$exposedOnlyIfTrue|
              (|isExposedConstructor| (|opOf| (car x)))
              (car x))
            result))))
    (cond
      ((and (consp conlist) (eq (qcdr conlist) nil))
        (|conPage|
          (if (and htPage (|httpProperty| htPage '|domname|))
            (car conlist)
            (|opOf| (car conlist)))))
      (t
        (setq conlist (loop for x in conlist collect (|opOf| x)))
        (setq kinds
          (apply #'|union|
            (loop for x in conlist collect (|dbConstructorKind| x))))
        (setq kind
          (if (and (consp kinds) (eq (qcdr kinds) nil))
            (qcar kinds)
            '|constructor|))
        (setq proplist (when htPage (|htCopyProplist| htPage)))
        (setq page
          (|htInitPageNoScroll| proplist
            (|dbConsHeading| htPage conlist key kind)))
        (if (setq u (|httpProperty| page '|specialMessage|))
          (apply (car u) (cdr u)))
        (|htSayStandard| "\\beginscroll ")
        (|httpSetProperty| page '|cAlist| cAlist)
        (setq |$conformsAreDomains| (|httpProperty| page '|domname|))
        (cond
          ((eq key '|names|) (|bcNameConTable| conlist))

```

```

((eq key '|abbrs|)
  (|bcAbbTable|
    (loop for con in conlist collect (|getCDTEEntry| con t))))
((eq key '|files|)
  (setq flist
    (for con in conlist collect (getdatabase con 'sourcefile)))
  (|bcUnixTable|
    (|listSort| (|function| glesseqp) (remdup flist))))
((eq key '|documentation|) (|dbShowConsDoc| page conlist))
(t
  (when |$exposedOnlyIfTrue|
    (setq cAlist
      (loop for x in cAlist
        when (|isExposedConstructor| (|opOf| (car x)))
        collect x)))
  (cond
    ((eq key '|conditions|) (|dbShowConditions| page cAlist kind))
    ((eq key '|parameters|)
      (|bcConTable| (remdup (assocleft cAlist))))
    ((eq key '|kinds|) (|dbShowConsKinds| cAlist))))
(|dbConsExposureMessage|)
(|htSayStandard| '|\\endscroll |)
(|dbPresentCons| page kind key)
(|htShowPageNoScroll|))))

```

defun dbConsExposureMessage

```

[htSay p??]
[$atLeastOneUnexposed p??]

```

— defun dbConsExposureMessage —

```

(defun |dbConsExposureMessage| ()
  (declare (special |$atLeastOneUnexposed|))
  (when |$atLeastOneUnexposed|
    (|htSay| "\\newline{}-----\\newline{}{\\em *} = unexposed")))

```

defun dbShowConsKindsFilter

```

[htpSetProperty p1254]
[dbShowCons p1387]

```


[httpProperty p1254]

— defun dbShowConsKindsFilter —

```
(defun |dbShowConsKindsFilter| (htPage args)
  (|httpSetProperty| htPage '|cAlist| (second args))
  (|dbShowCons| htPage (|httpProperty| htPage '|exclusion|)))
```

—————

defun dbShowConsDoc

```
[systemError p??]
[dbShowConsDoc1 p1393]
[getConstructorForm p??]
[opOf p??]
[httpProperty p1254]
[remdup p??]
```

— defun dbShowConsDoc —

```
(defun |dbShowConsDoc| (htPage conlist)
  (labels (
    (fn (cAlist x)
      (let ((index 0))
        (loop while (not (equal (caaar cAlist) x))
          do (setq index (1+ index))
              (setq cAlist (cdr cAlist))
              (unless cAlist (|systemError|)))
        index)))
    (let (index cAlist)
      (cond
        ((null (cdr conlist))
         (|dbShowConsDoc1| htPage
          (|getConstructorForm| (|opOf| (car conlist)) nil))
         (t
          (setq cAlist (|httpProperty| htPage '|cAlist|))
          (loop for x in (remdup conlist) do
            (|dbShowConsDoc1| htPage
             (|getConstructorForm| x) (fn cAlist x))))))))))
```

—————

defun dbShowConsDoc1

```

[member p1048]
[httpProperty p1254]
[get1 p1050]
[displayDomainOp p??]
[isExposedConstructor p820]
[getConstructorDocumentation p1394]
[getConstructorSignature p??]
[getdatabase p1010]
[sublislis p??]
[sublisFormal p??]
[htSaySaturn p??]
[displayDomainOp p??]
[htSaySaturn p??]
[$TriangleVariableList p??]
[$Primitives p??]

```

— defun dbShowConsDoc1 —

```

(defun |dbShowConsDoc1| (htPage conform indexOrNil)
  (let (conargs conname lt1 exposeFlag doc signature sig)
    (declare (special |$TriangleVariableList| |$Primitives|))
    (setq conname (car conform))
    (setq conargs (cdr conform))
    (cond
      ((member conname |$Primitives|)
       (setq conname (|httpProperty| htPage '|conname|))
       (setq lt1 (get1 conname '|documentation|))
       (cond ((eq (caar lt1) '|constructor|) (caar lt1)))
       (cond ((eq (caadar lt1) 'nil) (caadar lt1)))
       (setq doc (car (cdadar lt1)))
       (setq sig '((category domain) (|SetCategory|) (|SetCategory|)))
       (|displayDomainOp| htPage "constructor"
        conform conname sig t doc indexOrNil '|dbSelectCon| nil nil))
      (t
       (setq exposeFlag (|isExposedConstructor| conname))
       (setq doc (list (|getConstructorDocumentation| conname)))
       (setq signature (|getConstructorSignature| conname))
       (setq sig
        (if (eq (getdatabase conname 'constructorkind) '|category|)
            (sublislis conargs |$TriangleVariableList| signature)
            (|sublisFormal| conargs signature)))
       (|htSaySaturn| "\\begin{description}")
       (|displayDomainOp| htPage "constructor" conform conname sig t doc
        indexOrNil '|dbSelectCon| (null exposeFlag) nil)
       (|htSaySaturn| "\\end{description}")))))

```

defun getConstructorDocumentation

```
[lassoc p??]
[getdatabase p1010]
[qcar p??]
[qcaar p??]
[qcdar p??]
[qcadar p??]
```

— defun getConstructorDocumentation —

```
(defun |getConstructorDocumentation| (conname)
  (let (IT1)
    (setq IT1 (lassoc '|constructor| (getdatabase conname 'documentation)))
    (or
     (and (consp IT1) (consp (qcar IT1)) (null (qcaar IT1)) (consp (qcdar IT1))
      (qcadar IT1))
     "")))
```

defun dbSelectCon

```
[conPage p1343]
[opOf p??]
[httpProperty p1254]
```

— defun dbSelectCon —

```
(defun |dbSelectCon| (htPage which index)
  (declare (ignore which))
  (|conPage| (|opOf| (car (elt (|httpProperty| htPage '|cAlist|) index)))))
```

defun dbShowConditions

```
[httpProperty p1254]
[opOf p??]
[splitConTable p??]
[pluralize p??]
```

```
[stringimage p??]
[length p??]
[dbSayItems p??]
[htSaySaturn p??]
[bcConPredTable p??]
[htSayHrule p??]
[dbSayItems p??]
```

— defun dbShowConditions —

```
(defun |dbShowConditions| (htPage cAlist kind)
  (let (conform conname article whichever lt1 consNoPred consPred singular
        plural)
    (setq conform (|httpProperty| htPage '|conform|))
    (setq conname (|opOf| conform))
    (setq article (|httpProperty| htPage '|article|))
    (setq whichever (|httpProperty| htPage '|whichever|))
    (setq lt1 (|splitConTable| cAlist))
    (setq consNoPred (car lt1))
    (setq consPred (cdr lt1))
    (setq singular (list kind " is"))
    (setq plural (list (|pluralize| (stringimage kind)) " are"))
    (|dbSayItems| (|#| consNoPred) singular plural " unconditional")
    (|htSaySaturn| "\\|\\|\\|")
    (|bcConPredTable| consNoPred conname)
    (|htSayHrule|)
    (|dbSayItems| (|#| consPred) singular plural " conditional")
    (|htSaySaturn| "\\|\\|\\|")
    (|bcConPredTable| consPred conname))))
```

—————

defun dbConsHeading

```
[httpProperty p1254]
[length p??]
[remdup p??]
[stringimage p??]
[form2HtString p??]
[capitalize p??]
[pluralize p??]
[member p1048]
[nequal p??]
[$exposedOnlyIfTrue p??]
```

— defun dbConsHeading —

```

(defun |dbConsHeading| (htPage conlist view kind)
  (let (thing place count rank modifier exposureWord firstWord prefix
        placepart connective heading)
    (declare (special |$exposedOnlyIfTrue|))
    (setq thing (or (and htPage (|httpProperty| htPage '|thing|)) "constructor"))
    (setq place
      (when htPage
        (or (|httpProperty| htPage '|domname|) (|httpProperty| htPage '|conform|))))
    (setq count (|#| (remdup conlist)))
    (cond
      ((string= thing "benefactor")
        (list (stringimage count) " Constructors Used by "
              (|form2HtString| place nil t) ))
      (t
        (setq modifier
          (cond
            ((string= thing "argument")
              (setq rank (and htPage (|httpProperty| htPage '|rank|)))
              (list " Possible " rank " "))
            ((eq kind '|constructor|)
              (list " "))
            (t
              (cons " " (|capitalize| (stringimage kind)) " "))))
          (setq exposureWord (when |$exposedOnlyIfTrue| '(" Exposed ")))
          (setq prefix
            (cond
              ((eq count 1)
                (cons (stringimage count)
                  (append modifier (list (|capitalize| thing))))))
              (t
                (setq firstWord (if (eq count 0) "No " (stringimage count)))
                (cons firstWord
                  (append exposureWord
                    (append modifier
                      (list (|capitalize| (|pluralize| thing))))))))))
          (setq placepart
            (when place (list " of {" (|form2HtString| place nil t) '))))
          (setq heading (append prefix placepart))
          (setq connective
            (if (|member| view '(|abbrs| |files| |kinds|)) " as " " with "))
          (cond
            ((and (nequal count 0)
              (|member| view '(|abbrs| |files| |parameters| |conditions|)))
              (setq heading
                (append heading
                  (list " viewed" connective "{" (stringimage view) "}"))))
            (t
              heading))))))

```

defun dbShowConstructorLines

```
[getConstructorForm p??]
[intern p??]
[dbName p??]
[dbShowCons1 p1389]
[listSort p??]
[function p??]
[glesseqp p??]
```

— defun dbShowConstructorLines —

```
(defun |dbShowConstructorLines| (lines)
  (let (cAlist)
    (setq cAlist
      (loop for line in lines
        collect (cons (|getConstructorForm| (|intern| (|dbName| line))) t)))
    (|dbShowCons1| nil (|listSort| (|function| glesseqp) cAlist) '|names|)))
```

—————

defun bcUnixTable

```
[htSay p??]
[htBeginTable p??]
[htSaySaturn p??]
[namestring p1040]
[findfile p??]
[stringimage p??]
[htMakePage p1263]
[htEndTable p??]
```

— defun bcUnixTable —

```
(defun |bcUnixTable| (u)
  (let (firstTime filename)
    (|htSay| "\\newline")
    (|htBeginTable|)
    (setq firstTime t)
    (loop for x in u do
      (if firstTime (setq firstTime nil) (|htSaySaturn| "&"))
      (|htSay| "{")
      (setq filename (namestring ($findfile (stringimage x) "SPAD")))
      (|htMakePage|
        (list
          (list '|text| "\\unixcommand{" (pathname-name x)
```

```

      "){$AXIOM/lib/SPAEDIT " filename "} ")))
    (|htSay| "}")
  (|htEndTable|)))

```

Special Code for Union, Mapping, and Record

defun dbSpecialDescription

```

[getConstructorForm p??]
[form2HtString p??]
[htInitPage p1262]
[htpSetProperty p1254]
[dbShowConsDoc1 p1393]
[htShowPage p1263]
[$conformsAreDomains p??]

```

— defun dbSpecialDescription —

```

(defun |dbSpecialDescription| (conname)
  (let (conform heading page)
    (declare (special |$conformsAreDomains|))
    (setq conform (|getConstructorForm| conname))
    (setq heading
      (list "Description of Domain {\sf " (|form2HtString| conform) "}"))
    (setq page (|htInitPage| heading nil))
    (|htpSetProperty| page '|conname| conname)
    (setq |$conformsAreDomains| nil)
    (|dbShowConsDoc1| page conform nil)
    (|htShowPage|)))

```

defun dbSpecialOperations

```

[htInitPage p1262]
[getConstructorForm p??]
[dbSpecialExpandIfNecessary p1400]
[getl p1050]
[form2HtString p??]
[htpSetProperty p1254]
[dbShowOp1 p??]

```

— defun dbSpecialOperations —

```
(defun |dbSpecialOperations| (conname)
  (let (page conform opAlist fromHeading)
    (setq page (|htInitPage| nil nil))
    (setq conform (|getConstructorForm| conname))
    (setq opAlist
      (|dbSpecialExpandIfNecessary| conform
        (cdr (getl conname '|documentation|))))
    (setq fromHeading (list " from domain {\sf " (|form2HtString| conform) "}"))
    (|httpSetProperty| page '|fromHeading| fromHeading)
    (|httpSetProperty| page '|conform| conform)
    (|httpSetProperty| page '|opAlist| opAlist)
    (|httpSetProperty| page '|noUsage| t)
    (|httpSetProperty| page '|condition?| '|no|)
    (|dbShowOp1| page opAlist "operation" '|names|)))
```

defun dbSpecialExports

```
[getConstructorForm p??]
[|htInitPage| p1262]
[form2HtString p??]
[dbSpecialExpandIfNecessary p1400]
[getl p1050]
[kePageDisplay p1354]
[htShowPage p1263]
```

— defun dbSpecialExports —

```
(defun |dbSpecialExports| (conname)
  (let (conform page opAlist)
    (setq conform (|getConstructorForm| conname))
    (setq page
      (|htInitPage| (list "Exports of {\sf " (|form2HtString| conform) "}")))
    (setq opAlist
      (|dbSpecialExpandIfNecessary| conform
        (cdr (getl conname '|documentation|))))
    (|kePageDisplay| page "operation" opAlist)
    (|htShowPage|)))
```


defun dbSpecialExpandIfNecessary

```
[qcar p??]
[qcdar p??]
[qcadar p??]
[qcdr p??]
```

— defun dbSpecialExpandIfNecessary —

```
(defun |dbSpecialExpandIfNecessary| (conform opAlist)
  (if (and (consp opAlist) (consp (qcar opAlist)) (consp (qcdar opAlist))
        (consp (qcadar opAlist)) (cdr (qcdr (qcadar opAlist)))))
    opAlist
    (dolist (item opAlist)
      (dolist (pair (cdr item))
        (rplacd pair (list t conform t (second pair))))))
  opAlist)
```

—————

— initvars —

```
(defvar message1 (concatenate 'string
  "{\\sf Record(a:A,b:B)} is used to create the class of pairs of objects "
  "made up of a value of type {\\em A} selected by the symbol {\\em a} and "
  "a value of type {\\em B} selected by the symbol {\\em b}. "
  "In general, the {\\sf Record} constructor can take any number of arguments "
  "and thus can be used to create aggregates of heterogeneous components of "
  "arbitrary size selectable by name. "
  "{\\sf Record} is a primitive domain of Axiom which cannot be "
  "defined in the Axiom language."))
```

—————

— postvars —

```
(eval-when (eval load)
  (put '|Record| '|documentation|
    (subst message1 'message
      '(((|constructor| (nil message))
        (= (((|Boolean|) $ $)
          "\\spad{r = s} tests for equality of two records \\spad{r} and \\spad{s}"))
        (|coerce| (((|OutputForm|) $)
          "\\spad{coerce(r)} returns an representation of \\spad{r} as an output form")
        (($ (|List| (|Any|)))
```

```

      ,(concatenate 'string
"\spad{coerce(u)}, where \spad{u} is the list \spad{[x,y]} for \spad{x} "
"of type \spad{A} and \spad{y} of type \spad{B}, returns the record "
"\spad{[a:x,b:y]}"))
      (|elt| ((A $ "a")
      ,(concatenate 'string
"\spad{r . a} returns the value stored in record \spad{r} under "
"selector \spad{a}.")
      ((B $ "b")
      ,(concatenate 'string
"\spad{r . b} returns the value stored in record \spad{r} "
"under selector \spad{b}.")
      (|setelt| ((A $ "a" A)
      ,(concatenate 'string
"\spad{r . a := x} destructively replaces the value stored in "
"record \spad{r} under selector \spad{a} by the value of \spad{x}. "
"Error: if \spad{r} has not been previously assigned a value."))
      ((B $ "b" B)
      ,(concatenate 'string
"\spad{r . b := y} destructively replaces the value stored in "
"record \spad{r} under selector \spad{b} by the value of \spad{y}. "
"Error: if \spad{r} has not been previously assigned a value.))))
      :test #'equal)))

```

— initvars —

```

(defvar message2 (concatenate 'string
"\sf Union(A,B)} denotes the class of objects which are either "
"members of domain {\em A} or of domain {\em B}. The {\sf Union} "
"constructor can take any number of arguments. "
"For an alternate form of {\sf Union} with \"tags\", see "
"\downlink{Union(a:A,b:B)}{DomainUnion}. {\sf Union} is a primitive "
"domain of Axiom which cannot be defined in the Axiom language.))

```

— postvars —

```

(eval-when (eval load)
(put '|UntaggedUnion| '|documentation|
(subst message2 'message
'(|constructor| (nil message))
(= (|Boolean|) $ $)
,(concatenate 'string

```

```

"\spad{u = v} tests if two objects of the union are equal, "
"that is, u and v are hold objects of same branch which are equal.)))
  ((|case| (((|Boolean|) $ "A")
    ,(concatenate 'string
"\spad{u case A} tests if \spad{u} is of the type \spad{A} "
"branch of the union.)))
    (((|Boolean|) $ "B")
    ,(concatenate 'string
"\spad{u case B} tests if \spad{u} is of the \spad{B} branch "
"of the union.)))
    (|coerce| ((A $)
    ,(concatenate 'string
"\spad{coerce(u)} returns \spad{x} of type \spad{A} if "
"\spad{x} is of the \spad{A} branch of the union. "
"Error: if \spad{u} is of the \spad{B} branch of the union.)))
    ((B $)
    ,(concatenate 'string
"\spad{coerce(u)} returns \spad{x} of type \spad{B} if "
"\spad{x} is of the \spad{B} branch of the union. "
"Error: if \spad{u} is of the \spad{A} branch of the union.)))
    (($ A)
    ,(concatenate 'string
"\spad{coerce(x)}, where \spad{x} has type \spad{A}, "
"returns \spad{x} as a union type.)))
    (($ B)
    ,(concatenate 'string
"\spad{coerce(y)}, where \spad{y} has type \spad{B}, "
"returns \spad{y} as a union type.))))
:test #'equal)))

```

— initvars —

```

(defvar message3 (concatenate 'string
"{\sf Union(a:A,b:B)} denotes the class of objects which are either "
"members of domain {\em A} or of domain {\em B}. "
"The symbols {\em a} and {\em b} are called \"tags\" and are used to "
"identify the two \"branches\" of the union. "
"The {\sf Union} constructor can take any number of arguments and has an "
"alternate form without {\em tags} "
"(see \downlink{Union(A,B)}{UntaggedUnion}). "
"This tagged {\sf Union} type is necessary, for example, to disambiguate "
"two branches of a union where {\em A} and {\em B} denote the same type. "
"{\sf Union} is a primitive domain of Axiom which cannot be "
"defined in the Axiom language.))

```

— postvars —

```
(eval-when (eval load)
(put '|Union| '|documentation|
  (subst message3 'message
    '((|constructor| (NIL MESSAGE))
      (= ((|Boolean|) $ $)
        , (concatenate 'string
          "\\spad{u = v} tests if two objects of the union are equal, that "
          "is, \\spad{u} and \\spad{v} are objects of same branch which are equal.)))
      (|case| (((|Boolean|) $ "A")
        "\\spad{u case a} tests if \\spad{u} is of branch \\spad{a} of the union."
        (((|Boolean|) $ "B")
          "\\spad{u case b} tests if \\spad{u} is of branch \\spad{b} of the union.)))
      (|coerce| ((A $)
        , (concatenate 'string
          "\\spad{coerce(u)} returns \\spad{x} of type \\spad{A} if "
          "\\spad{x} is of branch \\spad{a} of the union. "
          "Error: if \\spad{u} is of branch \\spad{b} of the union.)))
        ((B $)
          , (concatenate 'string
            "\\spad{coerce(u)} returns \\spad{x} of type \\spad{B} if "
            "\\spad{x} is of branch \\spad{b} branch of the union. "
            "Error: if \\spad{u} is of the \\spad{a} branch of the union.)))
          (($ A)
            , (concatenate 'string
              "\\spad{coerce(x)}, where \\spad{x} has type \\spad{A}, returns "
              "\\spad{x} as a union type.)))
            (($ B)
              , (concatenate 'string
                "\\spad{coerce(y)}, where \\spad{y} has type \\spad{B}, returns "
                "\\spad{y} as a union type.))))))
:test #'equal)))
```

— initvars —

```
(defvar message4 (concatenate 'string
  "{\\sf Mapping(T,S,...)} denotes the class of objects which are mappings from "
  "a source domain ({\\em S,...}) into a target domain {\\em T}. The "
  "{\\sf Mapping} constructor can take any number of arguments."
  " All but the first argument is regarded as part of a source tuple for the "
  "mapping. For example, {\\sf Mapping(T,A,B)} denotes the class of mappings "
  "from {\\em (A,B)} into {\\em T}. "
```

```
"{\sf Mapping} is a primitive domain of Axiom which cannot be defined in "
"the Axiom language."))
```

— postvars —

```
(eval-when (eval load)
  (put '|Mapping| '|documentation|
    (subst message4 'message
      '((|constructor| (NIL MESSAGE))
        (= (((|Boolean|) $ $)
          "\spad{u = v} tests if mapping objects are equal.")))
    :test #'equal)))
```

— initvars —

```
(defvar message5 (concatenate 'string
  "{\em Enumeration(a1, a2 ,..., aN)} creates an object which is exactly one "
  "of the N symbols {\em a1}, {\em a2}, ..., or {\em aN}, N > 0. "
  " The {\em Enumeration} can constructor can take any number of symbols as "
  "arguments."))
```

— postvars —

```
(eval-when (eval load)
  (put '|Enumeration| '|documentation|
    (subst message5 'message
      '((|constructor| (nil message))
        (= (((|Boolean|) $ $)
          , (concatenate 'string
            "\spad{e = f} tests for equality of two enumerations \spad{e} "
            "and \spad{f}"))
          (^= (((|Boolean|) $ $)
            , (concatenate 'string
              "\spad{e ^= f} tests that two enumerations \spad{e} and "
              "\spad{f} are not equal"))
            (|coerce| (((|OutputForm|) $)
              , (concatenate 'string
```

```
"\spad{coerce(e)} returns a representation of enumeration "
"\spad{r} as an output form"))
  (($ (|Symbol|))
    ,(concatenate 'string
"\spad{coerce(s)} converts a symbol \spad{s} into an "
"enumeration which has \spad{s} as a member symbol"))))
:test #'equal)))
```

defun mkConArgSublis

```
[pname p1045]
[maxindex p??]
[digitp p1045]
[digits2Names p1405]
```

— defun mkConArgSublis —

```
(defun |mkConArgSublis| (args)
  (loop for arg in args
    when
      (and
        (setq s (pname arg))
        (some #'identity
          (loop for i from 0 to (maxindex s)
            collect (digitp (elt s i))))))
    collect (cons arg (intern (|digits2Names| (pname arg))))))
```

This is necessary since arguments of conforms CANNOT have digits in TechExplorer. Since Saturn is gone we can remove it.

defun digits2Names

```
[digit-char-p p??]
[concat p1047]
```

— defun digits2Names —

```
(defun |digits2Names| (s)
  (let (str c n segment)
    (setq str "")
    (for i from 0 to (maxindex s) do
```

```

(setq c (elt s i))
(setq segment
  (cond
    ((setq n (digit-char-p c))
      (elt
        '("Zero" "One" "Two" "Three" "Four" "Five" "Six" "Seven" "Eight" "Nine")
        n))
    (t c)))
(concat str segment))
str))

```

defun lefts

[hkeys p1044]
 [hascategory-hash p??]

— defun lefts —

```

(defun |lefts| (u)
  (let (keys)
    (setq keys (hkeys *hascategory-hash*))
    (loop for x in keys when (equal (cdr x) u) collect x)))

```

Build Library Database (libdb.text,...)

defun dbMkForm

— defun dbMkForm —

```

(defun |dbMkForm| (x)
  (or (and (atom x) (cons x nil)) x))

```

defun libConstructorSig

[getdatabase p1010]
 [take p??]

```
[length p??]
[sublislis p??]
[form2LispString p??]
[ncParseFromString p1067]
[sayBrightly p??]
[$TriangleVariableList p??]
```

— defun libConstructorSig —

```
(defun |libConstructorSig| (arg)
  (labels (
    (fn (x)
      (cond
        ((atom x) x)
        ((and (consp x) (eq (qcar x) '|Join|) (consp (qcdr x)))
          (list '|Join| (fn (qcadr x)) '|etc|'))
        ((and (consp x) (eq (qcar x) 'category))
          '|etc|)
        (t
          (loop for y in x collect (fn y))))))
    (g (x u i)
      "does x appear in any but i-th element of u?"
      (some #'identity
        (loop for y in u for j from 1
          when (not (= i j))
            collect (contained x y))))))
  (let (conname argl formals keys sig sigpart)
    (declare (special |$TriangleVariableList|))
    (setq conname (car arg))
    (setq argl (cdr arg))
    (setq sig (cdar (getdatabase conname 'constructormodemap)))
    (setq formals (take (|#| argl) |$FormalMapVariableList|))
    (setq sig (sublislis formals |$TriangleVariableList| sig))
    (setq keys
      (loop for f in formals for i from 1
        collect (g f sig i)))
    (setq sig
      (fn (sublislis argl |$FormalMapVariableList| sig)))
    (setq sig (cons (car sig)
      (loop for a in argl for s in (cdr sig) for k in keys
        collect (if k (list #\: a s) s))))
    (setq sigpart (|form2LispString| (cons '|Mapping| sig)))
    (unless (|ncParseFromString| sigpart)
      (|sayBrightly| (list "Won't parse: " sigpart)))
    sigpart)))
```

—————

Chapter 76

The Interpreter

— Interpreter —

```
(setq *print-array* nil)
(setq *print-circle* nil)
(setq *print-pretty* nil)

(in-package "BOOT")
\getchunk{initvars}

;;; level 0 macros

\getchunk{defmacro bit-to-truth 0}
\getchunk{defmacro bvec-elt 0}
\getchunk{defmacro idChar? 0}
\getchunk{defmacro identp 0}
\getchunk{defmacro qsabsval 0}
\getchunk{defmacro qsadd1 0}
\getchunk{defmacro qsdifference 0}
\getchunk{defmacro qslessp 0}
\getchunk{defmacro qsmax 0}
\getchunk{defmacro qsmin 0}
\getchunk{defmacro qsminus 0}
\getchunk{defmacro qsoddp 0}
\getchunk{defmacro qsplus 0}
\getchunk{defmacro qssub1 0}
\getchunk{defmacro qstimes 0}
\getchunk{defmacro qszerop 0}
\getchunk{defmacro spadConstant 0}

;;; above level 0 macros
```

```
\getchunk{defmacro ancotsU8}  
\getchunk{defmacro ancotsU16}  
\getchunk{defmacro ancotsU32}  
\getchunk{defmacro anrowsU8}  
\getchunk{defmacro anrowsU16}  
\getchunk{defmacro anrowsU32}  
\getchunk{defmacro aref2U8}  
\getchunk{defmacro aref2U16}  
\getchunk{defmacro aref2U32}  
\getchunk{defmacro assq}  
\getchunk{defmacro bvec-setelt}  
\getchunk{defmacro bvec-size}  
\getchunk{defmacro cdaref2}  
\getchunk{defmacro cdelt}  
\getchunk{defmacro cdlen}  
\getchunk{defmacro cdancots}  
\getchunk{defmacro cdanrows}  
\getchunk{defmacro cdsetaref2}  
\getchunk{defmacro cdsetelt}  
\getchunk{defmacro danrows}  
\getchunk{defmacro dancots}  
\getchunk{defmacro daref2}  
\getchunk{defmacro delt}  
\getchunk{defmacro DFAdd}  
\getchunk{defmacro DFAcos}  
\getchunk{defmacro DFAcosh}  
\getchunk{defmacro DFAsin}  
\getchunk{defmacro DFAsinh}  
\getchunk{defmacro DFAtan}  
\getchunk{defmacro DFAtan2}  
\getchunk{defmacro DFAtanh}  
\getchunk{defmacro DFCos}  
\getchunk{defmacro DFCosh}  
\getchunk{defmacro DFDivide}  
\getchunk{defmacro DFEql}  
\getchunk{defmacro DFExp}  
\getchunk{defmacro DFExpt}  
\getchunk{defmacro DFIntegerDivide}  
\getchunk{defmacro DFIntegerExpt}  
\getchunk{defmacro DFIntegerMultiply}  
\getchunk{defmacro DFLessThan}  
\getchunk{defmacro DFLog}  
\getchunk{defmacro DFLogE}  
\getchunk{defmacro DFMax}  
\getchunk{defmacro DFMin}  
\getchunk{defmacro DFMinusp}  
\getchunk{defmacro DFMultiply}  
\getchunk{defmacro DFSin}  
\getchunk{defmacro DFSinh}  
\getchunk{defmacro DFSqrt}
```

```

\getchunk{defmacro DFSubtract}
\getchunk{defmacro DFTan}
\getchunk{defmacro DFTanh}
\getchunk{defmacro DFUnaryMinus}
\getchunk{defmacro DFZerop}
\getchunk{defmacro dlen}
\getchunk{defmacro dsetaref2}
\getchunk{defmacro dsetelt}
\getchunk{defmacro eltU8}
\getchunk{defmacro eltU16}
\getchunk{defmacro eltU32}
\getchunk{defmacro funfind}
\getchunk{defmacro hget}
\getchunk{defmacro make-cdouble-matrix}
\getchunk{defmacro make-cdouble-vector}
\getchunk{defmacro make-double-matrix}
\getchunk{defmacro make-double-matrix1}
\getchunk{defmacro make-double-vector}
\getchunk{defmacro make-double-vector1}
\getchunk{defmacro makeMatrixU8}
\getchunk{defmacro makeMatrixU16}
\getchunk{defmacro makeMatrixU16}
\getchunk{defmacro makeMatrixU32}
\getchunk{defmacro makeMatrixU32}
\getchunk{defmacro qsDot26432}
\getchunk{defmacro qsDot2Mod6432}
\getchunk{defmacro qsMod6432}
\getchunk{defmacro qsMulAdd6432}
\getchunk{defmacro qsMulAddMod6432}
\getchunk{defmacro qsMul6432}
\getchunk{defmacro qsMulMod32}
\getchunk{defmacro qvlenU8}
\getchunk{defmacro qvlenU16}
\getchunk{defmacro qvlenU32}
\getchunk{defmacro Rest}
\getchunk{defmacro startsId?}
\getchunk{defmacro setAref2U8}
\getchunk{defmacro setAref2U16}
\getchunk{defmacro setAref2U32}
\getchunk{defmacro seteltU8}
\getchunk{defmacro seteltU16}
\getchunk{defmacro seteltU32}
\getchunk{defmacro trapNumericErrors}
\getchunk{defmacro truth-to-bit}
\getchunk{defmacro while}
\getchunk{defmacro whileWithResult}

```

```
;;; layer 0 (all common lisp)
```

```

\getchunk{defun acot 0}
\getchunk{defun acoth 0}
\getchunk{defun acsc 0}
\getchunk{defun acsch 0}
\getchunk{defun asec 0}
\getchunk{defun asech 0}
\getchunk{defun axiomVersion 0}

\getchunk{defun BooleanEquality 0}
\getchunk{defun bvec-and 0}
\getchunk{defun bvec-concat 0}
\getchunk{defun bvec-copy 0}
\getchunk{defun bvec-equal 0}
\getchunk{defun bvec-greater 0}
\getchunk{defun bvec-make-full 0}
\getchunk{defun bvec-nand 0}
\getchunk{defun bvec-nor 0}
\getchunk{defun bvec-not 0}
\getchunk{defun bvec-or 0}
\getchunk{defun bvec-xor 0}

\getchunk{defun cleanupLine 0}
\getchunk{defun clearMacroTable 0}
\getchunk{defun concat 0}
\getchunk{defun cot 0}
\getchunk{defun coth 0}
\getchunk{defun createCurrentInterpreterFrame 0}
\getchunk{defun credits 0}
\getchunk{defun csc 0}
\getchunk{defun csch 0}

\getchunk{defun Delay 0}
\getchunk{defun desiredMsg 0}
\getchunk{defun DirToString 0}
\getchunk{defun divide2 0}
\getchunk{defun dqAppend 0}
\getchunk{defun dqToList 0}
\getchunk{defun dqUnit 0}

\getchunk{defun emptyInterpreterFrame 0}

\getchunk{defun fin 0}
\getchunk{defun findFrameInRing 0}
\getchunk{defun flatten 0}
\getchunk{defun fnameExists? 0}
\getchunk{defun fnameName 0}
\getchunk{defun fnameReadable? 0}
\getchunk{defun fnameType 0}
\getchunk{defun frameExposureData 0}
\getchunk{defun frameHiFiAccess 0}

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\getchunk{defun frameHistList 0}
\getchunk{defun frameHistListAct 0}
\getchunk{defun frameHistListLen 0}
\getchunk{defun frameHistoryTable 0}
\getchunk{defun frameHistRecord 0}
\getchunk{defun frameInteractive 0}
\getchunk{defun frameIOIndex 0}
\getchunk{defun frameName 0}
\getchunk{defun frameNames 0}
\getchunk{defun From 0}
\getchunk{defun FromTo 0}

\getchunk{defun get-current-directory 0}
\getchunk{defun getenviron 0}
\getchunk{defun getl 0}
\getchunk{defun getLinePos 0}
\getchunk{defun getLineText 0}
\getchunk{defun getMsgArgL 0}
\getchunk{defun getMsgKey 0}
\getchunk{defun getMsgKey? 0}
\getchunk{defun getMsgPrefix 0}
\getchunk{defun getMsgPosTagOb 0}
\getchunk{defun getMsgPrefix? 0}
\getchunk{defun getMsgTag 0}
\getchunk{defun getMsgTag? 0}
\getchunk{defun getMsgText 0}
\getchunk{defun getParserMacroNames 0}
\getchunk{defun getPreStL 0}

\getchunk{defun hasOptArgs? 0}

\getchunk{defun incActive? 0}
\getchunk{defun incCommand? 0}
\getchunk{defun incDrop 0}
\getchunk{defun incHandleMessage 0}
\getchunk{defun inclmsgConsole 0}
\getchunk{defun inclmsgFinSkipped 0}
\getchunk{defun inclmsgPrematureEOF 0}
\getchunk{defun inclmsgCmdBug 0}
\getchunk{defun inclmsgIfBug 0}
\getchunk{defun incPrefix? 0}
\getchunk{defun init-memory-config 0}
\getchunk{defun insertPos 0}
\getchunk{defun integer-decode-float-denominator 0}
\getchunk{defun integer-decode-float-exponent 0}
\getchunk{defun integer-decode-float-sign 0}
\getchunk{defun integer-decode-float-numerator 0}
\getchunk{defun intloopPrefix? 0}
\getchunk{defun isIntegerString 0}

```

```

\getchunk{defun keyword 0}
\getchunk{defun keyword? 0}

\getchunk{defun lfcomment 0}
\getchunk{defun lferror 0}
\getchunk{defun lffloat 0}
\getchunk{defun lfid 0}
\getchunk{defun lfinteger 0}
\getchunk{defun lfnegcomment 0}
\getchunk{defun lfrinteger 0}
\getchunk{defun lfspaces 0}
\getchunk{defun lfstring 0}
\getchunk{defun lnCreate 0}
\getchunk{defun lnExtraBlanks 0}
\getchunk{defun lnFileName? 0}
\getchunk{defun lnGlobalNum 0}
\getchunk{defun lnImmediate? 0}
\getchunk{defun lnLocalNum 0}
\getchunk{defun lnPlaceOfOrigin 0}
\getchunk{defun lnSetGlobalNum 0}
\getchunk{defun lnString 0}

\getchunk{defun macODefine 0}
\getchunk{defun macOInfiniteExpansion,name 0}
\getchunk{defun make-absolute-filename 0}
\getchunk{defun makeByteWordVec2 0}
\getchunk{defun makeInitialModemapFrame 0}
\getchunk{defun manexp 0}
\getchunk{defun member 0}
\getchunk{defun monitor-add 0}
\getchunk{defun monitor-apropos 0}
\getchunk{defun monitor-autoload 0}
\getchunk{defun monitor-checkpoint 0}
\getchunk{defun monitor-decr 0}
\getchunk{defun monitor-delete 0}
\getchunk{defun monitor-dirname 0}
\getchunk{defun monitor-disable 0}
\getchunk{defun monitor-enable 0}
\getchunk{defun monitor-end 0}
\getchunk{defun monitor-exposedp 0}
\getchunk{defun monitor-file 0}
\getchunk{defun monitor-help 0}
\getchunk{defun monitor-incr 0}
\getchunk{defun monitor-info 0}
\getchunk{defun monitor-inittable 0}
\getchunk{defun monitor-libname 0}
\getchunk{defun monitor-nrlib 0}
\getchunk{defun monitor-parse 0}
\getchunk{defun monitor-percent 0}
\getchunk{defun monitor-readinterp 0}

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\getchunk{defun monitor-report 0}
\getchunk{defun monitor-reset 0}
\getchunk{defun monitor-restore 0}
\getchunk{defun monitor-results 0}
\getchunk{defun monitor-spadfile 0}
\getchunk{defun monitor-tested 0}
\getchunk{defun monitor-untested 0}
\getchunk{defun monitor-write 0}

\getchunk{defun ncError 0}
\getchunk{defun ncloopEscaped 0}
\getchunk{defun ncloopPrefix? 0}
\getchunk{defun ncloopPrintLines 0}
\getchunk{defun nonBlank 0}
\getchunk{defun npAnyNo 0}
\getchunk{defun npboot 0}
\getchunk{defun npEqPeek 0}
\getchunk{defun nplisp 0}
\getchunk{defun npPop1 0}
\getchunk{defun npPop2 0}
\getchunk{defun npPop3 0}
\getchunk{defun npPush 0}

\getchunk{defun opTran 0}

\getchunk{defun pfAndLeft 0}
\getchunk{defun pfAndRight 0}
\getchunk{defun pfAppend 0}
\getchunk{defun pfApplicationArg 0}
\getchunk{defun pfApplicationOp 0}
\getchunk{defun pfAssignLhsItems 0}
\getchunk{defun pf0AssignLhsItems 0}
\getchunk{defun pfAssignRhs 0}
\getchunk{defun pfBreakFrom 0}
\getchunk{defun pfCoercetoExpr 0}
\getchunk{defun pfCoercetoType 0}
\getchunk{defun pfCollectBody 0}
\getchunk{defun pfCollectIterators 0}
\getchunk{defun pfDefinitionLhsItems 0}
\getchunk{defun pfDefinitionRhs 0}
\getchunk{defun pfDoBody 0}
\getchunk{defun pfExitCond 0}
\getchunk{defun pfExitExpr 0}
\getchunk{defun pfFirst 0}
\getchunk{defun pfFreeItems 0}
\getchunk{defun pfForinLhs 0}
\getchunk{defun pfForinWhole 0}
\getchunk{defun pfFromdomDomain 0}
\getchunk{defun pfFromdomWhat 0}
\getchunk{defun pfIfCond 0}

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\getchunk{defun pfIfElse 0}
\getchunk{defun pfIfThen 0}
\getchunk{defun pfLambdaArgs 0}
\getchunk{defun pfLambdaBody 0}
\getchunk{defun pfLambdaRets 0}
\getchunk{defun pfLiteral? 0}
\getchunk{defun pfLocalItems 0}
\getchunk{defun pfLoopIterators 0}
\getchunk{defun pfMacroLhs 0}
\getchunk{defun pfMacroRhs 0}
\getchunk{defun pfMLambdaArgs 0}
\getchunk{defun pfMLambdaBody 0}
\getchunk{defun pfNotArg 0}
\getchunk{defun pfNoValueExpr 0}
\getchunk{defun pfOrLeft 0}
\getchunk{defun pfOrRight 0}
\getchunk{defun pfParts 0}
\getchunk{defun pfPile 0}
\getchunk{defun pfPretendExpr 0}
\getchunk{defun pfPretendType 0}
\getchunk{defun pfRestrictExpr 0}
\getchunk{defun pfRestrictType 0}
\getchunk{defun pfReturnExpr 0}
\getchunk{defun pfRuleLhsItems 0}
\getchunk{defun pfRuleRhs 0}
\getchunk{defun pfSecond 0}
\getchunk{defun pfSequenceArgs 0}
\getchunk{defun pfSuchthatCond 0}
\getchunk{defun pfTaggedExpr 0}
\getchunk{defun pfTaggedTag 0}
\getchunk{defun pfTree 0}
\getchunk{defun pfTypedId 0}
\getchunk{defun pfTypedType 0}
\getchunk{defun pfTupleParts 0}
\getchunk{defun pfWhereContext 0}
\getchunk{defun pfWhereExpr 0}
\getchunk{defun pfWhileCond 0}
\getchunk{defun pmDontQuote? 0}
\getchunk{defun poCharPosn 0}
\getchunk{defun poGetLineObject 0}
\getchunk{defun poNopos? 0}
\getchunk{defun poNoPosition 0}
\getchunk{defun poNoPosition? 0}
\getchunk{defun printAsTeX 0}
\getchunk{defun pname 0}

\getchunk{defun qenum 0}
\getchunk{defun qsquotient 0}
\getchunk{defun qsremainder 0}
\getchunk{defun quotient2 0}

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\getchunk{defun random 0}
\getchunk{defun rdigit? 0}
\getchunk{defun reclaim 0}
\getchunk{defun remainder2 0}
\getchunk{defun remLine 0}
\getchunk{defun rep 0}
\getchunk{defun resetStackLimits 0}

\getchunk{defun sameUnionBranch 0}
\getchunk{defun satisfiesUserLevel 0}
\getchunk{defun scanCloser? 0}
\getchunk{defun sec 0}
\getchunk{defun sech 0}
\getchunk{defun setCurrentLine 0}
\getchunk{defun setMsgPrefix 0}
\getchunk{defun setMsgText 0}
\getchunk{defun set-restart-hook 0}
\getchunk{defun showMsgPos? 0}
\getchunk{defun StreamNull 0}
\getchunk{defun stripLisp 0}
\getchunk{defun stripSpaces 0}

\getchunk{defun theid 0}
\getchunk{defun thefname 0}
\getchunk{defun theorigin 0}
\getchunk{defun tokPart 0}
\getchunk{defun To 0}
\getchunk{defun Top? 0}
\getchunk{defun trademark 0}

\getchunk{defun zeroOneTran 0}

;;; above level 0

\getchunk{defun abbQuery}
\getchunk{defun abbreviations}
\getchunk{defun abbreviationsSpad2Cmd}
\getchunk{defun addBinding}
\getchunk{defun addBindingInteractive}
\getchunk{defun addInputLibrary}
\getchunk{defun addNewInterpreterFrame}
\getchunk{defun addoperations}
\getchunk{defun addTraceItem}
\getchunk{defun algCoerceInteractive}
\getchunk{defun allConstructors}
\getchunk{defun allOperations}
\getchunk{defun alqlGetOrigin}
\getchunk{defun alqlGetParams}
\getchunk{defun alqlGetKindString}

```

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\getchunk{defun alreadyOpened?}
\getchunk{defun apropos}
\getchunk{defun assertCond}
\getchunk{defun augmentHasArgs}
\getchunk{defun augmentTraceNames}

\getchunk{defun basicLookup}
\getchunk{defun basicLookupCheckDefaults}
\getchunk{defun basicStringize}
\getchunk{defun bcComplexLimit}
\getchunk{defun bcComplexLimitGen}
\getchunk{defun bcCreateVariableString}
\getchunk{defun bcDefiniteIntegrate}
\getchunk{defun bcDefiniteIntegrateGen}
\getchunk{defun bcDifferentiate}
\getchunk{defun bcDifferentiateGen}
\getchunk{defun bcDraw}
\getchunk{defun bcDrawIt}
\getchunk{defun bcDrawIt2}
\getchunk{defun bcDraw2Dfun}
\getchunk{defun bcDraw2DfunGen}
\getchunk{defun bcDraw2Dpar}
\getchunk{defun bcDraw2DparGen}
\getchunk{defun bcDraw2DSolve}
\getchunk{defun bcDraw2DSolveGen}
\getchunk{defun bcDraw3Dfun}
\getchunk{defun bcDraw3DfunGen}
\getchunk{defun bcDraw3Dpar}
\getchunk{defun bcDraw3DparGen}
\getchunk{defun bcDraw3Dpar1}
\getchunk{defun bcDraw3Dpar1Gen}
\getchunk{defun bcError}
\getchunk{defun bcFindString}
\getchunk{defun bcFinish}
\getchunk{defun bcGen}
\getchunk{defun bcGenEquations}
\getchunk{defun bcGenExplicitMatrix}
\getchunk{defun bcHt}
\getchunk{defun bcHtMakeButton}
\getchunk{defun bcIndefiniteIntegrate}
\getchunk{defun bcIndefiniteIntegrateGen}
\getchunk{defun bcInputEquations}
\getchunk{defun bcInputEquationsEnd}
\getchunk{defun bcInputExplicitMatrix}
\getchunk{defun bcInputMatrixByFormula}
\getchunk{defun bcInputMatrixByFormulaGen}
\getchunk{defun bcInputSolveInfo}
\getchunk{defun bcIssueHt}
\getchunk{defun bcLaurentSeries}
\getchunk{defun bcLaurentSeriesGen}

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\getchunk{defun bcLimit}
\getchunk{defun bcLinearExtractMatrix}
\getchunk{defun bcLinearMatrixGen}
\getchunk{defun bcLinearSolve}
\getchunk{defun bcLinearSolveEqns}
\getchunk{defun bcLinearSolveEqns1}
\getchunk{defun bcLinearSolveEqnsGen}
\getchunk{defun bcLinearSolveMatrix}
\getchunk{defun bcLinearSolveMatrix1}
\getchunk{defun bcLinearSolveMatrixHomo}
\getchunk{defun bcLinearSolveMatrixInhomo}
\getchunk{defun bcLinearSolveMatrixInhomoGen}
\getchunk{defun bcMatrix}
\getchunk{defun bcMatrixGen}
\getchunk{defun bcMakeEquations}
\getchunk{defun bcMakeLinearEquations}
\getchunk{defun bcMakeUnknowns}
\getchunk{defun bcMkFunction}
\getchunk{defun bcNotReady}
\getchunk{defun bcOptional}
\getchunk{defun bcProduct}
\getchunk{defun bcProductGen}
\getchunk{defun bcPuisseuxSeries}
\getchunk{defun bcPuisseuxSeriesGen}
\getchunk{defun bcReadMatrix}
\getchunk{defun bcRealLimit}
\getchunk{defun bcRealLimitGen}
\getchunk{defun bcRealLimitGen1}
\getchunk{defun bcSadFaces}
\getchunk{defun bcSeries}
\getchunk{defun bcSeriesByFormula}
\getchunk{defun bcSeriesByFormulaGen}
\getchunk{defun bcSeriesExpansion}
\getchunk{defun bcSeriesExpansionGen}
\getchunk{defun bcSeriesGen}
\getchunk{defun bcSolve}
\getchunk{defun bcSolveEquations}
\getchunk{defun bcSolveEquationsNumerically}
\getchunk{defun bcSolveNumerically1}
\getchunk{defun bcSolveSingle}
\getchunk{defun bcString2HyString}
\getchunk{defun bcString2HyString2}
\getchunk{defun bcString2WordList}
\getchunk{defun bcSystemSolveEqns1}
\getchunk{defun bcSum}
\getchunk{defun bcSumGen}
\getchunk{defun bcSystemSolve}
\getchunk{defun bcTaylorSeries}
\getchunk{defun bcTaylorSeriesGen}
\getchunk{defun bcUnixTable}

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\getchunk{defun bcVectorGen}
\getchunk{defun bcvspace}
\getchunk{defun bcwords2liststring}
\getchunk{defun beforeAfter}
\getchunk{defun bracketString}
\getchunk{defun break}
\getchunk{defun breaklet}
\getchunk{defun brightprint}
\getchunk{defun brightprint-0}
\getchunk{defun browse}
\getchunk{defun browseOpen}
\getchunk{defun buttonNames}

\getchunk{defun cacheKeyedMsg}
\getchunk{defun canFuncall?}
\getchunk{defun categoryOpen}
\getchunk{defun changeHistListLen}
\getchunk{defun changeToNamedInterpreterFrame}
\getchunk{defun charDigitVal}
\getchunk{defun checkCondition}
\getchunk{defun chkAllNonNegativeInteger}
\getchunk{defun chkDirectory}
\getchunk{defun chkNameList}
\getchunk{defun chkNonNegativeInteger}
\getchunk{defun chkOutputFileName}
\getchunk{defun chkPosInteger}
\getchunk{defun chkRange}
\getchunk{defun cleanline}
\getchunk{defun clear}
\getchunk{defun clearCmdAll}
\getchunk{defun clearCmdCompletely}
\getchunk{defun clearCmdExcept}
\getchunk{defun clearCmdParts}
\getchunk{defun clearCmdSortedCaches}
\getchunk{defun clearFrame}
\getchunk{defun clearParserMacro}
\getchunk{defun clearSpad2Cmd}
\getchunk{defun close}
\getchunk{defun closeInterpreterFrame}
\getchunk{defun cmpnote}
\getchunk{defun coerceSpadArgs2E}
\getchunk{defun coerceSpadFunValue2E}
\getchunk{defun coerceTraceArgs2E}
\getchunk{defun coerceTraceFunValue2E}
\getchunk{defun commandAmbiguityError}
\getchunk{defun commandError}
\getchunk{defun commandErrorIfAmbiguous}
\getchunk{defun commandErrorMessage}
\getchunk{defun commandsForUserLevel}
\getchunk{defun commandUserLevelError}

```

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\getchunk{defun compareposns}
\getchunk{defun compileBoot}
\getchunk{defun compiledLookup}
\getchunk{defun compiledLookupCheck}
\getchunk{defun computeDomainVariableAlist}
\getchunk{defun condErrorMsg}
\getchunk{defun conOpPage}
\getchunk{defun conOpPage1}
\getchunk{defun conPage}
\getchunk{defun conPageChoose}
\getchunk{defun conPageConEntry}
\getchunk{defun conPageFastPath}
\getchunk{defun constoken}
\getchunk{defun constructSubst}
\getchunk{defun containsVars}
\getchunk{defun containsVars1}
\getchunk{defun copyright}
\getchunk{defun countCache}

\getchunk{defun DaaseName}
\getchunk{defun dbAddChain}
\getchunk{defun dbAddChainDomain}
\getchunk{defun dbAddDocTable}
\getchunk{defun dbCompositeWithMap}
\getchunk{defun dbConsExposureMessage}
\getchunk{defun dbConsHeading}
\getchunk{defun dbConstructorDoc}
\getchunk{defun dbConstructorDoc,hn}
\getchunk{defun dbConstructorDoc,gn}
\getchunk{defun dbDocTable}
\getchunk{defun dbExtractUnderlyingDomain}
\getchunk{defun dbGetDocTable}
\getchunk{defun dbGetDocTable,gn}
\getchunk{defun dbGetDocTable,hn}
\getchunk{defun dbMkForm}
\getchunk{defun dbNonEmptyPattern}
\getchunk{defun dbSearchOrder}
\getchunk{defun dbSelectCon}
\getchunk{defun dbShowConditions}
\getchunk{defun dbShowCons}
\getchunk{defun dbShowCons1}
\getchunk{defun dbShowConsDoc}
\getchunk{defun dbShowConsDoc1}
\getchunk{defun dbShowConsKindsFilter}
\getchunk{defun dbShowConstructorLines}
\getchunk{defun dbSpecialDescription}
\getchunk{defun dbSpecialExpandIfNecessary}
\getchunk{defun dbSpecialExports}
\getchunk{defun dbSpecialOperations}
\getchunk{defun dbSubConform}

```

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\getchunk{defun decideHowMuch}
\getchunk{defun defaultTargetFE}
\getchunk{defun defiostream}
\getchunk{defun deldatabase}
\getchunk{defun deleteFile}
\getchunk{defun describe}
\getchunk{defun describeFortPersistence}
\getchunk{defun describeInputLibraryArgs}
\getchunk{defun describeOutputLibraryArgs}
\getchunk{defun describeSetFortDir}
\getchunk{defun describeSetFortTmpDir}
\getchunk{defun describeSetFunctionsCache}
\getchunk{defun describeSetLinkerArgs}
\getchunk{defun describeSetNagHost}
\getchunk{defun describeSetOutputAlgebra}
\getchunk{defun describeSetOutputFormula}
\getchunk{defun describeSetOutputFortran}
\getchunk{defun describeSetOutputHtml}
\getchunk{defun describeSetOutputMathml}
\getchunk{defun describeSetOutputOpenMath}
\getchunk{defun describeSetOutputTex}
\getchunk{defun describeSetStreamsCalculate}
\getchunk{defun describeSpad2Cmd}
\getchunk{defun dewritify}
\getchunk{defun dewritify,dewritifyInner}
\getchunk{defun diffAlist}
\getchunk{defun digit?}
\getchunk{defun digitp}
\getchunk{defun digits2Names}
\getchunk{defun disableHist}
\getchunk{defun display}
\getchunk{defun displayCondition}
\getchunk{defun displayExposedConstructors}
\getchunk{defun displayExposedGroups}
\getchunk{defun displayFrameNames}
\getchunk{defun displayHiddenConstructors}
\getchunk{defun displayMacro}
\getchunk{defun displayMacros}
\getchunk{defun displayMode}
\getchunk{defun displayModemap}
\getchunk{defun displayOperations}
\getchunk{defun displayOperationsFromLisplib}
\getchunk{defun displayParserMacro}
\getchunk{defun displayProperties}
\getchunk{defun displayProperties,sayFunctionDeps}
\getchunk{defun displaySetOptionInformation}
\getchunk{defun displaySetVariableSettings}
\getchunk{defun displaySpad2Cmd}
\getchunk{defun displayType}
\getchunk{defun displayValue}

```

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\getchunk{defun displayWorkspaceNames}
\getchunk{defun doDoitButton}
\getchunk{defun domainDescendantsOf}
\getchunk{defun domainToGenvar}
\getchunk{defun domArg}
\getchunk{defun domArg2}
\getchunk{defun doSystemCommand}
\getchunk{defun downlink}
\getchunk{defun downlinkSaturn}
\getchunk{defun dqConcat}
\getchunk{defun dropInputLibrary}
\getchunk{defun dumbTokenize}

\getchunk{defun edit}
\getchunk{defun editFile}
\getchunk{defun editSpad2Cmd}
\getchunk{defun Else?}
\getchunk{defun Elseif?}
\getchunk{defun enPile}
\getchunk{defun eofp}
\getchunk{defun eqpileTree}
\getchunk{defun erMsgCompare}
\getchunk{defun erMsgSep}
\getchunk{defun erMsgSort}
\getchunk{defun evalCategory}
\getchunk{defun evalDomain}
\getchunk{defun evaluateSignature}
\getchunk{defun evaluateType}
\getchunk{defun evaluateType1}
\getchunk{defun executeInterpreterCommand}
\getchunk{defun ExecuteInterpSystemCommand}
\getchunk{defun executeQuietCommand}
\getchunk{defun explainLinear}

\getchunk{defun fetchKeyedMsg}
\getchunk{defun fetchOutput}
\getchunk{defun fillerSpaces}
\getchunk{defun filterAndFormatConstructors}
\getchunk{defun filterListOfStrings}
\getchunk{defun filterListOfStringsWithFn}
\getchunk{defun finalExactRequest}
\getchunk{defun firstTokPosn}
\getchunk{defun fixObjectForPrinting}
\getchunk{defun flattenOperationAList}
\getchunk{defun float2Sex}
\getchunk{defun fnameDirectory}
\getchunk{defun fnameMake}
\getchunk{defun fnameNew}
\getchunk{defun fnameWritable?}
\getchunk{defun frame}

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\getchunk{defun frameEnvironment}
\getchunk{defun frameSpad2Cmd}
\getchunk{defun funfind,LAM}

\getchunk{defun gatherGlossLines}
\getchunk{defun genDomainTraceName}
\getchunk{defun gensymInt}
\getchunk{defun getAliasIfTracedMapParameter}
\getchunk{defun getAndEvalConstructorArgument}
\getchunk{defun getAndSay}
\getchunk{defun getBpiNameIfTracedMap}
\getchunk{defun getBrowseDatabase}
\getchunk{defun getConstructorDocumentation}
\getchunk{defun getdatabase}
\getchunk{defun getDependentsOfConstructor}
\getchunk{defun getDirectoryList}
\getchunk{defun getFirstWord}
\getchunk{defun getKeyedMsg}
\getchunk{defun getMapSig}
\getchunk{defun getMapSubNames}
\getchunk{defun getMsgCatAttr}
\getchunk{defun getMsgFTTag?}
\getchunk{defun getMsgInfoFromKey}
\getchunk{defun getMsgLitSym}
\getchunk{defun getMsgPos}
\getchunk{defun getMsgPos2}
\getchunk{defun getMsgToWhere}
\getchunk{defun getOplistForConstructorForm}
\getchunk{defun getOplistWithUniqueSignatures}
\getchunk{defun getOption}
\getchunk{defun getPosStL}
\getchunk{defun getPreviousMapSubNames}
\getchunk{defun getProplist}
\getchunk{defun getRefvU8}
\getchunk{defun getRefvU16}
\getchunk{defun getRefvU32}
\getchunk{defun getStFromMsg}
\getchunk{defun getSystemCommandLine}
\getchunk{defun getTraceOption}
\getchunk{defun getTraceOption,hn}
\getchunk{defun getTraceOptions}
\getchunk{defun getUsersOfConstructor}
\getchunk{defun getWorkspaceNames}

\getchunk{defun handleNoParseCommands}
\getchunk{defun handleParsedSystemCommands}
\getchunk{defun handleTokenSizeSystemCommands}
\getchunk{defun hasAtt}
\getchunk{defun hasAttSig}
\getchunk{defun hasCatExpression}

```

```

\getchunk{defun hasCate}
\getchunk{defun hasCateSpecial}
\getchunk{defun hasCateSpecialNew}
\getchunk{defun hasCate1}
\getchunk{defun hasCaty}
\getchunk{defun hasCaty1}
\getchunk{defun hashable}
\getchunk{defun hasOption}
\getchunk{defun hasPair}
\getchunk{defun hasSig}
\getchunk{defun hasSigAnd}
\getchunk{defun hasSigOr}
\getchunk{defun help}
\getchunk{defun helpSpad2Cmd}
\getchunk{defun histFileErase}
\getchunk{defun histFileName}
\getchunk{defun histInputFileName}
\getchunk{defun history}
\getchunk{defun historySpad2Cmd}
\getchunk{defun hkeys}
\getchunk{defun hput}
\getchunk{defun htAddHeading}
\getchunk{defun htAllOrNum}
\getchunk{defun htBcLinks}
\getchunk{defun htBcLispLinks}
\getchunk{defun htBcRadioButtons}
\getchunk{defun htCacheAddChoice}
\getchunk{defun htCacheOne}
\getchunk{defun htCacheSet}
\getchunk{defun htCheckList}
\getchunk{defun htCheck}
\getchunk{defun htDoneButton}
\getchunk{defun htDoNothing}
\getchunk{defun htEscapeString}
\getchunk{defun htFunctionSetLiteral}
\getchunk{defun htGlossPage}
\getchunk{defun htGlossSearch}
\getchunk{defun htGloss}
\getchunk{defun htGreekSearch}
\getchunk{defun htInitPage}
\getchunk{defun htInputStrings}
\getchunk{defun htKill}
\getchunk{defun htLispLinks}
\getchunk{defun htLispMemoLinks}
\getchunk{defun htMakeButton}
\getchunk{defun htMakeDoitButton}
\getchunk{defun htMakeDoneButton}
\getchunk{defun htMakeErrorPage}
\getchunk{defun htMakeInputList}
\getchunk{defun htMakeLabel}

```

```
\getchunk{defun htMakePage}  
\getchunk{defun htMakePage1}  
\getchunk{defun htMakePathKey,fn}  
\getchunk{defun htMakePathKey}  
\getchunk{defun htMakeTemplates,substLabel}  
\getchunk{defun htMakeTemplates}  
\getchunk{defun htMarkTree}  
\getchunk{defun htMkName}  
\getchunk{defun httpAddInputAreaProp}  
\getchunk{defun httpAddToPageDescription}  
\getchunk{defun httpButtonValue}  
\getchunk{defun httpDestroyPage}  
\getchunk{defun httpDomainConditions}  
\getchunk{defun httpDomainPvarSubstList}  
\getchunk{defun httpDomainVariableAlist}  
\getchunk{defun httpInputAreaAlist}  
\getchunk{defun httpLabelDefault}  
\getchunk{defun httpLabelErrorMsg}  
\getchunk{defun httpLabelFilteredInputString}  
\getchunk{defun httpLabelFilter}  
\getchunk{defun httpLabelInputString}  
\getchunk{defun httpLabelSpadType}  
\getchunk{defun httpLabelSpadValue}  
\getchunk{defun httpLabelType}  
\getchunk{defun httpName}  
\getchunk{defun httpPageDescription}  
\getchunk{defun httpProperty}  
\getchunk{defun httpPropertyList}  
\getchunk{defun htProcessBcButtons}  
\getchunk{defun htProcessBcStrings}  
\getchunk{defun htProcessDoitButton}  
\getchunk{defun htProcessDomainConditions}  
\getchunk{defun htProcessDoneButton}  
\getchunk{defun htProcessToggleButtons}  
\getchunk{defun httpSetDomainConditions}  
\getchunk{defun httpSetDomainPvarSubstList}  
\getchunk{defun httpSetDomainVariableAlist}  
\getchunk{defun httpSetInputAreaAlist}  
\getchunk{defun httpSetLabelErrorMsg}  
\getchunk{defun httpSetLabelInputString}  
\getchunk{defun httpSetLabelSpadValue}  
\getchunk{defun httpSetName}  
\getchunk{defun httpSetPageDescription}  
\getchunk{defun httpSetProperty}  
\getchunk{defun httpSetRadioButtonAlist}  
\getchunk{defun htQuote}  
\getchunk{defun htRadioButtons}  
\getchunk{defun htSetCache}  
\getchunk{defun htSetExpose}  
\getchunk{defun htSetFunCommandContinue}
```

```

\getchunk{defun htSetFunCommand}
\getchunk{defun htSetHistory}
\getchunk{defun htSetInputLibrary}
\getchunk{defun htSetInteger}
\getchunk{defun htSetLinkerArgs}
\getchunk{defun htSetLiterals}
\getchunk{defun htSetLiteral}
\getchunk{defun htSetNotAvailable}
\getchunk{defun htSetOutputCharacters}
\getchunk{defun htSetOutputLibrary}
\getchunk{defun htSetSystemVariableKind}
\getchunk{defun htSetSystemVariable}
\getchunk{defun htSetVars}
\getchunk{defun htSetvarDoneButton}
\getchunk{defun htShowCount}
\getchunk{defun htShowFunctionPageContinued}
\getchunk{defun htShowFunctionPage}
\getchunk{defun htShowIntegerPage}
\getchunk{defun htShowLiteralsPage}
\getchunk{defun htShowPage}
\getchunk{defun htShowPageNoScroll}
\getchunk{defun htShowSetPage}
\getchunk{defun htShowSetTreeValue}
\getchunk{defun htShowSetTree}
\getchunk{defun htStringPad}
\getchunk{defun htstv}
\getchunk{defun htSystemVariables,displayOptions}
\getchunk{defun htSystemVariables,fn}
\getchunk{defun htSystemVariables,functionTail}
\getchunk{defun htSystemVariables,gn}
\getchunk{defun htSystemVariables}
\getchunk{defun htTextSearch}
\getchunk{defun htTutorialSearch}

\getchunk{defun If?}
\getchunk{defun ifCond}
\getchunk{defun iht}
\getchunk{defun importFromFrame}
\getchunk{defun incAppend}
\getchunk{defun incAppend1}
\getchunk{defun incBiteOff}
\getchunk{defun incClassify}
\getchunk{defun incCommandTail}
\getchunk{defun incConsoleInput}
\getchunk{defun incFileInput}
\getchunk{defun incFileName}
\getchunk{defun incIgen}
\getchunk{defun incIgen1}
\getchunk{defun inclFname}
\getchunk{defun incLine}

```

```

\getchunk{defun incLine1}
\getchunk{defun inclmsgCannotRead}
\getchunk{defun inclmsgFileCycle}
\getchunk{defun inclmsgPrematureFin}
\getchunk{defun include}
\getchunk{defun include1}
\getchunk{defun inclmsgConActive}
\getchunk{defun inclmsgConStill}
\getchunk{defun inclmsgIfSyntax}
\getchunk{defun inclmsgNoSuchFile}
\getchunk{defun inclmsgSay}
\getchunk{defun incNConsoles}
\getchunk{defun incRenumber}
\getchunk{defun incRenumberItem}
\getchunk{defun incRenumberLine}
\getchunk{defun incRgen}
\getchunk{defun incRgen1}
\getchunk{defun incStream}
\getchunk{defun incString}
\getchunk{defun incZip}
\getchunk{defun incZip1}
\getchunk{defun init-boot/spad-reader}
\getchunk{defun initHist}
\getchunk{defun initHistList}
\getchunk{defun initial-getdatabase}
\getchunk{defun initializeInterpreterFrameRing}
\getchunk{defun initializeSetVariables}
\getchunk{defun initImPr}
\getchunk{defun initroot}
\getchunk{defun initToWhere}
\getchunk{defun insertAlist}
\getchunk{defun insertpile}
\getchunk{defun InterpExecuteSpadSystemCommand}
\getchunk{defun interpFunctionDepAlists}
\getchunk{defun interpOpen}
\getchunk{defun interpret}
\getchunk{defun interpret1}
\getchunk{defun interpret2}
\getchunk{defun interpretTopLevel}
\getchunk{defun intInterpretPform}
\getchunk{defun intloop}
\getchunk{defun intloopEchoParse}
\getchunk{defun intloopInclude}
\getchunk{defun intloopInclude0}
\getchunk{defun intnplisp}
\getchunk{defun intloopProcess}
\getchunk{defun intloopProcessString}
\getchunk{defun intloopReadConsole}
\getchunk{defun intloopSpadProcess}
\getchunk{defun intloopSpadProcess,interp}

```

```

\getchunk{defun intProcessSynonyms}
\getchunk{defun ioclear}
\getchunk{defun iostat}
\getchunk{defun isDomainOrPackage}
\getchunk{defun isDomainValuedVariable}
\getchunk{defun isEqualOrSubDomain}
\getchunk{defun isExposedConstructor}
\getchunk{defun isgenvar}
\getchunk{defun isInterpOnlyMap}
\getchunk{defun isListOfIdentifiers}
\getchunk{defun isListOfIdentifiersOrStrings}
\getchunk{defun isPartialMode}
\getchunk{defun isPatternVar}
\getchunk{defun isSharpVar}
\getchunk{defun isSharpVarWithNum}
\getchunk{defun isSubForRedundantMapName}
\getchunk{defun isSystemDirectory}
\getchunk{defun isTraceGensym}
\getchunk{defun isUncompiledMap}

\getchunk{defun justifyMyType}

\getchunk{defun kArgPage}
\getchunk{defun kArgumentCheck}
\getchunk{defun kcaPage}
\getchunk{defun kcaPage1}
\getchunk{defun kccPage}
\getchunk{defun kcdePage}
\getchunk{defun kcdPage}
\getchunk{defun kcdoPage}
\getchunk{defun kCheckArgumentNumbers}
\getchunk{defun kcnPage}
\getchunk{defun kcPage}
\getchunk{defun kcpPage}
\getchunk{defun kDomainName}
\getchunk{defun kdPageInfo}
\getchunk{defun KeepPart?}
\getchunk{defun kePage}
\getchunk{defun kePageDisplay}
\getchunk{defun kePageOpAlist}
\getchunk{defun kiPage}
\getchunk{defun kisValidType}
\getchunk{defun koaPageFilterByName}
\getchunk{defun koPage}
\getchunk{defun koPageAux}
\getchunk{defun koPageAux1}
\getchunk{defun koPageFromKKPage}
\getchunk{defun koPageInputAreaUnchanged?}
\getchunk{defun ksPage}
\getchunk{defun kcuPage}

```

```

\getchunk{defun kTestPred}

\getchunk{defun lassocSub}
\getchunk{defun lastTokPosn}
\getchunk{defun leader?}
\getchunk{defun leaveScratchpad}
\getchunk{defun lefts}
\getchunk{defun letPrint}
\getchunk{defun letPrint2}
\getchunk{defun letPrint3}
\getchunk{defun lfkey}
\getchunk{defun libConstructorSig}
\getchunk{defun library}
\getchunk{defun line?}
\getchunk{defun linearFinalRequest}
\getchunk{defun lineoftoks}
\getchunk{defun linkGen}
\getchunk{defun listConstructorAbbreviations}
\getchunk{defun listDecideHowMuch}
\getchunk{defun listOfStrings2String}
\getchunk{defun listOutputter}
\getchunk{defun lnFileName}
\getchunk{defun load}
\getchunk{defun loadFunctor}
\getchunk{defun loadLib}
\getchunk{defun loadLibNoUpdate}
\getchunk{defun localdatabase}
\getchunk{defun localnrlib}
\getchunk{defun lookupInDomainVector}
\getchunk{defun loopIters2Sex}
\getchunk{defun lotsof}
\getchunk{defun ltrace}

\getchunk{defun macApplication}
\getchunk{defun macExpand}
\getchunk{defun macId}
\getchunk{defun macLambda}
\getchunk{defun macLambda,mac}
\getchunk{defun macLambdaParameterHandling}
\getchunk{defun macMacro}
\getchunk{defun macSubstituteId}
\getchunk{defun macSubstituteOuter}
\getchunk{defun macroExpanded}
\getchunk{defun macWhere}
\getchunk{defun macWhere,mac}
\getchunk{defun macOExpandBody}
\getchunk{defun macOGet}
\getchunk{defun macOGetName}
\getchunk{defun macOInfiniteExpansion}
\getchunk{defun macOMLambdaApply}

```

```

\getchunk{defun macOSubstituteOuter}
\getchunk{defun make-appendstream}
\getchunk{defun make-databases}
\getchunk{defun makeFullNamestring}
\getchunk{defun makeHistFileName}
\getchunk{defun makeInputFilename}
\getchunk{defun make-instream}
\getchunk{defun makeLeaderMsg}
\getchunk{defun makeMsgFromLine}
\getchunk{defun makeOrdinal}
\getchunk{defun make-outstream}
\getchunk{defun makePathname}
\getchunk{defun makeSpadCommand}
\getchunk{defun makeStream}
\getchunk{defun mapLetPrint}
\getchunk{defun mapStringize}
\getchunk{defun mergePathnames}
\getchunk{defun messageprint}
\getchunk{defun messageprint-1}
\getchunk{defun messageprint-2}
\getchunk{defun mkConArgSublis}
\getchunk{defun mkConform}
\getchunk{defun mkCurryFun}
\getchunk{defun mkDomPvar}
\getchunk{defun mkDomTypeForm}
\getchunk{defun mkEvalable}
\getchunk{defun mkEvalableMapping}
\getchunk{defun mkEvalableRecord}
\getchunk{defun mkEvalableUnion}
\getchunk{defun mkLineList}
\getchunk{defun mkprompt}
\getchunk{defun mkSetTitle}
\getchunk{defun mkUnixPattern}
\getchunk{defun msgCreate}
\getchunk{defun msgImPr?}
\getchunk{defun msgNoRep?}
\getchunk{defun msgOutputter}
\getchunk{defun msgText}
\getchunk{defun myWritable?}

\getchunk{defun namestring}
\getchunk{defun ncAlist}
\getchunk{defun ncBug}
\getchunk{defun ncConversationPhase}
\getchunk{defun ncConversationPhase,wrapup}
\getchunk{defun ncEltQ}
\getchunk{defun ncHardError}
\getchunk{defun ncIntLoop}
\getchunk{defun ncloopCommand}
\getchunk{defun ncloopDQlines}

```



```

\getchunk{defun ncloopIncFileName}
\getchunk{defun ncloopInclude}
\getchunk{defun ncloopInclude0}
\getchunk{defun ncloopInclude1}
\getchunk{defun ncloopParse}
\getchunk{defun ncParseFromString}
\getchunk{defun ncPutQ}
\getchunk{defun ncSoftError}
\getchunk{defun ncTag}
\getchunk{defun ncTopLevel}
\getchunk{defun newHelpSpad2Cmd}
\getchunk{defun next}
\getchunk{defun next1}
\getchunk{defun nextInterpreterFrame}
\getchunk{defun nextline}
\getchunk{defun next-lines-clear}
\getchunk{defun next-lines-show}
\getchunk{defun npAdd}
\getchunk{defun npADD}
\getchunk{defun npAmpersand}
\getchunk{defun npAmpersandFrom}
\getchunk{defun npAndOr}
\getchunk{defun npAngleBared}
\getchunk{defun npApplication}
\getchunk{defun npApplication2}
\getchunk{defun npArith}
\getchunk{defun npAssign}
\getchunk{defun npAssignment}
\getchunk{defun npAssignVariable}
\getchunk{defun npAtom1}
\getchunk{defun npAtom2}
\getchunk{defun npBacksetElse}
\getchunk{defun npBackTrack}
\getchunk{defun npBDefinition}
\getchunk{defun npBPileDefinition}
\getchunk{defun npBraced}
\getchunk{defun npBracked}
\getchunk{defun npBracketed}
\getchunk{defun npBreak}
\getchunk{defun npBy}
\getchunk{defun npCategory}
\getchunk{defun npCategoryL}
\getchunk{defun npCoerceTo}
\getchunk{defun npColon}
\getchunk{defun npColonQuery}
\getchunk{defun npComma}
\getchunk{defun npCommaBackSet}
\getchunk{defun npCompMissing}
\getchunk{defun npConditional}
\getchunk{defun npConditionalStatement}

```

```

\getchunk{defun npConstTok}
\getchunk{defun npDDInfKey}
\getchunk{defun npDecl}
\getchunk{defun npDef}
\getchunk{defun npDefaultDecl}
\getchunk{defun npDefaultItem}
\getchunk{defun npDefaultItemList}
\getchunk{defun npDefaultValue}
\getchunk{defun npDefinition}
\getchunk{defun npDefinitionItem}
\getchunk{defun npDefinitionlist}
\getchunk{defun npDefinitionOrStatement}
\getchunk{defun npDefn}
\getchunk{defun npDefTail}
\getchunk{defun npDiscrim}
\getchunk{defun npDisjand}
\getchunk{defun npDollar}
\getchunk{defun npDotted}
\getchunk{defun npElse}
\getchunk{defun npEncAp}
\getchunk{defun npEncl}
\getchunk{defun npEnclosed}
\getchunk{defun npEqKey}
\getchunk{defun npExit}
\getchunk{defun npExpress}
\getchunk{defun npExpress1}
\getchunk{defun npExport}
\getchunk{defun npFirstTok}
\getchunk{defun npFix}
\getchunk{defun npForIn}
\getchunk{defun npFree}
\getchunk{defun npFromdom}
\getchunk{defun npFromdom1}
\getchunk{defun npGives}
\getchunk{defun npId}
\getchunk{defun npImport}
\getchunk{defun npInfGeneric}
\getchunk{defun npInfixOp}
\getchunk{defun npInfixOperator}
\getchunk{defun npInfKey}
\getchunk{defun npInline}
\getchunk{defun npInterval}
\getchunk{defun npItem}
\getchunk{defun npItem1}
\getchunk{defun npIterate}
\getchunk{defun npIterator}
\getchunk{defun npIterators}
\getchunk{defun npLambda}
\getchunk{defun npLeftAssoc}
\getchunk{defun npLet}

```

```
\getchunk{defun npLetQualified}  
\getchunk{defun npList}  
\getchunk{defun npListAndRecover}  
\getchunk{defun npListing}  
\getchunk{defun npListofFun}  
\getchunk{defun npLocal}  
\getchunk{defun npLocalDecl}  
\getchunk{defun npLocalItem}  
\getchunk{defun npLocalItemlist}  
\getchunk{defun npLogical}  
\getchunk{defun npLoop}  
\getchunk{defun npMacro}  
\getchunk{defun npMatch}  
\getchunk{defun npMdef}  
\getchunk{defun npMDEF}  
\getchunk{defun npMDEFinition}  
\getchunk{defun npMissing}  
\getchunk{defun npMissingMate}  
\getchunk{defun npMoveTo}  
\getchunk{defun npName}  
\getchunk{defun npNext}  
\getchunk{defun npNull}  
\getchunk{defun npParened}  
\getchunk{defun npParenthesize}  
\getchunk{defun npParenthesized}  
\getchunk{defun npParse}  
\getchunk{defun npPDefinition}  
\getchunk{defun npPileBracketed}  
\getchunk{defun npPileDefinitionlist}  
\getchunk{defun npPileExit}  
\getchunk{defun npPower}  
\getchunk{defun npPP}  
\getchunk{defun npPPf}  
\getchunk{defun npPPff}  
\getchunk{defun npPPg}  
\getchunk{defun npPrefixColon}  
\getchunk{defun npPretend}  
\getchunk{defun npPrimary}  
\getchunk{defun npPrimary1}  
\getchunk{defun npPrimary2}  
\getchunk{defun npProcessSynonym}  
\getchunk{defun npProduct}  
\getchunk{defun npPushId}  
\getchunk{defun npRelation}  
\getchunk{defun npRemainder}  
\getchunk{defun npQualDef}  
\getchunk{defun npQualified}  
\getchunk{defun npQualifiedDefinition}  
\getchunk{defun npQualType}  
\getchunk{defun npQualTypelist}
```

```

\getchunk{defun npQuiver}
\getchunk{defun npRecoverTrap}
\getchunk{defun npRestore}
\getchunk{defun npRestrict}
\getchunk{defun npReturn}
\getchunk{defun npRightAssoc}
\getchunk{defun npRule}
\getchunk{defun npSCategory}
\getchunk{defun npSDefaultItem}
\getchunk{defun npSegment}
\getchunk{defun npSelector}
\getchunk{defun npSemiBackSet}
\getchunk{defun npSemiListing}
\getchunk{defun npSigDecl}
\getchunk{defun npSigItem}
\getchunk{defun npSigItemList}
\getchunk{defun npSignature}
\getchunk{defun npSignatureDefinee}
\getchunk{defun npSingleRule}
\getchunk{defun npSLocalItem}
\getchunk{defun npSQualTypelist}
\getchunk{defun npStatement}
\getchunk{defun npSuch}
\getchunk{defun npSuchThat}
\getchunk{defun npSum}
\getchunk{defun npsynonym}
\getchunk{defun npSymbolVariable}
\getchunk{defun npSynthetic}
\getchunk{defun npsystem}
\getchunk{defun npState}
\getchunk{defun npTagged}
\getchunk{defun npTerm}
\getchunk{defun npTrap}
\getchunk{defun npTrapForm}
\getchunk{defun npTuple}
\getchunk{defun npType}
\getchunk{defun npTypedForm}
\getchunk{defun npTypedForm1}
\getchunk{defun npTypeStyle}
\getchunk{defun npTypified}
\getchunk{defun npTyping}
\getchunk{defun npTypeVariable}
\getchunk{defun npTypeVariablelist}
\getchunk{defun npVariable}
\getchunk{defun npVariablelist}
\getchunk{defun npVariableName}
\getchunk{defun npVoid}
\getchunk{defun npWConditional}
\getchunk{defun npWhile}
\getchunk{defun npWith}

```

```
\getchunk{defun npZeroOrMore}
\getchunk{defun NRTevalDomain}

\getchunk{defun ofCategory}
\getchunk{defun oldCompLookup}
\getchunk{defun oldHistFileName}
\getchunk{defun oldParseString}
\getchunk{defun om-bindTCP}
\getchunk{defun om-closeConn}
\getchunk{defun om-closeDev}
\getchunk{defun om-connectTCP}
\getchunk{defun om-getApp}
\getchunk{defun om-getAtp}
\getchunk{defun om-getAttr}
\getchunk{defun om-getBind}
\getchunk{defun om-getBVar}
\getchunk{defun om-getConnInDev}
\getchunk{defun om-getConnOutDev}
\getchunk{defun om-getEndApp}
\getchunk{defun om-getEndAtp}
\getchunk{defun om-getEndAttr}
\getchunk{defun om-getEndBind}
\getchunk{defun om-getEndBVar}
\getchunk{defun om-getEndError}
\getchunk{defun om-getEndObject}
\getchunk{defun om-getError}
\getchunk{defun om-getFloat}
\getchunk{defun om-getInt}
\getchunk{defun om-getObject}
\getchunk{defun om-getString}
\getchunk{defun om-getSymbol}
\getchunk{defun om-getType}
\getchunk{defun om-getVar}
\getchunk{defun om-listCDs}
\getchunk{defun om-listSymbols}
\getchunk{defun om-makeConn}
\getchunk{defun om-openFileDev}
\getchunk{defun om-openStringDev}
\getchunk{defun om-putApp}
\getchunk{defun om-putAtp}
\getchunk{defun om-putAttr}
\getchunk{defun om-putBind}
\getchunk{defun om-putBVar}
\getchunk{defun om-putByteArray}
\getchunk{defun om-putEndApp}
\getchunk{defun om-putEndAtp}
\getchunk{defun om-putEndAttr}
\getchunk{defun om-putEndBind}
\getchunk{defun om-putEndBVar}
\getchunk{defun om-putEndError}
```

```

\getchunk{defun om-putEndObject}
\getchunk{defun om-putError}
\getchunk{defun om-putFloat}
\getchunk{defun om-putInt}
\getchunk{defun om-putObject}
\getchunk{defun om-putString}
\getchunk{defun om-putSymbol}
\getchunk{defun om-putVar}
\getchunk{defun om-Read}
\getchunk{defun om-setDevEncoding}
\getchunk{defun om-stringPtrToString}
\getchunk{defun om-stringToStringPtr}
\getchunk{defun om-supportsCD}
\getchunk{defun om-supportsSymbol}
\getchunk{defun openOutputLibrary}
\getchunk{defun openserver}
\getchunk{defun operationOpen}
\getchunk{defun optionError}
\getchunk{defun optionUserLevelError}
\getchunk{defun orderBySlotNumber}
\getchunk{defun originsInOrder}

\getchunk{defun parseAndEval}
\getchunk{defun parseAndEval1}
\getchunk{defun parseAndInterpret}
\getchunk{defun parseFromString}
\getchunk{defun parseNoMacroFromString}
\getchunk{defun parseSystemCmd}
\getchunk{defun parseWord}
\getchunk{defun pathname}
\getchunk{defun pathnameDirectory}
\getchunk{defun pathnameName}
\getchunk{defun pathnameType}
\getchunk{defun pathnameTypeId}
\getchunk{defun patternVarsOf}
\getchunk{defun patternVarsOf1}
\getchunk{defun pcounters}
\getchunk{defun pfAbSynOp}
\getchunk{defun pfAbSynOp?}
\getchunk{defun pfAdd}
\getchunk{defun pfAnd}
\getchunk{defun pfAnd?}
\getchunk{defun pfApplication}
\getchunk{defun pfApplication?}
\getchunk{defun pfApplication2Sex}
\getchunk{defun pfAssign}
\getchunk{defun pfAssign?}
\getchunk{defun pfAttribute}
\getchunk{defun pfBrace}
\getchunk{defun pfBraceBar}

```

```
\getchunk{defun pfBracket}
\getchunk{defun pfBracketBar}
\getchunk{defun pfBreak}
\getchunk{defun pfBreak?}
\getchunk{defun pfCharPosn}
\getchunk{defun pfCheckArg}
\getchunk{defun pfCheckMacroOut}
\getchunk{defun pfCheckId}
\getchunk{defun pfCheckItOut}
\getchunk{defun pfCoerceto}
\getchunk{defun pfCoerceto?}
\getchunk{defun pfCollect}
\getchunk{defun pfCollect?}
\getchunk{defun pfCollect1?}
\getchunk{defun pfCollectArgTran}
\getchunk{defun pfCollectVariable1}
\getchunk{defun pfCollect2Sex}
\getchunk{defun pfCopyWithPos}
\getchunk{defun pfDefinition}
\getchunk{defun pfDefinition?}
\getchunk{defun pfDefinition2Sex}
\getchunk{defun pfDo}
\getchunk{defun pfDo?}
\getchunk{defun pfDocument}
\getchunk{defun pfEnSequence}
\getchunk{defun pfExit}
\getchunk{defun pfExit?}
\getchunk{defun pfExport}
\getchunk{defun pfExpression}
\getchunk{defun pfFileName}
\getchunk{defun pfFix}
\getchunk{defun pfFlattenApp}
\getchunk{defun pfFree}
\getchunk{defun pfFree?}
\getchunk{defun pfForin}
\getchunk{defun pfForin?}
\getchunk{defun pfFromDom}
\getchunk{defun pfFromdom}
\getchunk{defun pfFromdom?}
\getchunk{defun pfGlobalLinePosn}
\getchunk{defun pfHide}
\getchunk{defun pfId}
\getchunk{defun pfId?}
\getchunk{defun pfIdPos}
\getchunk{defun pfIdSymbol}
\getchunk{defun pfIf}
\getchunk{defun pfIf?}
\getchunk{defun pfIfThenOnly}
\getchunk{defun pfImport}
\getchunk{defun pfInline}
```

```

\getchunk{defun pfInfApplication}
\getchunk{defun pfIterate}
\getchunk{defun pfIterate?}
\getchunk{defun pfLam}
\getchunk{defun pfLambda}
\getchunk{defun pfLambdaTran}
\getchunk{defun pfLambda?}
\getchunk{defun pfLambda2Sex}
\getchunk{defun pfLeaf}
\getchunk{defun pfLeaf?}
\getchunk{defun pfLeafPosition}
\getchunk{defun pfLeafToken}
\getchunk{defun pfLhsRule2Sex}
\getchunk{defun pfLinePosn}
\getchunk{defun pfListOf}
\getchunk{defun pfLiteralClass}
\getchunk{defun pfLiteralString}
\getchunk{defun pfLiteral2Sex}
\getchunk{defun pfLocal}
\getchunk{defun pfLocal?}
\getchunk{defun pfLoop}
\getchunk{defun pfLoop1}
\getchunk{defun pfLoop?}
\getchunk{defun pfLp}
\getchunk{defun pfMacro}
\getchunk{defun pfMacro?}
\getchunk{defun pfMapParts}
\getchunk{defun pfMLambda}
\getchunk{defun pfMLambda?}
\getchunk{defun pfname}
\getchunk{defun pfNoPosition}
\getchunk{defun pfNoPosition?}
\getchunk{defun pfNot?}
\getchunk{defun pfNothing}
\getchunk{defun pfNothing?}
\getchunk{defun pfNovalue}
\getchunk{defun pfNovalue?}
\getchunk{defun pfOp2Sex}
\getchunk{defun pfOr}
\getchunk{defun pfOr?}
\getchunk{defun pfParen}
\getchunk{defun pfPretend}
\getchunk{defun pfPretend?}
\getchunk{defun pfPushBody}
\getchunk{defun pfPushMacroBody}
\getchunk{defun pfQualType}
\getchunk{defun pfRestrict}
\getchunk{defun pfRestrict?}
\getchunk{defun pfRetractTo}
\getchunk{defun pfReturn}

```



```

\getchunk{defun pfReturn?}
\getchunk{defun pfReturnNoName}
\getchunk{defun pfReturnTyped}
\getchunk{defun pfRhsRule2Sex}
\getchunk{defun pfRule}
\getchunk{defun pfRule?}
\getchunk{defun pfRule2Sex}
\getchunk{defun pfSequence}
\getchunk{defun pfSequence?}
\getchunk{defun pfSequenceToList}
\getchunk{defun pfSequence2Sex}
\getchunk{defun pfSequence2Sex0}
\getchunk{defun pfSexpr}
\getchunk{defun pfSexpr,strip}
\getchunk{defun pfSourcePosition}
\getchunk{defun pfSourceStok}
\getchunk{defun pfSpread}
\getchunk{defun pfSuch}
\getchunk{defun pfSuchthat}
\getchunk{defun pfSuchthat?}
\getchunk{defun pfSuchThat2Sex}
\getchunk{defun pfSymb}
\getchunk{defun pfSymbol}
\getchunk{defun pfSymbol?}
\getchunk{defun pfSymbolSymbol}
\getchunk{defun pfTagged}
\getchunk{defun pfTagged?}
\getchunk{defun pfTaggedToTyped}
\getchunk{defun pfTaggedToTyped1}
\getchunk{defun pfTransformArg}
\getchunk{defun pfTuple}
\getchunk{defun pfTupleListOf}
\getchunk{defun pfTweakIf}
\getchunk{defun pfTyped}
\getchunk{defun pfTyped?}
\getchunk{defun pfTyping}
\getchunk{defun pfTuple?}
\getchunk{defun pfUnSequence}
\getchunk{defun pfWDec}
\getchunk{defun pfWDeclare}
\getchunk{defun pfWhere}
\getchunk{defun pfWhere?}
\getchunk{defun pfWhile}
\getchunk{defun pfWhile?}
\getchunk{defun pfWith}
\getchunk{defun pfWrong}
\getchunk{defun pfWrong?}
\getchunk{defun pf0ApplicationArgs}
\getchunk{defun pf0DefinitionLhsItems}
\getchunk{defun pf0FlattenSyntacticTuple}

```

```

\getchunk{defun pf0ForinLhs}
\getchunk{defun pf0FreeItems}
\getchunk{defun pf0LambdaArgs}
\getchunk{defun pf0LocalItems}
\getchunk{defun pf0LoopIterators}
\getchunk{defun pf0MLambdaArgs}
\getchunk{defun pf0SequenceArgs}
\getchunk{defun pf0TupleParts}
\getchunk{defun pf0WhereContext}
\getchunk{defun pf2Sex}
\getchunk{defun pf2Sex1}
\getchunk{defun phMacro}
\getchunk{defun phParse}
\getchunk{defun phInterpret}
\getchunk{defun phIntReportMsgs}
\getchunk{defun pileCforest}
\getchunk{defun pileColumn}
\getchunk{defun pileCtree}
\getchunk{defun pileForest}
\getchunk{defun pileForest1}
\getchunk{defun pileForests}
\getchunk{defun pilePlusComment}
\getchunk{defun pilePlusComments}
\getchunk{defun pileTree}
\getchunk{defun poFileName}
\getchunk{defun poGlobalLinePosn}
\getchunk{defun poLinePosn}
\getchunk{defun poPosImmediate?}
\getchunk{defun porigin}
\getchunk{defun posend}
\getchunk{defun posPointers}
\getchunk{defun ppos}
\getchunk{defun pquit}
\getchunk{defun pquitSpad2Cmd}
\getchunk{defun previousInterpreterFrame}
\getchunk{defun printLabelledList}
\getchunk{defun printStatisticsSummary}
\getchunk{defun printStorage}
\getchunk{defun printSynonyms}
\getchunk{defun printTypeAndTime}
\getchunk{defun printTypeAndTimeNormal}
\getchunk{defun printTypeAndTimeSaturn}
\getchunk{defun probeName}
\getchunk{defun processChPosesForOneLine}
\getchunk{defun processInteractive}
\getchunk{defun processInteractive1}
\getchunk{defun processKeyedError}
\getchunk{defun processMsgList}
\getchunk{defun protectedEVAL}
\getchunk{defun processSynonymLine}

```

```

\getchunk{defun processSynonymLine,removeKeyFromLine}
\getchunk{defun processSynonyms}
\getchunk{defun prTraceNames}
\getchunk{defun prTraceNames,fn}
\getchunk{defun pspacers}
\getchunk{defun ptimers}
\getchunk{defun put}
\getchunk{defun putFTText}
\getchunk{defun punctuation?}
\getchunk{defun putDatabaseStuff}
\getchunk{defun putHist}
\getchunk{defun pvarCondList1}
\getchunk{defun pvarCondList}
\getchunk{defun pvarPredTran}
\getchunk{defun pvarsOfPattern}

\getchunk{defun queryClients}
\getchunk{defun queueUpErrors}
\getchunk{defun quit}
\getchunk{defun quitSpad2Cmd}
\getchunk{defun quoteString}

\getchunk{defun rassocSub}
\getchunk{defun rdefinstream}
\getchunk{defun rdefoutstream}
\getchunk{defun read}
\getchunk{defun /read}
\getchunk{defun readHiFi}
\getchunk{defun readSpadProfileIfThere}
\getchunk{defun readSpad2Cmd}
\getchunk{defun recordAndPrint}
\getchunk{defun recordFrame}
\getchunk{defun recordNewValue}
\getchunk{defun recordNewValue0}
\getchunk{defun recordOldValue}
\getchunk{defun recordOldValue0}
\getchunk{defun reduceAlistForDomain}
\getchunk{defun redundant}
\getchunk{defun regress}
\getchunk{defun remFile}
\getchunk{defun removeOption}
\getchunk{defun remover}
\getchunk{defun removeTracedMapSigs}
\getchunk{defun removeUndoLines}
\getchunk{defun renamePatternVariables1}
\getchunk{defun renamePatternVariables}
\getchunk{defun replaceFile}
\getchunk{defun replacePercentByDollar,fn}
\getchunk{defun replacePercentByDollar}
\getchunk{defun replaceSharps}

```

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\getchunk{defun reportA0}
\getchunk{defun reportCategory}
\getchunk{defun reportInstantiations}
\getchunk{defun reportOperations}
\getchunk{defun reportOpsFromLisplib}
\getchunk{defun reportOpsFromLisplib0}
\getchunk{defun reportOpsFromLisplib1}
\getchunk{defun reportOpsFromUnitDirectly}
\getchunk{defun reportOpsFromUnitDirectly0}
\getchunk{defun reportOpsFromUnitDirectly1}
\getchunk{defun reportSpadTrace}
\getchunk{defun reportUndo}
\getchunk{defun reportWhatOptions}
\getchunk{defun reroot}
\getchunk{defun resetCounters}
\getchunk{defun resetHashtables}
\getchunk{defun resetInCoreHist}
\getchunk{defun resetSpacers}
\getchunk{defun resetTimers}
\getchunk{defun resetWorkspaceVariables}
\getchunk{defun restart}
\getchunk{defun restart0}
\getchunk{defun restoreHistory}
\getchunk{defun retract}
\getchunk{defun rread}
\getchunk{defun ruleLhsTran}
\getchunk{defun rulePredicateTran}
\getchunk{defun runspad}
\getchunk{defun rwrite}

\getchunk{defun safeWritify}
\getchunk{defun sameMsg?}
\getchunk{defun satisfiesRegularExpressions}
\getchunk{defun saveHistory}
\getchunk{defun saveMapSig}
\getchunk{defun savesystem}
\getchunk{defun saveDependentsHashTable}
\getchunk{defun saveUsersHashTable}
\getchunk{defun sayAllCacheCounts}
\getchunk{defun sayBrightly1}
\getchunk{defun sayCacheCount}
\getchunk{defun sayExample}
\getchunk{defun sayKeyedMsg}
\getchunk{defun sayKeyedMsgLocal}
\getchunk{defun sayMSG}
\getchunk{defun sayMSG2File}
\getchunk{defun sayShowWarning}
\getchunk{defun scanCheckRadix}
\getchunk{defun scanComment}
\getchunk{defun scanDictCons}

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\getchunk{defun scanError}  
\getchunk{defun scanEsc}  
\getchunk{defun scanEscape}  
\getchunk{defun scanExponent}  
\getchunk{defun scanIgnoreLine}  
\getchunk{defun scanInsert}  
\getchunk{defun scanKeyTr}  
\getchunk{defun scanNegComment}  
\getchunk{defun scanNumber}  
\getchunk{defun ScanOrPairVec}  
\getchunk{defun ScanOrPairVec,ScanOrInner}  
\getchunk{defun scanPossFloat}  
\getchunk{defun scanPunct}  
\getchunk{defun scanPunCons}  
\getchunk{defun scanS}  
\getchunk{defun scanSpace}  
\getchunk{defun scanString}  
\getchunk{defun scanKeyTableCons}  
\getchunk{defun scanToken}  
\getchunk{defun scanTransform}  
\getchunk{defun scanW}  
\getchunk{defun scanWord}  
\getchunk{defun search}  
\getchunk{defun searchCurrentEnv}  
\getchunk{defun searchTailEnv}  
\getchunk{defun segmentKeyedMsg}  
\getchunk{defun selectOption}  
\getchunk{defun selectOptionLC}  
\getchunk{defun separatePiles}  
\getchunk{defun serverReadLine}  
\getchunk{defun set}  
\getchunk{defun set1}  
\getchunk{defun setdatabase}  
\getchunk{defun setExpose}  
\getchunk{defun setExposeAdd}  
\getchunk{defun setExposeAddConstr}  
\getchunk{defun setExposeAddGroup}  
\getchunk{defun setExposeDrop}  
\getchunk{defun setExposeDropConstr}  
\getchunk{defun setExposeDropGroup}  
\getchunk{defun setFortDir}  
\getchunk{defun setFortPers}  
\getchunk{defun setFortTmpDir}  
\getchunk{defun setFunctionsCache}  
\getchunk{defun setHistoryCore}  
\getchunk{defun setInputLibrary}  
\getchunk{defun setIOindex}  
\getchunk{defun setLinkerArgs}  
\getchunk{defun setMsgCatlessAttr}  
\getchunk{defun setMsgForcedAttr}
```

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\getchunk{defun setMsgForcedAttrList}
\getchunk{defun setMsgUnforcedAttr}
\getchunk{defun setMsgUnforcedAttrList}
\getchunk{defun setNagHost}
\getchunk{defun setOutputAlgebra}
\getchunk{defun setOutputCharacters}
\getchunk{defun setOutputFormula}
\getchunk{defun setOutputFortran}
\getchunk{defun setOutputLibrary}
\getchunk{defun setOutputHtml}
\getchunk{defun setOutputMathml}
\getchunk{defun setOutputOpenMath}
\getchunk{defun setOutputTex}
\getchunk{defun setStreamsCalculate}
\getchunk{defun setUpDefault}
\getchunk{defun shortenForPrinting}
\getchunk{defun show}
\getchunk{defun showdatabase}
\getchunk{defun showInOut}
\getchunk{defun showInput}
\getchunk{defun showSpad2Cmd}
\getchunk{defun shut}
\getchunk{defun size}
\getchunk{defun SkipEnd?}
\getchunk{defun SkipPart?}
\getchunk{defun Skipping?}
\getchunk{defun spad}
\getchunk{defun spadClosure?}
\getchunk{defun spad-error-loc}
\getchunk{defun SpadInterpretStream}
\getchunk{defun spad-long-error}
\getchunk{defun spadReply}
\getchunk{defun spadReply,printName}
\getchunk{defun spadrread}
\getchunk{defun spadrwrite}
\getchunk{defun spadrwrite0}
\getchunk{defun spad-save}
\getchunk{defun spad-short-error}
\getchunk{defun spadStartUpMsgs}
\getchunk{defun spad-syntax-error}
\getchunk{defun spadTrace}
\getchunk{defun spadTraceAlias}
\getchunk{defun spadTrace,g}
\getchunk{defun spadTrace,isTraceable}
\getchunk{defun spadUntrace}
\getchunk{defun spad2BootCoerce}
\getchunk{defun specialChar}
\getchunk{defun spleI}
\getchunk{defun spleI1}
\getchunk{defun splitIntoOptionBlocks}

```

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\getchunk{defun stackTraceOptionError}
\getchunk{defun startsComment?}
\getchunk{defun startsNegComment?}
\getchunk{defun statisticsInitialization}
\getchunk{defun streamChop}
\getchunk{defun stringize}
\getchunk{defun stringList2String}
\getchunk{defun stringMatches?}
\getchunk{defun StringToDir}
\getchunk{defun strpos}
\getchunk{defun strposl}
\getchunk{defun stupidIsSpadFunction}
\getchunk{defun subMatch}
\getchunk{defun substFromAlist}
\getchunk{defun substringMatch}
\getchunk{defun subTypes}
\getchunk{defun summary}
\getchunk{defun syGeneralErrorHere}
\getchunk{defun syIgnoredFromTo}
\getchunk{defun synonym}
\getchunk{defun synonymsForUserLevel}
\getchunk{defun synonymSpad2Cmd}
\getchunk{defun sySpecificErrorAtToken}
\getchunk{defun sySpecificErrorHere}
\getchunk{defun systemCommand}

\getchunk{defun ?t}
\getchunk{defun tabbing}
\getchunk{defun templateParts}
\getchunk{defun tangle}
\getchunk{defun terminateSystemCommand}
\getchunk{defun tersyscommand}
\getchunk{defun thisPosIsEqual}
\getchunk{defun thisPosIsLess}
\getchunk{defun throwEvalTypeMsg}
\getchunk{defun toFile?}
\getchunk{defun tokConstruct}
\getchunk{defun token-stack-show}
\getchunk{defun tokPosn}
\getchunk{defun tokTran}
\getchunk{defun tokType}
\getchunk{defun topLevelInterpEval}
\getchunk{defun toScreen?}
\getchunk{defun trace}
\getchunk{defun trace1}
\getchunk{defun traceDomainConstructor}
\getchunk{defun traceDomainLocalOps}
\getchunk{defun tracelet}
\getchunk{defun traceOptionError}
\getchunk{defun /tracereply}

```

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\getchunk{defun traceReply}
\getchunk{defun traceSpad2Cmd}
\getchunk{defun translateTrueFalse2YesNo}
\getchunk{defun translateYesNo2TrueFalse}
\getchunk{defun translateYesNoToTrueFalse}
\getchunk{defun transOnlyOption}
\getchunk{defun transTraceItem}
\getchunk{defun typeCheckInputAreas}

\getchunk{defun unAbbreviateKeyword}
\getchunk{defun undo}
\getchunk{defun undoChanges}
\getchunk{defun undoCount}
\getchunk{defun undoFromFile}
\getchunk{defun undoInCore}
\getchunk{defun undoLocalModemapHack}
\getchunk{defun undoSingleStep}
\getchunk{defun undoSteps}
\getchunk{defun unescapeStringsInForm}
\getchunk{defun unifyStruct}
\getchunk{defun unifyStructVar}
\getchunk{defun unparseInputForm}
\getchunk{defun untrace}
\getchunk{defun untraceDomainConstructor}
\getchunk{defun untraceDomainConstructor,keepTraced?}
\getchunk{defun untraceDomainLocalOps}
\getchunk{defun untraceMapSubNames}
\getchunk{defun unwritable?}
\getchunk{defun updateCurrentInterpreterFrame}
\getchunk{defun updateDatabase}
\getchunk{defun updateFromCurrentInterpreterFrame}
\getchunk{defun updateHist}
\getchunk{defun updateInCoreHist}
\getchunk{defun updateSourceFiles}
\getchunk{defun userLevelErrorMessage}

\getchunk{defun validateOutputDirectory}
\getchunk{defun vec2list}
\getchunk{defun voidValue}

\getchunk{defun what}
\getchunk{defun whatCommands}
\getchunk{defun whatConstructors}
\getchunk{defun whatSpad2Cmd}
\getchunk{defun whatSpad2Cmd,fixpat}
\getchunk{defun whichCat}
\getchunk{defun with}
\getchunk{defun workfiles}
\getchunk{defun workfilesSpad2Cmd}
\getchunk{defun wrap}

```



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\getchunk{defun write-browsedb}
\getchunk{defun write-categorydb}
\getchunk{defun writeHiFi}
\getchunk{defun writeHistModesAndValues}
\getchunk{defun writeInputLines}
\getchunk{defun write-interpdb}
\getchunk{defun write-operationdb}
\getchunk{defun write-warmdata}
\getchunk{defun writify}
\getchunk{defun writifyComplain}
\getchunk{defun writify,writifyInner}

\getchunk{defun xlCannotRead}
\getchunk{defun xlCmdBug}
\getchunk{defun xlConActive}
\getchunk{defun xlConsole}
\getchunk{defun xlConStill}
\getchunk{defun xlFileCycle}
\getchunk{defun xlIfBug}
\getchunk{defun xlIfSyntax}
\getchunk{defun xlMsg}
\getchunk{defun xlNoSuchFile}
\getchunk{defun xlOK}
\getchunk{defun xlOK1}
\getchunk{defun xlPrematureEOF}
\getchunk{defun xlPrematureFin}
\getchunk{defun xlSay}
\getchunk{defun xlSkip}
\getchunk{defun xlSkippingFin}

\getchunk{defun yesanswer}

\getchunk{defun zsystemdevelopment}
\getchunk{defun zsystemdevelopment1}
\getchunk{defun zsystemDevelopmentSpad2Cmd}

\getchunk{postvars}

```

Chapter 77

The Global Variables

77.1 Star Global Variables

NAME	SET	USE
<code>eof*</code>	<code>ncTopLevel</code>	
<code>features*</code>		restart
<code>package*</code>		restart
<code>standard-input*</code>		<code>ncIntLoop</code>
<code>standard-output*</code>		<code>ncIntLoop</code>
<code>top-level-hook*</code>	<code>set-restart-hook</code>	

`*eof*`

The `*eof*` variable is set to `NIL` in `ncTopLevel`.

`*features*`

The `*features*` variable from common lisp is tested for the presence of the `:unix` keyword. Apparently this controls the use of Saturn, a previous Axiom frontend. The Saturn frontend was never released as open source and so this test and the associated variables are probably not used.

`*package*`

The `*package*` variable, from common lisp, is set in restart to the `BOOT` package where the interpreter lives.

standard-input

The ***standard-input*** common lisp variable is used to set the `curinstream` variable in `ncIntLoop`.

This variable is an argument to `serverReadLine` in the `intloopReadConsole` function.

standard-output

The ***standard-output*** common lisp variable is used to set the `curoutstream` variable in `ncIntLoop`.

top-level-hook

The ***top-level-hook*** common lisp variable contains the name of a function to invoke when an image is started. In our case it is called `restart`. This is the entry point to the Axiom interpreter.

77.2 Dollar Global Variables

NAME	SET	USE
\$boot	ncTopLevel	
coerceFailure		runspad
curinstream	ncIntLoop	
curoutstream	ncIntLoop	
\$currentLine	restart	removeUndoLines
\$dalymode		intloopReadConsole
\$displayStartMsgs		restart
\$e	ncTopLevel	
\$erMsgToss	SpadInterpretStream	
\$fn	SpadInterpretStream	
\$frameRecord	initvars	
	clearFrame	
	undoSteps	undoSteps
	recordFrame	recordFrame
\$HiFiAccess	initHist	historySpad2Cmd
	historySpad2Cmd	
		setHistoryCore
\$HistList	initHist	
\$HistListAct	initHist	
\$HistListLen	initHistList	
\$HistRecord	initHistList	
\$historyDirectory		makeHistFileName
		makeHistFileName
\$historyFileType	initvars	histInputFileName
\$InteractiveFrame	restart	ncTopLevel
	undo	recordFrame
	undoSteps	undoSteps
		reportUndo
\$internalHistoryTable	initvars	
\$interpreterFrameName	initializeInterpreterFrameRing	
\$interpreterFrameRing	initializeInterpreterFrameRing	
\$intRestart		intloop
\$intTopLevel	intloop	
\$IOindex	restart	historySpad2Cmd
	removeUndoLines	undoCount
\$genValue	bookvol5	i-toplev
		i-analy
		i-syscmd
		i-spec1
		i-spec2
		i-map
\$lastPos	SpadInterpretStream	
\$libQuiet	SpadInterpretStream	
\$msgDatabaseName	reroot *	
\$ncMsgList	SpadInterpretStream	
\$newcompErrorCount	SpadInterpretStream	
\$newspad	ncTopLevel	
\$nopus		SpadInterpretStream
\$okToExecuteMachineCode	SpadInterpretStream	
\$oldHistoryFileName	initvars	oldHistFileName
\$options		history
	historySpad2Cmd	historySpad2Cmd
		undo

\$boot

The `$boot` variable is set to NIL in `ncTopLevel`.

coerceFailure

The `coerceFailure` symbol is a catch tag used in `runspad` to catch an exit from `ncTopLevel`.

\$currentLine

The `$currentLine` line is set to NIL in restart. It is used in `removeUndoLines` in the undo mechanism.

\$displayStartMsgs

The `$displayStartMsgs` variable is used in restart but is not set so this is likely a bug.

\$e

The `$e` variable is set to the value of `$InteractiveFrame` which is set in restart to the value of the call to the `makeInitialModemapFrame` function. This function simply returns a copy of the variable `$InitialModemapFrame`.

Thus `$e` is a copy of the variable `$InitialModemapFrame`.

This variable is used in the undo mechanism.

\$erMsgToss

The `$erMsgToss` variable is set to NIL in `SpadInterpretStream`.

\$fn

The `$fn` variable is set in `SpadInterpretStream`. It is set to the second argument which is a list. It appears that this list has the same structure as an argument to the `LispVM rdefiostream` function.

\$frameRecord

`$frameRecord = [delta1, delta2, ...]` where `delta(i)` contains changes in the “backwards” direction. Each `delta(i)` has the form `((var . proplist)...)` where `proplist` denotes an ordinary `proplist`. For example, an entry of the form `((x (value) (mode (Integer))))` indicates that to undo 1 step, `x`’s value is cleared and its mode should be set to `(Integer)`.

A `delta(i)` of the form `(systemCommand . delta)` is a special delta indicating changes due to system commands executed between the last command and the current command. By recording these deltas separately, it is possible to undo to either BEFORE or AFTER the command. These special `delta(i)`s are given ONLY when a system command is given which alters the environment.

`recordFrame('system)` is called before a command is executed, and `recordFrame('normal)` is called after (see `processInteractive1`). If no changes are found for former, no special entry is given.

This is part of the undo mechanism.

\$HiFiAccess

The `$HiFiAccess` is set by `initHist` to T. It is a flag used by the history mechanism to record whether the history function is currently on. It can be reset by using the axiom command

```
)history off
```

It appears that the name means “History File Access”.

The `$HiFiAccess` variable is used by `historySpad2Cmd` to check whether history is turned on. T means it is, NIL means it is not.

\$HistList

This `$HistList` variable is set by `initHistList` to an initial value of NIL elements. The last element of the list is smashed to point to the first element to make the list circular. This is a circular list of length `$HistListLen`.

\$HistListAct

The `$HistListAct` variable is set by `initHistList` to 0. This variable holds the actual number of elements in the history list. This is the number of “undoable” steps.

\$HistListLen

The `$HistListLen` variable is set by `initHistList` to 20. This is the length of a circular list maintained in the variable `$HistList`.

\$HistRecord

The `$HistRecord` variable is set by `initHistList` to NIL. `$HistRecord` collects the input line, all variable bindings and the output of a step, before it is written to the file named by the function `histFileName`.

\$historyFileType

The `$historyFileType` is set at load time by a call to `initvars` to a value of “axh”. It appears that this is intended to be used as a filetype extension. It is part of the history mechanism. It is used in `makeHistFileName` as part of the history file name.

\$internalHistoryTable

The `$internalHistoryTable` variable is set at load time by a call to `initvars` to a value of `NIL`. It is part of the history mechanism.

\$interpreterFrameName

The `$interpreterFrameName` variable, set in `initializeInterpreterFrameRing` to the constant `initial` to indicate that this is the initial (default) frame.

Frames are structures that capture all of the variables defined in a session. There can be multiple frames and the user can freely switch between them. Frames are kept in a ring data structure so you can move around the ring.

\$interpreterFrameRing

The `$interpreterFrameRing` is set to a pair whose `car` is set to the result of `emptyInterpreterFrame`

\$InteractiveFrame

The `$InteractiveFrame` is set in the `restart` function to the value of the call to the `makeInitialModemapFrame` function. This function simply returns a copy of the variable `$InitialModemapFrame`

\$intRestart

The `$intRestart` variable is used in `intloop` but has no value. This is probably a bug. While the variable’s value is unchanged the system will continually reenter the `SpadInterpretStream` function.

\$intTopLevel

The `$intTopLevel` is a catch tag. Throwing to this tag which is caught in the `intloop` will restart the `SpadInterpretStream` function.

\$IOindex

The `$IOindex` index variable is set to 1 in restart. This variable is used in the `historySpad2Cmd` function in the history mechanism. It is set in the `removeUndoLines` function in the undo mechanism.

This is used in the undo mechanism in function `undoCount` to compute the number of undos. You can't undo more actions than have already happened.

\$lastPos

The `$lastPos` variable is set in `SpadInterpretStream` to the value of the `$nopus` variable. Since `$nopus` appears to have no value this is likely a bug.

\$libQuiet

The `$libQuiet` variable is set to the third argument of the `SpadInterpretStream` function. This is passed from `intloop` with the value of T. This variable appears to be intended to control the printing of library loading messages which would need to be suppressed if input was coming from a file.

\$msgDatabaseName

The `$msgDatabaseName` is set to NIL in `reroot`.

\$ncMsgList

The `$ncMsgList` is set to NIL in `SpadInterpretStream`.

\$newcompErrorCount

The `$newcompErrorCount` is set to 0 in `SpadInterpretStream`.

\$newspad

The `$newspad` is set to T in `ncTopLevel`.

\$nopus

The `$nopus` variable is used in `SpadInterpretStream` but does not appear to have a value and is likely a bug.

\$oldHistoryFileName

The `$oldHistoryFileName` is set at load time by a call to `initvars` to a value of “last”. It is part of the history mechanism. It is used in the function `oldHistFileName` and `restoreHistory`.

\$okToExecuteMachineCode

The `$okToExecuteMachineCode` is set to T in `SpadInterpretStream`.

\$options

The `$options` variable is tested by the history function. If it is NIL then output the message

```
You have not used the correct syntax for the history command.  
Issue )help history for more information.
```

The `$options` variable is tested in the `historySpad2Cmd` function. It appears to record the options that were given to a `spad` command on the input line. The function `selectOptionLC` appears to take a list off options to scan.

This variable is not yet set and is probably a bug.

\$previousBindings

The `$previousBindings` is a copy of the CAAR `$InteractiveFrame`. This is used to compute the `delta(i)s` stored in `$frameRecord`. This is part of the undo mechanism.

\$PrintCompilerMessageIfTrue

The `$PrintCompilerMessageIfTrue` variable is set to NIL in `spad`.

\$reportundo

The `$reportundo` variable is used in `diffAlist`. It was not normally bound but has been set to T in `initvars`. If the variable is set to T then we call `reportUndo`.

It is part of the undo mechanism.

\$spad

The `$spad` variable is set to T in `ncTopLevel`.

\$SpadServer

If an open server is not requested then this variable is T. It has no value before this time (and is thus a bug).

\$SpadServerName

The `$SpadServerName` is passed to the `openServer` function, if the function exists.

\$systemCommandFunction

The `$systemCommandFunction` is set in `SpadInterpretStream` to point to the function `InterpExecuteSpadSystemCommand`.

top_level

The `top_level` symbol is a catch tag used in `runspad` to catch an exit from `ncTopLevel`.

\$quitTag

The `$quitTag` is used as a variable in a catch block. It appears that it can be thrown somewhere below `ncTopLevel`.

\$useInternalHistoryTable

The `$useInternalHistoryTable` variable is set at load time by a call to `initvars` to a value of `NIL`. It is part of the history mechanism.

\$undoFlag

The `$undoFlag` is used in `recordFrame` to decide whether to do undo recording. It is initially set to T in `initvars`. This is part of the undo mechanism.

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