axiom™

The 30 Year Horizon

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Volume 5: Axiom Interpreter

Contents

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On October 1, 2001 Axiom was withdrawn from the market and ended life as a commercial product.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

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:

1.0.1 defvar $credits

⟨*initvars*⟩≡

```
(defvar credits '(
"An alphabetical listing of contributors to AXIOM:"
"Cyril Alberga          Roy Adler              Christian Aistleitner"
"Richard Anderson       George Andrews         S.J. Atkins"
"Henry Baker            Martin Baker           Stephen Balzac"
"Yurij Baransky         David R. Barton        Gerald Baumgartner"
"Gilbert Baumslag       Michael Becker         Nelson H. F. Beebe"
"Jay Belanger           David Bindel           Fred Blair"
"Vladimir Bondarenko    Mark Botch             Alexandre Bouyer"
"Peter A. Broadbery     Martin Brock           Manuel Bronstein"
"Stephen Buchwald       Florian Bundschuh      Luanne Burns"
"William Burge"
"Quentin Carpent        Robert Caviness        Bruce Char"
"Ondrej Certik          Cheekai Chin           David V. Chudnovsky"
"Gregory V. Chudnovsky  Josh Cohen             Christophe Conil"
"Don Coppersmith        George Corliss         Robert Corless"
"Gary Cornell           Meino Cramer           Claire Di Crescenzo"
"David Cyganski"
"Nathaniel Daly         Timothy Daly Sr.       Timothy Daly Jr."
"James H. Davenport     Didier Deshommes       Michael Dewar"
"Jean Della Dora        Gabriel Dos Reis       Claire DiCrescendo"
"Sam Dooley             Lionel Ducos           Lee Duhem"
```

"Martin Dunstan Brian Dupee Dominique Duval"
"Robert Edwards Heow Eide-Goodman Lars Erickson"
"Richard Fateman Bertfried Fauser Stuart Feldman"
"John Fletcher Brian Ford Albrecht Fortenbacher"
"George Frances Constantine Frangos Timothy Freeman"
"Korrinn Fu"
"Marc Gaetano Rudiger Gebauer Kathy Gerber"
"Patricia Gianni Samantha Goldrich Holger Gollan"
"Teresa Gomez-Diaz Laureano Gonzalez-Vega Stephen Gortler"
"Johannes Grabmeier Matt Grayson Klaus Ebbe Grue"
"James Griesmer Vladimir Grinberg Oswald Gschnitzer"
"Jocelyn Guidry"
"Gaetan Hache Steve Hague Satoshi Hamaguchi"
"Mike Hansen Richard Harke Bill Hart"
"Vilya Harvey Martin Hassner Arthur S. Hathaway"
"Dan Hatton Waldek Hebisch Karl Hegbloom"
"Ralf Hemmecke Henderson Antoine Hersen"
"Gernot Hueber"
"Pietro Iglio"
"Alejandro Jakubi Richard Jenks"
"Kai Kaminski Grant Keady Tony Kennedy"
"Ted Kosan Paul Kosinski Klaus Kusche"
"Bernhard Kutzler"
"Tim Lahey Larry Lambe Kaj Laurson"
"Franz Lehner Frederic Lehobey Michel Levaud"
"Howard Levy Liu Xiaojun Rudiger Loos"
"Michael Lucks Richard Luczak"
"Camm Maguire Francois Maltey Alasdair McAndrew"
"Bob McElrath Michael McGettrick Ian Meikle"
"David Mentre Victor S. Miller Gerard Milmeister"
"Mohammed Mobarak H. Michael Moeller Michael Monagan"
"Marc Moreno-Maza Scott Morrison Joel Moses"
"Mark Murray"
"William Naylor Patrice Naudin C. Andrew Neff"
"John Nelder Godfrey Nolan Arthur Norman"
"Jinzhong Niu"
"Michael O'Connor Summat Oemrawsingh Kostas Oikonomou"
"Humberto Ortiz-Zuazaga"
"Julian A. Padget Bill Page David Parnas"
"Susan Pelzel Michel Petitot Didier Pinchon"
"Ayal Pinkus Jose Alfredo Portes"
"Claude Quitte"
"Arthur C. Ralfs Norman Ramsey Anatoly Raportirenko"
"Albert D. Rich Michael Richardson Renaud Rioboo"
"Jean Rivlin Nicolas Robidoux Simon Robinson"
"Raymond Rogers Michael Rothstein Martin Rubey"

```
"Philip Santas          Alfred Scheerhorn      William Schelter"
"Gerhard Schneider      Martin Schoenert       Marshall Schor"
"Frithjof Schulze       Fritz Schwarz          Steven Segletes"
"Nick Simicich          William Sit            Elena Smirnova"
"Jonathan Steinbach     Fabio Stumbo           Christine Sundaresan"
"Robert Sutor           Moss E. Sweedler       Eugene Surowitz"
"Max Tegmark            James Thatcher         Balbir Thomas"
"Mike Thomas            Dylan Thurston         Steve Toleque"
"Barry Trager           Themos T. Tsikas"
"Gregory Vanuxem"
"Bernhard Wall          Stephen Watt           Jaap Weel"
"Juergen Weiss          M. Weller              Mark Wegman"
"James Wen              Thorsten Werther       Michael Wester"
"John M. Wiley          Berhard Will           Clifton J. Williamson"
"Stephen Wilson         Shmuel Winograd        Robert Wisbauer"
"Sandra Wityak          Waldemar Wiwianka      Knut Wolf"
"Clifford Yapp          David Yun"
"Vadim Zhytnikov        Richard Zippel         Evelyn Zoernack"
"Bruno Zuercher         Dan Zwillinger"
))
```

Chapter 2

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 3

The Fundamental Data Structures

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

3.1 The global variables

3.1.1 defvar $current-directory

The `$current-directory` variable is set to the current directory at startup. This is used by the `)cd` function and some of the compile routines. This is the result of the (p37) get-current-directory function. This variable is used to set `*default-pathname-defaults*`. The (p42) reroot function resets it to `$spadroot`.

An example of a runtime value is:

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

⟨*initvars*⟩+≡

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

3.1.2 defvar $defaultMsgDatabaseName

The `$defaultMsgDatabaseName` variable contains the location of the international message database. This can be changed to use a translated version of the messages. It defaults to the United States English version. The relative pathname used as the default is hardcoded in the (p42) reroot function. This value is prefixed with the `$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/msgs/s2-us.msgs"
```

⟨*initvars*⟩+≡

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

3.1.3 defvar $directory-list

The `$directory-list` is a runtime list of absolute pathnames. This list is generated by the (p42) reroot function from the list of relative paths held in the variable `$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/msgs/"
   "/research/test/mnt/ubuntu/../../src/algebra/"
   "/research/test/mnt/ubuntu/../../src/interp/"
   "/research/test/mnt/ubuntu/doc/spadhelp/")
```

⟨*initvars*⟩+≡

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

3.1.4 defvar $InitialModemapFrame

The `$InitialModemapFrame` is used as the initial value.

See the function "makeInitialModemapFrame" (5.3.14 p 37).

An example of a runtime value is:

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

⟨*initvars*⟩+≡

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

3.1.5 defvar $library-directory-list

The `$library-directory-list` variable is the system-wide search path for library files. It is set up in the (p42) reroot function by prepending the `$spadroot` variable to the `$relative-library-directory-list` variable.

An example of a runtime value is:

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

⟨*initvars*⟩+≡

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

3.1.6 defvar $msgDatabaseName

The `$msgDatabaseName` is a locally shared variable among the message database routines.

An example of a runtime value is:

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

⟨*initvars*⟩+≡

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

3.1.7 defvar $openServerIfTrue

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" (60.0.23 p 1043).

An example of a runtime value is:

```
$openServerIfTrue = nil
```

⟨*initvars*⟩+≡

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

3.1.8 defvar $relative-directory-list

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 (p42) 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/msgs/"
   "/../../src/algebra/"
   "/../../src/interp/"
   "/doc/spadhelp/")
```

⟨*initvars*⟩+≡

```
(defvar $relative-directory-list
  '("/../../src/input/"
    "/doc/msgs/"
    "/../../src/algebra/"
    "/../../src/interp/"  ; for lisp  files (helps fd)
    "/doc/spadhelp/" ))
```

3.1.9 defvar $relative-library-directory-list

The `$relative-library-directory-list` is a hand-generated list of directories containing algebra. The (p42) reroot function will prefix every path in this list with the value of the `$spadroot` variable to construct the `$library-directory-list` variable.

An example of a runtime value is:

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

⟨*initvars*⟩+≡

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

3.1.10 defvar $spadroot

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 (p36) initroot function uses this variable if the AXIOM shell variable is not set. The (p37) 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"
```

⟨*initvars*⟩+≡

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

3.1.11 defvar $SpadServer

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

See the function "openserver" (60.0.23 p 1043).

An example of a runtime value is:

```
$SpadServer = nil
```

⟨*initvars*⟩+≡

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

3.1.12 defvar $SpadServerName

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

See the function "openserver" (60.0.23 p 1043).

An example of a runtime value is:

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

⟨*initvars*⟩+≡

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

Chapter 4

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.

4.1 Variables Used

4.2 Data Structures

4.3 Functions

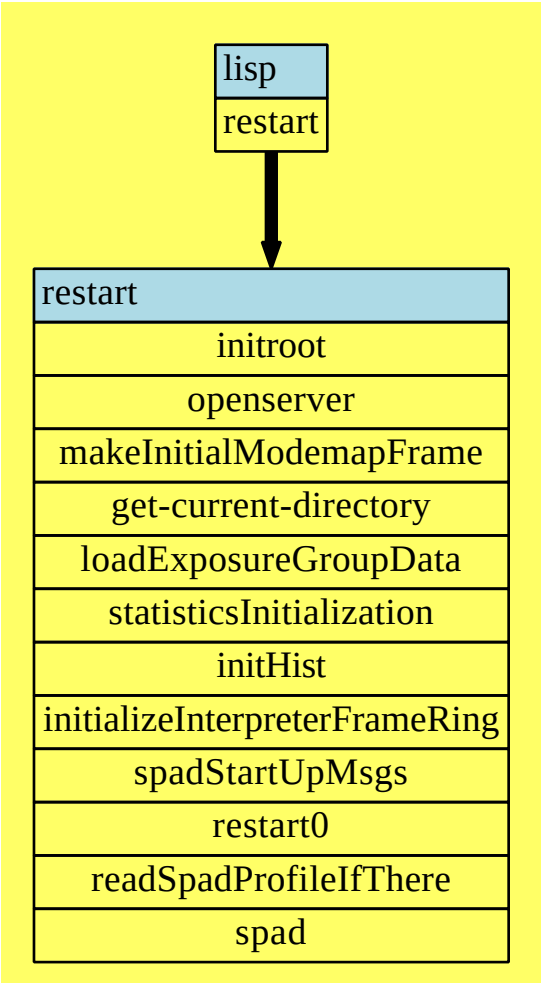
4.3.1 Set the restart hook

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
 )
```

4.3.2 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" (5.3.9 p 36) 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" (60.0.23 p 1043) 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.

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.

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 (32.3.1 page 573).

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" (44.30.4 p 773) variable controls whether load messages will be output as library routines are loaded. We disnable this by default. It can be changed by using `)set message autoload`.

The "current-directory" (3.1.1 p 7) variable is set to the current directory. This is used by the `)cd` function and some of the compile routines.

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

[init-memory-config p35]
[initroot p36]
[openserver p1043]
[makeInitialModemapFrame p37]
[get-current-directory p37]
[statisticsInitialization p??]
[initHist p605]
[initializeInterpreterFrameRing p575]
[spadStartUpMsgs p19]
[restart0 p18]
[readSpadProfileIfThere p1015]
[spad p20]
[$openServerIfTrue p10]
[$SpadServername p??]
[$SpadServer p11]
[$IOindex p??]
[$InteractiveFrame p??]
[$printLoadMsgs p773]
[$current-directory p7]
[$displayStartMsgs p787]
[$currentLine p??]

⟨*defun restart*⟩≡

```
(defun restart ()
  (declare (special $openServerIfTrue $SpadServerName |$SpadServer|
    |$IOindex| |$InteractiveFrame| |$printLoadMsgs| $current-directory
    |$displayStartMsgs| |$currentLine|))
#+:akcl
  (init-memory-config :cons 500 :fixnum 200 :symbol 500 :package 8
    :array 400 :string 500 :cfun 100 :cpages 3000 :rpages 1000 :hole 2000)
#+:akcl (setq compiler::*compile-verbose* nil)
#+:akcl (setq compiler::*suppress-compiler-warnings* t)
#+:akcl (setq compiler::*suppress-compiler-notes* t)
  (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|))
```

4.3.3 defun Non-interactive restarts

[compressopen p??]
[interpopen p??]
[operationopen p??]
[categoryopen p??]
[browseopen p??]
[getEnv p??]

⟨*defun restart0*⟩≡

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

4.3.4 defun The startup banner messages

[fillerSpaces p19]
[specialChar p1036]
[sayKeyedMsg p357]
[sayMSG p359]
[$msgAlist p354]
[$opSysName p??]
[$linelength p817]
[*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| '| |))))
```

4.3.5 defun Make a vector of filler characters

[ifcar p??]

⟨*defun fillerSpaces*⟩≡
```
(defun |fillerSpaces| (&rest arglist &aux charPart n)
 (dsetq (n . charPart) arglist)
 (if (<= n 0)
  ""
  (make-string n :initial-element (character (or (ifcar charPart) " ")))))
```

4.3.6 Starts the interpreter but do not read in profiles

[setOutputAlgebra p803]
[runspad p21]
[$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|))
```

4.3.7 defvar $quitTag

⟨*initvars*⟩+≡
```
(defvar |$quitTag| system::*quit-tag*)
```

4.3.8 defun runspad

[quitTag p20]
[coerceFailure p??]
[top-level p??]
[seq p??]
[exit p??]
[resetStackLimits p21]
[ncTopLevel p25]
[$quitTag p20]

⟨*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|)))))))))))))
```

4.3.9 defun Reset the stack limits

[reset-stack-limits p??]

⟨*defun resetStackLimits 0*⟩≡
```
(defun |resetStackLimits| ()
 "Reset the stack limits"
 (system:reset-stack-limits))
```

Chapter 5

Handling Terminal Input

5.1 Streams

5.1.1 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*))
```

5.1.2 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*))
```

5.1.3 defvar $errorinstream

⟨*initvars*⟩+≡
```
(defvar errorinstream (make-synonym-stream '*terminal-io*))
```

5.1.4 defvar $erroroutstream

⟨*initvars*⟩+≡
```
(defvar erroroutstream (make-synonym-stream '*terminal-io*))
```

5.1.5 defvar $*eof*

⟨*initvars*⟩+≡
```
(defvar *eof* nil)
```

5.1.6 defvar $*whitespace*

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

5.1.7 defvar $InteractiveMode

⟨*initvars*⟩+≡
```
(defvar |$InteractiveMode| t)
```

5.1.8 defvar $boot

⟨*initvars*⟩+≡
```
(defvar $boot nil)
```

5.1.9 Top-level read-parse-eval-print loop

Top-level read-parse-eval-print loop for the interpreter. Uses the Bill Burge's parser. [ncIntLoop p25]
[$e p??]
[$spad p20]
[$newspad p??]
[$boot p24]
[$InteractiveMode p24]
[$InteractiveFrame p??]
[*eof* p24]
[in-stream p1016]

⟨*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|)))
```

5.1.10 defun ncIntLoop

[intloop p26]
[curinstream p23]
[curoutstream p23]

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

5.1.11 defvar $intTopLevel

⟨*initvars*⟩+≡
```
(defvar |$intTopLevel| '|top_level|)
```

5.1.12 defvar $intRestart

⟨*initvars*⟩+≡
```
(defvar |$intRestart| '|restart|)
```

5.1.13 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 p26]
[SpadInterpretStream p27]
[resetStackLimits p21]
[$intTopLevel p26]
[$intRestart p26]

⟨*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))))))))))))
```

5.1.14 defvar $ncMsgList

⟨*initvars*⟩+≡
```
(defvar |$ncMsgList| nil)
```

5.1.15 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).

The system commands are handled by the function kept 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/msgs/s2-us.msgs. This message does nothing but print the argument value.

5.1.16 defvar $promptMsg

⟨*initvars*⟩+≡
```
(defvar |$promptMsg| 'S2CTP023)
```

5.1.17 defvar $newcompErrorCount

⟨*initvars*⟩+≡
```
(defvar |$newcompErrorCount| 0)
```

5.1.18 defvar $nopos

⟨*initvars*⟩+≡
```
(defvar |$nopos| (list '|noposition|))
```

[mkprompt p45]
[intloopReadConsole p29]
[intloopInclude p69]
[$promptMsg p27]
[$systemCommandFunction p??]
[$ncMsgList p27]
[$erMsgToss p??]
[$lastPos p??]
[$inclAssertions p??]
[$okToExecuteMachineCode p??]
[$newcompErrorCount p27]
[$libQuiet p??]
[$fn p??]
[$nopos p27]

⟨*defun SpadInterpretStream*⟩≡

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

5.2 The Read-Eval-Print Loop

5.2.1 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 p47]
[leaveScratchpad p671]
[mkprompt p45]
[intloopReadConsole p29]
[intloopPrefix? p36]
[intnplisp p36]
[setCurrentLine p44]
[ncloopCommand p497]
[concat p1112]
[ncloopEscaped p38]

[intloopProcessString p38]
[$dalymode p693]

⟨*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)))
```

5.3 Helper Functions

5.3.1 Get the value of an evironment variable

[getenv p??]

⟨*defun getenviron 0*⟩≡
```
(defun getenviron (var)
 "Get the value of an evironment 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)
 )
```

5.3.2 defvar $intCoerceFailure

⟨*initvars*⟩+≡
```
(defvar |$intCoerceFailure| '|coerceFailure|)
```

5.3.3 defvar $intSpadReader

⟨*initvars*⟩+≡
```
(defvar |$intSpadReader| 'SPAD_READER)
```

5.3.4 defun InterpExecuteSpadSystemCommand

[intCoerceFailure p31]
[intSpadReader p31]
[ExecuteInterpSystemCommand p32]
[$intSpadReader p31]
[$intCoerceFailure p31]

⟨*defun InterpExecuteSpadSystemCommand*⟩≡
```
(defun |InterpExecuteSpadSystemCommand| (string)
 (declare (special |$intSpadReader| |$intCoerceFailure|))
  (catch |$intCoerceFailure|
   (catch |$intSpadReader|
    (|ExecuteInterpSystemCommand| string))))
```

5.3.5 defun ExecuteInterpSystemCommand

[intProcessSynonyms p33]
[substring p??]
[doSystemCommand p456]
[$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))))
```

5.3.6 defun Handle Synonyms

[processSynonyms p34]
[line p??]

⟨*defun intProcessSynonyms*⟩≡

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

5.3.7 defun Synonym File Reader

[strpos p1111]
[substring p??]
[string2id-n p??]
[lassoc p??]
[nequal p??]
[strconc p??]
[size p1110]
[concat p1112]
[rplacstr p??]
[processSynonyms p34]
[$CommandSynonymAlist p496]
[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 (nequal 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|))))
```

5.3.8 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 efficently. 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)
```

5.3.9 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 p42]
[getenviron p31]
[$spadroot p11]

⟨*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)"))))
```

5.3.10 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))))
```

5.3.11 defun Interpret a line of lisp code

This is used to hande `)lisp` top level commands [nplisp p488]
[$currentLine p**??**]

⟨*defun intnplisp*⟩≡
```
(defun |intnplisp| (s)
 (declare (special |$currentLine|))
 (setq |$currentLine| s)
 (|nplisp| |$currentLine|))
```

5.3.12 Get the current directory

⟨*defun get-current-directory 0*⟩≡
```
(defun get-current-directory ()
 "Get the current directory"
  (namestring (truename "")))
```

5.3.13 Prepend the absolute path to a filename

Prefix a filename with the **AXIOM** shell variable. [$spadroot p11]

⟨*defun make-absolute-filename 0*⟩≡
```
(defun make-absolute-filename (name)
 "Prepend the absolute path to a filename"
 (declare (special $spadroot))
 (concatenate 'string $spadroot name))
```

5.3.14 Make the initial modemap frame

[copy p**??**]
[$InitialModemapFrame p9]

⟨*defun makeInitialModemapFrame 0*⟩≡
```
(defun |makeInitialModemapFrame| ()
  "Make the initial modemap frame"
  (declare (special |$InitialModemapFrame|))
  (copy |$InitialModemapFrame|))
```

5.3.15 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)))))
```

5.3.16 defun intloopProcessString

[setCurrentLine p44]
[intloopProcess p71]
[next p39]
[incString p40]

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

5.3.17 defun ncloopParse

[ncloopDQlines p80]
[npParse p155]
[dqToList p372]

⟨*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))))
```

5.3.18 defun next

[Delay p112]
[next1 p40]

⟨*defun next*⟩≡
```
(defun |next| (f s)
 (|Delay| #'|next1| (list f s)))
```

5.3.19 defun next1

[StreamNull p362]
[incAppend p95]
[next p39]

⟨*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)))))))
```

5.3.20 defun incString

[incRenumber p83]
[incLude p85]
[Top p86]

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

5.3.21 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))
```

5.3.22 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/msgs/"
   "/../../src/algebra/"
   "/../../src/interp/"
   "/doc/spadhelp/")

$directory-list =
  ("/research/test/mnt/ubuntu/../../src/input/"
   "/research/test/mnt/ubuntu/doc/msgs/"
   "/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/msgs/s2-us.msgs"

|$msgDatabaseName| = nil

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

[make-absolute-filename p37]
[$spadroot p11]

[$directory-list p8]
[$relative-directory-list p10]
[$library-directory-list p9]
[$relative-library-directory-list p11]
[$defaultMsgDatabaseName p8]
[$msgDatabaseName p354]
[$current-directory p7]

⟨*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/msgs/s2-us.msgs")))
  (setq |$msgDatabaseName| ())
  (setq $current-directory $spadroot))
```

5.3.23 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|)
```

5.3.24 Show the Axiom prompt

[concat p1112]
[substring p??]
[currenttime p??]
[$inputPromptType p785]
[$IOindex p??]
[$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|) "] -> "))))
```

5.3.25 defvar $frameAlist

⟨*initvars*⟩+≡
```
(defvar |$frameAlist| nil)
```

5.3.26 defvar $frameNumber

⟨*initvars*⟩+≡
```
(defvar |$frameNumber| 0)
```

5.3.27 defvar $currentFrameNum

⟨*initvars*⟩+≡
```
(defvar |$currentFrameNum| 0)
```

5.3.28 defvar $EndServerSession

⟨*initvars*⟩+≡
```
(defvar |$EndServerSession| nil)
```

5.3.29 defvar $NeedToSignalSessionManager

⟨*initvars*⟩+≡
```
(defvar |$NeedToSignalSessionManager| nil)
```

5.3.30 defvar $sockBufferLength

⟨*initvars*⟩+≡
```
(defvar |$sockBufferLength| 9217)
```

5.3.31 READ-LINE in an Axiom server system

[coerceFailure p??]
[top-level p??]
[spad-reader p??]
[read-line p??]
[addNewInterpreterFrame p583]
[sockSendInt p??]
[sockSendString p??]
[mkprompt p45]
[sockGetInt p??]
[lassoc p??]
[changeToNamedInterpreterFrame p581]
[sockGetString p??]
[unescapeStringsInForm p69]
[protectedEVAL p49]
[executeQuietCommand p50]
[parseAndInterpret p51]
[is-console p??]
[serverSwitch p??]
[$KillLispSystem p??]
[$NonSmanSession p??]
[$SpadCommand p??]
[$QuietSpadCommand p??]
[$MenuServer p??]
[$sockBufferLength p46]
[$LispCommand p??]
[$EndServerSession p46]
[$EndSession p??]
[$SwitchFrames p??]
[$CreateFrameAnswer p??]
[$currentFrameNum p45]
[$frameNumber p45]
[$frameAlist p45]
[$CreateFrame p??]
[$CallInterp p??]
[$EndOfOutput p??]
[$SessionManager p??]
[$NeedToSignalSessionManager p46]
[$EndServerSession p46]
[$SpadServer p11]
[*eof* p24]
[in-stream p1016]

⟨*defun serverReadLine*⟩≡

```
(defun |serverReadLine| (stream)
 "used in place of READ-LINE in a Axiom server system."
 (let (in-stream *eof* l framename currentframe form stringbuf 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 '|||||||)))
```

5.3.32 defun protectedEVAL

[resetStackLimits p21]
[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)))
```

5.3.33 defvar $QuietCommand

⟨*initvars*⟩+≡
```
(defvar |$QuietCommand| nil "If true, produce no top level output")
```

5.3.34 defun executeQuietCommand

When `$QuiteCommand` is true Spad will not produce any output from a top level command [spad-reader p**??**]
[coerceFailure p**??**]
[toplevel p**??**]
[spadreader p**??**]
[make-string p**??**]
[sockGetString p**??**]
[parseAndInterpret p51]
[$MenuServer p**??**]
[$QuietCommand p50]

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

5.3.35 defun parseAndInterpret

[ncParseAndInterpretString p51]
[$InteractiveMode p24]
[$boot p24]
[$spad p20]
[$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|)
  (|ncParseAndInterpretString| str)))
```

5.3.36 defun ncParseAndInterpretString

[processInteractive p53]
[packageTran p74]
[parseFromString p52]

⟨*defun ncParseAndInterpretString*⟩≡
```
(defun |ncParseAndInterpretString| (s)
  (|processInteractive| (|packageTran| (|parseFromString| s)) nil))
```

5.3.37 defun parseFromString

[next p39]
[ncloopParse p39]
[lineoftoks p122]
[incString p40]
[StreamNull p362]
[pf2Sex p323]
[macroExpanded p245]

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

5.3.38 defvar $interpOnly

⟨*initvars*⟩+≡
```
(defvar |$interpOnly| nil)
```

5.3.39 defvar $minivectorNames

⟨*initvars*⟩+≡
```
(defvar |$minivectorNames| nil)
```

5.3.40 defvar $domPvar

⟨*initvars*⟩+≡
```
(defvar |$domPvar| nil)
```

5.3.41 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. [initializeTimedNames p??]
[pairp p??]
[qcar p??]
[processInteractive1 p56]
[reportInstantiations p780]
[clrhash p??]
[writeHistModesAndValues p634]
[updateHist p616]
[$op p??]
[$Coerce p??]
[$compErrorMessageStack p??]
[$freeVars p??]
[$mapList p??]
[$compilingMap p??]
[$compilingLoop p??]
[$interpOnly p52]
[$whereCacheList p??]
[$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 p52]
[$domPvar p52]
[$inRetract p??]
[$instantRecord p??]
[$reportInstantiations p780]
[$ProcessInteractiveValue p55]
[$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 (pairp 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))
```

5.3.42 defvar $ProcessInteractiveValue

⟨*initvars*⟩+≡

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

5.3.43 defvar $HTCompanionWindowID

⟨*initvars*⟩+≡

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

5.3.44 defun processInteractive1

This calls the analysis and output printing routines [recordFrame p977]
[startTimingProcess p**??**]
[interpretTopLevel p57]
[stopTimingProcess p**??**]
[recordAndPrint p61]
[objValUnwrap p**??**]
[objMode p**??**]
[$e p**??**]
[$ProcessInteractiveValue p55]
[$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))
```

5.3.45 defun interpretTopLevel

[interpreter p??]
[interpret p58]
[stopTimingProcess p??]
[peekTimedName p??]
[interpretTopLevel p57]
[$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)))
```

5.3.46 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")
```

5.3.47 defun Type analyzes and evaluates expression x, returns object

[pairp p**??**]
[interpret1 p59]
[$env p**??**]
[$eval p**??**]
[$genValue p57]

⟨*defun interpret*⟩≡

```
(defun |interpret| (&rest arg &aux restargs x)
 (dsetq (x . restargs) arg)
 (let (|$env| |$eval| |$genValue| posnForm)
 (declare (special |$env| |$eval| |$genValue|))
  (if (pairp 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)))
```

5.3.48 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 `$EmptyMode`. It returns an object if evaluating, and a modeset otherwise. It creates the attributed tree. [mkAtreeWithSrcPos p**??**]
[putTarget p**??**]
[bottomUp p**??**]
[getArgValue p**??**]
[objNew p**??**]
[getValue p**??**]
[interpret2 p60]
[keyedSystemError p**??**]
[$genValue p57]
[$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))))))))
```

5.3.49 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**??**]
[pairp p**??**]
[member p1113]
[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 (pairp 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))))))
```

5.3.50 defun Result Output Printing

Prints out the value x which is of type m, and records the changes in environment `$e` into `$InteractiveFrame` `$printAnyIfTrue` is documented in setvart.boot. It is controlled with the `)se me any` command. [nequal p**??**]
[output p**??**]
[putHist p617]
[objNewWrap p**??**]
[printTypeAndTime p63]
[printStorage p63]
[printStatisticsSummary p62]
[mkCcompanionPage p**??**]
[recordAndPrintTest p**??**]
[$outputMode p**??**]
[$mkTestOutputType p**??**]
[$runTestFlag p**??**]
[$e p**??**]
[$mkTestFlag p**??**]
[$HTCompanionWindowID p55]
[$QuietCommand p50]
[$printStatisticsSummaryIfTrue p788]
[$printTypeIfTrue p790]
[$printStorageIfTrue p**??**]
[$printTimeIfTrue p789]
[$Void p**??**]
[$algebraOutputStream p802]
[$collectOutput p**??**]
[$EmptyMode p**??**]
[$printVoidIfTrue p791]
[$outputMode p**??**]
[$printAnyIfTrue p772]

⟨*defun recordAndPrint*⟩≡

```
(defun |recordAndPrint| (x md)
 (let (|$outputMode| xp mdp mode)
 (declare (special |$outputMode| |$mkTestOutputType| |$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 (nequal 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|))))
```

5.3.51 defun printStatisticsSummary

[sayKeyedMsg p357]
[statisticsSummary p??]
[$collectOutput p??]

⟨*defun printStatisticsSummary*⟩≡

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

5.3.52 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|)))))
```

5.3.53 defun printTypeAndTime

[printTypeAndTimeSaturn p66]
[printTypeAndTimeNormal p64]
[$saturn p**??**]

⟨*defun printTypeAndTime*⟩≡
```
(defun |printTypeAndTime| (x m)
 (declare (special |$saturn|))
 (if |$saturn|
  (|printTypeAndTimeSaturn| x m)
  (|printTypeAndTimeNormal| x m)))
```

5.3.54 defun printTypeAndTimeNormal

[qcar p??]
[pairp p??]
[retract p??]
[objNewWrap p??]
[objMode p??]
[sameUnionBranch p67]
[makeLongTimeString p??]
[msgText p68]
[sayKeyedMsg p357]
[justifyMyType p68]
[$outputLines p??]
[$collectOutput p??]
[$printTypeIfTrue p790]
[$printTimeIfTrue p789]
[$outputLines p??]
[$interpreterTimedNames p??]
[$interpreterTimedClasses p??]

⟨*defun printTypeAndTimeNormal*⟩≡

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

5.3.55 defun printTypeAndTimeSaturn

[makeLongTimeString p**??**]
[form2StringAsTeX p**??**]
[devaluate p**??**]
[printAsTeX p67]
[$printTimeIfTrue p789]
[$printTypeIfTrue p790]
[$interpreterTimedClasses p**??**]
[$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 |$printTypeIfTrue|
   (|printAsTeX| "\\axPrintType{")
   (if (consp typeString)
    (mapc #'|printAsTeX| typeString)
    (|printAsTeX| typeString))
   (|printAsTeX| "}"))
  (when |$printTimeIfTrue|
   (|printAsTeX| "\\axPrintTime{")
   (|printAsTeX| timeString)
   (|printAsTeX| "}"))))
```

5.3.56 defun printAsTeX

[$texOutputStream p??]

⟨*defun printAsTeX 0*⟩≡
```
(defun |printAsTeX| (x)
 (declare (special |$texOutputStream|))
 (princ x |$texOutputStream|))
```

5.3.57 defun sameUnionBranch

```
sameUnionBranch(uArg, m) ==
  uArg is [":", ., t] => t = m
  uArg = m
```

⟨*defun sameUnionBranch 0*⟩≡
```
(defun |sameUnionBranch| (uArg m)
 (let (t1 t2 t3)
 (cond
  ((and (pairp uArg)
        (eq (qcar uArg) '|:|)
        (progn
         (setq t1 (qcdr uArg))
         (and (pairp t1)
              (progn
               (setq t2 (qcdr t1))
               (and (pairp t2)
                    (eq (qcdr t2) nil)
                    (progn (setq t3 (qcar t2)) t))))))
   (equal t3 m))
  (t (equal uArg m)))))
```

5.3.58 defun msgText

[segmentKeyedMsg p358]
[getKeyedMsg p357]
[substituteSegmentedMsg p??]
[flowSegmentedMsg p??]
[stringimage p??]
[$linelength p817]
[$margin p816]

⟨*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 #'stringimage (cdar msg)))))
```

5.3.59 defun Right-justify the Type output

[fillerSpaces p19]
[$linelength p817]

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

5.3.60 defun Destructively fix quotes in strings

[unescapeStringsInForm p69]
[$funnyBacks p??]
[$funnyQuote p??]

⟨*defun unescapeStringsInForm*⟩≡
```
(defun |unescapeStringsInForm| (form)
 (let (str)
 (declare (special |$funnyBacks| |$funnyQuote|))
  (cond
   ((stringp form)
    (setq str (nsubstitute #\" |$funnyQuote| form))
    (nsubstitute #\\ |$funnyBacks| str))
   ((consp form)
    (|unescapeStringsInForm| (car form))
    (|unescapeStringsInForm| (cdr form))
    form)
   (t form))))
```

5.3.61 Include a file into the stream

[ST p??]
[intloopInclude0 p70]

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

5.3.62 defun intloopInclude0

[incStream p82]
[intloopProcess p71]
[next p39]
[intloopEchoParse p78]
[insertpile p363]
[lineoftoks p122]
[$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|))))))
```

5.3.63 defun intloopProcess

[StreamNull p362]
[pfAbSynOp? p444]
[setCurrentLine p44]
[tokPart p445]
[intloopProcess p71]
[intloopSpadProcess p72]
[$systemCommandFunction p??]
[$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))))))))
```

5.3.64 defun intloopSpadProcess

[flung p??]
[SpadCompileItem p??]
[intCoerceFailure p31]
[intSpadReader p31]
[ncPutQ p449]
[CatchAsCan p??]
[Catch p??]
[intloopSpadProcess,interp p73]
[$currentCarrier p??]
[$ncMsgList p27]
[$intCoerceFailure p31]
[$intSpadReader p31]
[$prevCarrier p??]
[$stepNo p??]
[$NeedToSignalSessionManager p46]
[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
   (|CatchAsCan| |flung|
    (|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)))))
```

5.3.65 defun intloopSpadProcess,interp

[ncConversationPhase p76]
[ncEltQ p448]
[ncError p77]

⟨*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|)))
```

5.3.66 defun phParse

TPDHERE: The pform function has a leading percent sign. fix this

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

[intSayKeyedMsg p73]
[pform p**??**]
[ncPutQ p449]

⟨*defun phParse*⟩≡
```
(defun |phParse| (carrier ptree)
  (|ncPutQ| carrier '|ptree| ptree)
  'ok)
```

5.3.67 defun intSayKeyedMsg

[sayKeyedMsg p357]
[packageTran p74]

⟨*defun intSayKeyedMsg*⟩≡
```
(defun |intSayKeyedMsg| (key args)
  (|sayKeyedMsg| (|packageTran| key) (|packageTran| args)))
```

5.3.68 defun packageTran

[packageTran p74]

⟨*defun packageTran 0*⟩≡

```
(defun |packageTran| (sex)
 (cond
  ((symbolp sex)
   (cond
    ((eq *package* (symbol-package sex)) sex)
    (t (intern (string sex)))))
  ((consp sex)
    (rplaca sex (|packageTran| (car sex)))
    (rplacd sex (|packageTran| (cdr sex)))
    sex)
  (t sex)))
```

5.3.69 defun phIntReportMsgs

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

[ncEltQ p448]
[ncPutQ p449]
[processMsgList p397]
[intSayKeyedMsg p73]
[$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?| (eql nerr 0))
     (cond
      ((eql nerr 0) 'ok)
      (t
       (|processMsgList| msgs lines)
       (|intSayKeyedMsg| 'S2CTP010 (list nerr))
       'ok))))))
```

5.3.70 defun phInterpret

[ncEltQ p448]
[intInterpretPform p76]
[ncPutQ p449]

⟨*defun phInterpret*⟩≡

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

5.3.71 defun intInterpretPform

[processInteractive p53]
[zeroOneTran p76]
[packageTran p74]
[pf2Sex p323]

⟨*defun intInterpretPform*⟩≡
```
(defun |intInterpretPform| (pf)
  (|processInteractive| (|zeroOneTran| (|packageTran| (|pf2Sex| pf))) pf))
```

5.3.72 defun zeroOneTran

[nsubst p**??**]

⟨*defun zeroOneTran 0*⟩≡
```
(defun |zeroOneTran| (sex)
 (nsubst '|$EmptyMode| '? sex))
```

5.3.73 defun ncConversationPhase

[ncConversationPhase,wrapup p77]
[$ncMsgList p27]

⟨*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))))
```

5.3.74 defun ncConversationPhase,wrapup

[$ncMsgList p27]

⟨*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))
```

5.3.75 defun ncError

[SpadCompileItem p**??**]

⟨*defun ncError 0*⟩≡
```
(defun |ncError| ()
 (throw '|SpadCompileItem| '|ncError|))
```

5.3.76 defun intloopEchoParse

[ncloopDQlines p80]
[setCurrentLine p44]
[mkLineList p79]
[ncloopPrintLines p78]
[npParse p155]
[dqToList p372]
[$EchoLines p??]
[$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))))
```

5.3.77 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 " "))
```

5.3.78 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
   ((eql (length l) 1) (car l))
   (t l))))
```

5.3.79 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) (|char| '| |)))
         (identity (progn (setq value t) (return value)))))))
    (setq i (+ i 1))))
   (maxindex str) 0)
  value))
```

5.3.80 defun ncloopDQlines

[StreamNull p362]
[poGlobalLinePosn p81]
[tokPosn p445]
[streamChop p81]

⟨*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)))
```

5.3.81 defun poGlobalLinePosn

[lnGlobalNum p374]
[poGetLineObject p388]
[ncBug p396]

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

5.3.82 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 p362]
[streamChop p81]
[ncloopPrefix? p497]

⟨*defun streamChop*⟩≡
```
(defun |streamChop| (n s)
 (let (d c lyne b a tmp1)
  (cond
   ((|StreamNull| s) (list nil nil))
   ((eql 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 (|ncloopPrefix?| ")command" (cdr lyne)))
     (setq d (cons (car lyne) (cond (c c) (t (cdr lyne)))))
     (list (cons d a) b)))))
```

5.3.83 defun ncloopInclude0

[incStream p82]
[ncloopProcess p??]
[next p39]
[ncloopEchoParse p??]
[insertpile p363]
[lineoftoks p122]
[$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|))))))
```

5.3.84 defun incStream

[incRenumber p83]
[incLude p85]
[incRgen p112]
[Top p86]

⟨*defun incStream*⟩≡
```
(defun |incStream| (st fn)
 (declare (special |Top|))
 (|incRenumber| (|incLude| 0 (|incRgen| st) 0 (list fn) (list |Top|))))
```

5.3.85 defun incRenumber

[incZip p83]
[incIgen p84]

⟨*defun incRenumber*⟩≡
```
(defun |incRenumber| (ssx)
 (|incZip| #'|incRenumberLine| ssx (|incIgen| 0)))
```

5.3.86 defun incZip

[Delay p112]
[incZip1 p83]

⟨*defun incZip*⟩≡
```
(defun |incZip| (g f1 f2)
  (|Delay| #'|incZip1| (list g f1 f2)))
```

5.3.87 defun incZip1

[StreamNull p362]
[incZip p83]

⟨*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)))))))
```

5.3.88 defun incIgen

[Delay p112]
[incIgen1 p84]

⟨*defun incIgen*⟩≡
```
(defun |incIgen| (n)
 (|Delay| #'|incIgen1| (list n)))
```

5.3.89 defun incIgen1

[incIgen p84]

⟨*defun incIgen1*⟩≡
```
(defun |incIgen1| (&rest z)
 (let (n)
  (setq n (car z))
  (setq n (+ n 1))
  (cons n (|incIgen| n))))
```

5.3.90 defun incRenumberLine

[incRenumberItem p85]
[incHandleMessage p85]

⟨*defun incRenumberLine*⟩≡
```
(defun |incRenumberLine| (xl gno)
 (let (l)
  (setq l (|incRenumberItem| (elt xl 0) gno))
  (|incHandleMessage| xl)
  l))
```

5.3.91 defun incRenumberItem

[lnSetGlobalNum p374]

⟨*defun incRenumberItem*⟩≡
```
(defun |incRenumberItem| (f i)
 (let (l)
  (setq l (caar f))
  (|lnSetGlobalNum| l i) f))
```

5.3.92 defun incHandleMessage

[ncSoftError p378]
[ncBug p396]

⟨*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)))))
```

5.3.93 defun incLude

[Delay p112]
[incLude1 p90]

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

5.3.94 defmacro Rest

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

5.3.95 defvar $Top

⟨*initvars*⟩+≡
```
(defvar |Top| 1 "used in incLude1 for parsing")
```

5.3.96 defvar $IfSkipToEnd

⟨*initvars*⟩+≡
```
(defvar |IfSkipToEnd| 10 "used in incLude1 for parsing")
```

5.3.97 defvar $IfKeepPart

⟨*initvars*⟩+≡
```
(defvar |IfKeepPart| 11 "used in incLude1 for parsing")
```

5.3.98 defvar $IfSkipPart

⟨*initvars*⟩+≡
```
(defvar |IfSkipPart| 12 "used in incLude1 for parsing")
```

5.3.99 defvar $ElseifSkipToEnd

⟨*initvars*⟩+≡
```
(defvar |ElseifSkipToEnd| 20 "used in incLude1 for parsing")
```

5.3.100 defvar $ElseifKeepPart

⟨*initvars*⟩+≡
```
(defvar |ElseifKeepPart| 21 "used in incLude1 for parsing")
```

5.3.101 defvar $ElseifSkipPart

⟨*initvars*⟩+≡
```
(defvar |ElseifSkipPart| 22 "used in incLude1 for parsing")
```

5.3.102 defvar $ElseSkipToEnd

⟨*initvars*⟩+≡
```
(defvar |ElseSkipToEnd| 30 "used in incLude1 for parsing")
```

5.3.103 defvar $ElseKeepPart

⟨*initvars*⟩+≡
```
(defvar |ElseKeepPart| 31 "used in incLude1 for parsing")
```

5.3.104 defvar $Top?

[quotient p**??**]

⟨*defun Top? 0*⟩≡
```
(defun |Top?| (|st|)
 "used in incLude1 for parsing"
 (eql (quotient |st| 10) 0))
```

5.3.105 defvar $If?

[quotient p**??**]

⟨*defun If?*⟩≡
```
(defun |If?| (|st|)
 "used in incLude1 for parsing"
 (eql (quotient |st| 10) 1))
```

5.3.106 defvar $Elseif?

[QUOTIENT p**??**]

⟨*defun Elseif?*⟩≡
```
(defun |Elseif?| (|st|)
 "used in incLude1 for parsing"
 (eql (quotient |st| 10) 2))
```

5.3.107 defvar $Else?

[QUOTIENT p**??**]

⟨*defun Else?*⟩≡
```
(defun |Else?| (|st|)
 "used in incLude1 for parsing"
 (eql (quotient |st| 10) 3))
```

5.3.108 defvar $SkipEnd?

[remainder p**??**]

⟨*defun SkipEnd?*⟩≡
```
(defun |SkipEnd?| (|st|)
 "used in incLude1 for parsing"
 (eql (remainder |st| 10) 0))
```

5.3.109 defvar $KeepPart?

[remainder p**??**]

⟨*defun KeepPart?*⟩≡
```
(defun |KeepPart?| (|st|)
 "used in incLude1 for parsing"
 (eql (remainder |st| 10) 1))
```

5.3.110 defvar $SkipPart?

[remainder p**??**]

⟨*defun SkipPart?*⟩≡
```
(defun |SkipPart?| (|st|)
 "used in incLude1 for parsing"
 (eql (remainder |st| 10) 2))
```

5.3.111 defvar $Skipping?

[KeepPart? p89]

⟨*defun Skipping?*⟩≡
```
(defun |Skipping?| (|st|)
 "used in incLude1 for parsing"
 (null (|KeepPart?| |st|)))
```

5.3.112 defun incLude1

[StreamNull p362]
[Top? p87]
[xlPrematureEOF p94]
[Skipping? p89]
[xlSkip p98]
[Rest p86]
[xlOK p95]
[xlOK1 p95]
[concat p1112]
[incCommandTail p110]
[xlSay p98]
[xlNoSuchFile p99]
[xlCannotRead p100]
[incActive? p112]
[xlFileCycle p100]
[incLude p85]
[incFileInput p111]
[incAppend p95]
[inclFname p111]
[xlConActive p102]
[xlConStill p102]
[incConsoleInput p111]
[incNConsoles p112]
[xlConsole p103]
[xlSkippingFin p103]
[xlPrematureFin p104]
[assertCond p104]
[ifCond p97]
[If? p88]
[Elseif? p88]
[xlIfSyntax p105]
[SkipEnd? p88]
[KeepPart? p89]
[SkipPart? p89]
[xlIfBug p106]
[xlCmdBug p106]
[expand-tabs p**??**]
[incClassify p108]

⟨*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 (cadddr . (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)))
    (setq tail (|Rest|))
    (setq n (|incNConsoles| ufos))
    (cond
     ((< 0 n)
      (setq head
       (cons (|xlConActive| eb str lno ufos n) head))
      (setq tail
       (cons (|xlConStill| eb str lno ufos n) tail))))
    (setq 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|))))))))
```

5.3.113 defun xlPrematureEOF

[xlMsg p95]
[inclmsgPrematureEOF p97]

⟨*defun xlPrematureEOF*⟩≡

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

5.3.114 defun xlMsg

[incLine p96]

⟨*defun xlMsg*⟩≡
```
(defun |xlMsg| (extrablanks string localnum fileobj mess)
 (let ((globalnum -1))
  (list (incLine extrablanks string globalnum localnum fileobj) mess)))
```

5.3.115 defun xlOK

[lxOK1 p**??**]

⟨*defun xlOK*⟩≡
```
(defun |xlOK| (extrablanks string localnum fileobj)
 (|xlOK1| extrablanks string string localnum fileobj))
```

5.3.116 defun xlOK1

[incLine1 p96]

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

5.3.117 defun incAppend

[Delay p112]
[incAppend1 p96]

⟨*defun incAppend*⟩≡
```
(defun |incAppend| (x y)
 (|Delay| #'|incAppend1| (list x y)))
```

5.3.118 defun incAppend1

[StreamNull p362]
[incAppend p95]

⟨*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))))))
```

5.3.119 defun incLine

[incLine1 p96]

⟨*defun incLine*⟩≡
```
(defun incLine (extrablanks string globalnum localnum fileobj)
 (incLine1 extrablanks string string globalnum localnum fileobj))
```

5.3.120 defun incLine1

[lnCreate p373]

⟨*defun incLine1*⟩≡
```
(defun incLine1 (extrablanks string string1 globalnum localnum fileobj)
 (cons
  (cons (|lnCreate| extrablanks string globalnum localnum fileobj) 1) string1))
```

5.3.121 defun inclmsgPrematureEOF

[origin p**??**]

⟨*defun inclmsgPrematureEOF 0*⟩≡
```
(defun |inclmsgPrematureEOF| (ufo)
 (list 'S2CI0002 (list (|theorigin| ufo))))
```

5.3.122 defun theorigin

⟨*defun theorigin 0*⟩≡
```
(defun |theorigin| (x) (list #'|porigin| x))
```

5.3.123 defun porigin

[stringp p**??**]

⟨*defun porigin*⟩≡
```
(defun |porigin| (x)
 (if (stringp x)
  x
  (|pfname| x)))
```

5.3.124 defun ifCond

[MakeSymbol p**??**]
[incCommandTail p110]
[ListMemberQ? p**??**]
[$inclAssertions p**??**]

⟨*defun ifCond*⟩≡
```
(defun |ifCond| (s info)
 (let (word)
 (declare (special |$inclAssertions|))
  (setq word
   (|MakeSymbol| (string-trim *whitespace* (|incCommandTail| s info))))
  (|ListMemberQ?| word |$inclAssertions|)))
```

5.3.125 defun xlSkip

[incLine p96]
[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|))))
```

5.3.126 defun xlSay

[xlMsg p95]
[inclmsgSay p98]

⟨*defun xlSay*⟩≡
```
(defun |xlSay| (eb str lno ufos x)
 (|xlMsg| eb str lno (elt ufos 0) (list (|inclmsgSay| x) '|say|)))
```

5.3.127 defun inclmsgSay

[id p??]

⟨*defun inclmsgSay*⟩≡
```
(defun |inclmsgSay| (str)
 (list 'S2CI0001 (list (|theid| str))))
```

5.3.128 defun theid

⟨*defun theid 0*⟩≡
```
(defun |theid| (a) (list identity a))
```

5.3.129 defun xlNoSuchFile

[xlMsg p95]
[inclmsgNoSuchFile p99]

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

5.3.130 defun inclmsgNoSuchFile

[thefname p99]

⟨*defun inclmsgNoSuchFile*⟩≡
```
(defun |inclmsgNoSuchFile| (fn)
 (list 'S2CI0010 (list (|thefname| fn))))
```

5.3.131 defun thefname

[pfname p99]

⟨*defun thefname 0*⟩≡
```
(defun |thefname| (x) (list #'|pfname| x))
```

5.3.132 defun pfname

[PathnameString p**??**]

⟨*defun pfname*⟩≡
```
(defun |pfname| (x) (|PathnameString| x))
```

5.3.133 defun xlCannotRead

[xlMsg p95]
[inclmsgCannotRead p100]

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

5.3.134 defun inclmsgCannotRead

[thefname p99]

⟨*defun inclmsgCannotRead*⟩≡
```
(defun |inclmsgCannotRead| (fn)
 (list 'S2CI0011 (list (|thefname| fn))))
```

5.3.135 defun xlFileCycle

[xlMsg p95]
[inclmsgFileCycle p101]

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

5.3.136 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 p97]
[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)))))
```

5.3.137 defun xlConActive

[xlMsg p95]
[inclmsgConActive p102]

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

5.3.138 defun inclmsgConActive

[id p??]

⟨*defun inclmsgConActive*⟩≡
```
(defun |inclmsgConActive| (n)
 (list 'S2CI0006 (list (|theid| n))))
```

5.3.139 defun xlConStill

[xlMsg p95]
[inclmsgConStill p102]

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

5.3.140 defun inclmsgConStill

[id p??]

⟨*defun inclmsgConStill*⟩≡
```
(defun |inclmsgConStill| (n)
 (list 'S2CI0007 (list (|theid| n))))
```

5.3.141 defun xlConsole

[xlMsg p95]
[inclmsgConsole p103]

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

5.3.142 defun inclmsgConsole

⟨*defun inclmsgConsole 0*⟩≡
```
(defun |inclmsgConsole| ()
 (list 'S2CI0005 nil))
```

5.3.143 defun xlSkippingFin

[xlMsg p95]
[inclmsgFinSkipped p103]

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

5.3.144 defun inclmsgFinSkipped

⟨*defun inclmsgFinSkipped 0*⟩≡
```
(defun |inclmsgFinSkipped| ()
 (list 'S2CI0008 nil))
```

5.3.145 defun xlPrematureFin

[xlMsg p95]
[inclmsgPrematureFin p104]

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

5.3.146 defun inclmsgPrematureFin

[origin p**??**]

⟨*defun inclmsgPrematureFin*⟩≡
```
(defun |inclmsgPrematureFin| (ufo)
 (list 'S2CI0003 (list (|theorigin| ufo))))
```

5.3.147 defun assertCond

[MakeSymbol p**??**]
[incCommandTail p110]
[ListMemberQ? p**??**]
[$inclAssertions p**??**]
[*whitespace* p24]

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

5.3.148 defun xlIfSyntax

[Top? p87]
[Else? p88]
[xlMsg p95]
[inclmsgIfSyntax p105]

⟨*defun xlIfSyntax*⟩≡
```
(defun |xlIfSyntax| (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|)))
  (|xlMsg| eb str lno (elt ufos 0)
    (list (|inclmsgIfSyntax| (elt ufos 0) found context) '|error|))))
```

5.3.149 defun inclmsgIfSyntax

[concat p1112]
[id p**??**]
[origin p**??**]

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

5.3.150 defun xlIfBug

[xlMsg p95]
[inclmsgIfBug p106]

⟨*defun xlIfBug*⟩≡
```
(defun |xlIfBug| (eb str lno ufos)
 (|xlMsg| eb str lno (elt ufos 0) (list (|inclmsgIfBug|) '|bug|)))
```

5.3.151 defun inclmsgIfBug

⟨*defun inclmsgIfBug 0*⟩≡
```
(defun |inclmsgIfBug| ()
  (list 'S2CB0002 nil))
```

5.3.152 defun xlCmdBug

[xlMsg p95]
[inclmsgCmdBug p106]

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

5.3.153 defun inclmsgCmdBug

⟨*defun inclmsgCmdBug 0*⟩≡
```
(defun |inclmsgCmdBug| ()
 (list 'S2CB0003 nil))
```

5.3.154 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")))
```

5.3.155 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))
```

5.3.156 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? p109]
[incCommands p107]

⟨*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))))))))
```

5.3.157 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) (|char| '|)|))))
```

5.3.158 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))))
```

5.3.159 defun incCommandTail

[incDrop p111]

⟨*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)))
```

5.3.160 defun incDrop

[substring p??]

⟨*defun incDrop 0*⟩≡
```
(defun |incDrop| (n b)
 (if (>= n (length b))
  '||
  (substring b n nil)))
```

5.3.161 defun inclFname

[incFileName p655]
[incCommandTail p110]

⟨*defun inclFname*⟩≡
```
(defun |inclFname| (s info)
 (|incFileName| (|incCommandTail| s info)))
```

5.3.162 defun incFileInput

[incRgen p112]
[make-instream p1037]

⟨*defun incFileInput*⟩≡
```
(defun |incFileInput| (fn)
  (|incRgen| (make-instream fn)))
```

5.3.163 defun incConsoleInput

[incRgen p112]
[make-instream p1037]

⟨*defun incConsoleInput*⟩≡
```
(defun |incConsoleInput| ()
  (|incRgen| (make-instream 0)))
```

5.3.164 defun incNConsoles

[incNConsoles p112]

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

5.3.165 defun incActive?

⟨*defun incActive? 0*⟩≡
```
(defun |incActive?| (fn ufos)
 (member fn ufos))
```

5.3.166 defun incRgen

Note that incRgen1 recursively calls this function. [Delay p112]
[incRgen1 p113]

⟨*defun incRgen*⟩≡
```
(defun |incRgen| (s)
 (|Delay| #'|incRgen1| (list s)))
```

5.3.167 defun Delay

⟨*defun Delay 0*⟩≡
```
(defun |Delay| (f x)
 (cons '|nonnullstream| (cons f x)))
```

⟨*initvars*⟩+≡
```
(defvar |StreamNil| (list '|nullstream|))
```

5.3.168 defvar $StreamNil

⟨*postvars*⟩+≡
```
(eval-when (eval load)
  (setq |StreamNil| (list '|nullstream|)))
```

5.3.169 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 p112]
[StreamNil p113]

⟨*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 6

The Token Scanner

6.0.170 defvar $space

⟨*postvars*⟩+≡
```
(eval-when (eval load)
(defvar space (qenum "    " 0)))
```

6.0.171 defvar $escape

⟨*postvars*⟩+≡
```
(eval-when (eval load)
(defvar escape (qenum "_  " 0)))
```

6.0.172 defvar $stringchar

⟨*postvars*⟩+≡
```
(eval-when (eval load)
(defvar stringchar (qenum "\"  " 0)))
```

6.0.173 defvar $pluscomment

⟨*postvars*⟩+≡
```
(eval-when (eval load)
(defvar pluscomment (qenum "+   " 0)))
```

6.0.174 defvar $minuscomment

⟨*postvars*⟩+≡
```
(eval-when (eval load)
(defvar minuscomment (qenum "-   " 0)))
```

6.0.175 defvar $radixchar

⟨*postvars*⟩+≡
```
(eval-when (eval load)
(defvar radixchar (qenum "r   " 0)))
```

6.0.176 defvar $dot

⟨*postvars*⟩+≡
```
(eval-when (eval load)
(defvar dot (qenum ".   " 0)))
```

6.0.177 defvar $exponent1

⟨*postvars*⟩+≡
```
(eval-when (eval load)
(defvar exponent1 (qenum "E   " 0)))
```

6.0.178 defvar $exponent2

⟨*postvars*⟩+≡
```
(eval-when (eval load)
(defvar exponent2 (qenum "e   " 0)))
```

6.0.179 defvar $closeparen

⟨*postvars*⟩+≡
```
(eval-when (eval load)
(defvar closeparen (qenum ")   " 0)))
```

6.0.180 defvar $closeangle

⟨*postvars*⟩+≡
```
(eval-when (eval load)
(defvar closeangle (qenum ">   " 0)))
```

6.0.181 defvar $question

⟨*postvars*⟩+≡
```
(eval-when (eval load)
(defvar question (qenum "?   " 0)))
```

6.0.182 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 "//" 'slashslash)
(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))))
```

6.0.183 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 'slashslash '//)
      (list 'backslashbackslash '|\\\\|)
      (list 'slashbackslash '|/\\|)
      (list 'backslashslash '|\\/|)
      (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))))
```

6.0.184 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 p124]
[scanIgnoreLine p125]
[incPrefix? p110]
[substring p??]
[dqUnit p371]
[constoken p125]
[$floatok p??]
[$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|)))))))))
```

6.0.185 defun nextline

[npNull p361]
[strposl p1111]
[$sz p??]
[$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 |$n| (strposl " " |$ln| 0 t)) ; spaces at beginning
   (setq |$sz| (length |$ln|))
   t)))
```

6.0.186 defun scanIgnoreLine

[qenum p1111]
[incPrefix? p110]

⟨*defun scanIgnoreLine*⟩≡
```
(defun |scanIgnoreLine| (ln n)
 (let (fst)
  (cond
   ((null n) n)
   (t
    (setq fst (qenum ln 0))
    (cond
     ((eq fst closeparen)
      (cond
        ((|incPrefix?| "command" 1 ln) t)
        (t nil)))
     (t n))))))
```

6.0.187 defun constoken

[ncPutQ p449]

⟨*defun constoken*⟩≡
```
(defun |constoken| (ln lp b n)
 (declare (ignore ln))
 (let (a)
  (setq a (cons (elt b 0) (elt b 1)))
  (|ncPutQ| a '|posn| (cons lp n))
  a))
```

6.0.188 defun scanToken

[qenum p1111]
[startsComment? p127]
[scanComment p128]
[startsNegComment? p129]
[scanNegComment p129]
[lfid p127]
[punctuation? p130]
[scanPunct p130]
[startsId? p1109]
[scanWord p138]
[scanSpace p142]
[scanString p143]
[digit? p133]
[scanNumber p146]
[scanEscape p149]
[scanError p149]
[dqUnit p371]
[constoken p125]
[lnExtraBlanks p373]
[$linepos p??]
[$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))))))))
```

6.0.189 defun lfid

To pair badge and badgee

⟨*defun lfid 0*⟩≡

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

6.0.190 defun startsComment?

[qenum p1111]
[$ln p**??**]
[$sz p**??**]
[$n p**??**]
[pluscomment p115]

⟨*defun startsComment?*⟩≡

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

6.0.191 defun scanComment

[lfcomment p128]
[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))))
```

6.0.192 defun lfcomment

⟨*defun lfcomment 0*⟩≡
```
(defun |lfcomment| (x)
 (list '|comment| x))
```

6.0.193 defun startsNegComment?

[qenum p1111]
[$ln p??]
[$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))))
```

6.0.194 defun scanNegComment

[lfnegcomment p130]
[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))))
```

6.0.195 defun lfnegcomment

⟨*defun lfnegcomment 0*⟩≡
```
(defun |lfnegcomment| (x)
 (list '|negcomment| x))
```

6.0.196 defun punctuation?

⟨*defun punctuation?*⟩≡
```
(defun |punctuation?| (c)
 (eql (elt |scanPun| c) 1))
```

6.0.197 defun scanPunct

[subMatch p130]
[scanError p149]
[scanKeyTr p132]
[$n p**??**]
[$ln p**??**]

⟨*defun scanPunct*⟩≡
```
(defun |scanPunct| ()
 (let (a sss)
 (declare (special |$n| |$ln|))
  (setq sss (|subMatch| |$ln| |$n|))
  (setq a (length sss))
  (cond
   ((eql a 0) (|scanError|))
   (t (setq |$n| (+ |$n| a)) (|scanKeyTr| sss)))))
```

6.0.198 defun subMatch

[substringMatch p131]

⟨*defun subMatch*⟩≡
```
(defun |subMatch| (a b)
 (|substringMatch| a |scanDict| b))
```

6.0.199 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 p1111]
[size p1110]

⟨*defun substringMatch*⟩≡

```
(defun |substringMatch| (l dict i)
 (let (equl 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 equl t)
          ((lambda (Var5 k)
```

```
            (loop
             (cond
              ((or (> k Var5) (not equl)) (return nil))
              (t
               (setq equl (eql (qenum s k) (qenum l (+ k i))))))
               (setq k (+ k 1))))
            (- ls 1) 1)
           (cond (equl (setq s1 s) t) (t nil)))))))
      (setq j (+ j 1))))
     (- (size u) 1) 0)
    s1))
```

6.0.200 defun scanKeyTr

[keyword p132]
[scanPossFloat p133]
[lfkey p134]
[scanCloser? p138]
[$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))))
```

6.0.201 defun keyword

[hget p1110]

⟨*defun keyword 0*⟩≡

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

6.0.202 defun keyword?

[hget p1110]

⟨*defun keyword? 0*⟩≡
```
(defun |keyword?| (st)
 (null (null (hget |scanKeyTable| st))))
```

6.0.203 defun scanPossFloat

[digit? p133]
[lfkey p134]
[spleI p134]
[scanExponent p139]
[$ln p??]
[$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))))
```

6.0.204 defun digit?

[digitp p1110]

⟨*defun digit?*⟩≡
```
(defun |digit?| (x)
 (digitp x))
```

6.0.205 defun lfkey

[keyword p132]

⟨*defun lfkey*⟩≡
```
(defun |lfkey| (x)
 (list '|key| (|keyword| x)))
```

6.0.206 defun spleI

[spleI1 p135]

⟨*defun spleI*⟩≡
```
(defun |spleI| (dig)
 (|spleI1| dig nil))
```

6.0.207 defun spleI1

[qenum p1111]
[substring p??]
[scanEsc p136]
[spleI1 p135]
[concat p1112]
[$ln p??]
[$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)))))
```

6.0.208 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 p124]
[scanEsc p136]
[strposl p1111]
[qenum p1111]
[startsNegComment? p129]
[startsComment? p127]
[$ln p??]
[$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)))))))
```

6.0.209 defvar $scanCloser

⟨*postvars*⟩+≡
```
(eval-when (eval load)
  (defvar |scanCloser| (list '|)| '} '] '|\|)| '|\|}| '|\|]|)))
```

6.0.210 defun scanCloser?

[keyword p132]
[scanCloser p138]

⟨*defun scanCloser? 0*⟩≡
```
(defun |scanCloser?| (w)
 (declare (special |scanCloser|))
 (member (|keyword| w) |scanCloser|))
```

6.0.211 defun scanWord

[scanW p141]
[lfid p127]
[keyword? p133]
[lfkey p134]
[$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)))))
```

6.0.212 defun scanExponent

[lffloat p140]
[qenum p1111]
[digit? p133]
[spleI p134]
[concat p1112]
[$ln p??]
[$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")))))))
```

6.0.213 defun lffloat

[concat p1112]

⟨*defun lffloat 0*⟩≡
```
(defun |lffloat| (a w e)
 (list '|float| (concat a "." w "e" e)))
```

6.0.214 defmacro idChar?

⟨*defmacro idChar? 0*⟩≡
```
(defmacro |idChar?| (x)
 `(or (alphanumericp ,x) (member ,x '(#\? #\% #\' #\!) :test #'char=)))
```

6.0.215 defun scanW

[posend p142]
[qenum p1111]
[substring p??]
[scanEsc p136]
[scanW p141]
[idChar? p140]
[concat p1112]
[$ln p??]
[$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)))))))
```

6.0.216 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)
```

6.0.217 defun scanSpace

[strposl p1111]
[lfspaces p142]
[$floatok p??]
[$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))))
```

6.0.218 defun lfspaces

⟨*defun lfspaces 0*⟩≡

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

6.0.219 defun scanString

[lfstring p143]
[scanS p144]
[$floatok p??]
[$n p??]

⟨*defun scanString*⟩≡
```
(defun |scanString| ()
 (declare (special |$floatok| |$n|))
  (setq |$n| (+ |$n| 1))
  (setq |$floatok| nil)
  (|lfstring| (|scanS|)))
```

6.0.220 defun lfstring

⟨*defun lfstring 0*⟩≡
```
(defun |lfstring| (x)
 (if (eql (length x) 1)
  (list '|char| x)
  (list '|string| x)))
```

6.0.221 defun scanS

[ncSoftError p378]
[lnExtraBlanks p373]
[strpos p1111]
[substring p??]
[scanEsc p136]
[concat p1112]
[scanTransform p145]
[scanS p144]
[$ln p??]
[$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)))))))
```

6.0.222 defun scanTransform

⟨*defun scanTransform*⟩≡

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

6.0.223 defun scanNumber

[spleI p134]
[lfinteger p147]
[qenum p1111]
[spleI1 p135]
[scanExponent p139]
[scanCheckRadix p148]
[lfrinteger p147]
[concat p1112]
[$floatok p??]
[$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)))))))
```

6.0.224 defun rdigit?

[strpos p1111]

⟨*defun rdigit? 0*⟩≡

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

6.0.225 defun lfinteger

⟨*defun lfinteger 0*⟩≡

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

6.0.226 defun lfrinteger

[concat p1112]

⟨*defun lfrinteger 0*⟩≡

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

6.0.227 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)))
```

6.0.228 defun scanEscape

[scanEsc p136]
[scanWord p138]
[$n p??]

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

6.0.229 defun scanError

[ncSoftError p378]
[lnExtraBlanks p373]
[lferror p149]
[$ln p??]
[$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)))
  (|lferror| (elt |$ln| n))))
```

6.0.230 defun lferror

⟨*defun lferror 0*⟩≡
```
(defun |lferror| (x)
 (list '|error| x))
```

6.0.231 defvar $scanKeyTable

⟨*postvars*⟩+≡
```
(eval-when (eval load)
 (defvar |scanKeyTable| (|scanKeyTableCons|)))
```

6.0.232 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))
```

6.0.233 defvar $scanDict

⟨*postvars*⟩+≡
```
(eval-when (eval load)
 (defvar |scanDict| (|scanDictCons|)))
```

6.0.234 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 p1110]

⟨*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))))
   l nil)
  d))
```

6.0.235 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 p1111]

⟨*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))
```

6.0.236 defvar $scanPun

⟨*postvars*⟩+≡

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

6.0.237 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 p1110]

⟨*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 7

Input Stream Parser

7.0.238 defun Input Stream Parser

[trappoint p??]
[npFirstTok p157]
[npItem p156]
[ncSoftError p378]
[tokPosn p445]
[pfWrong p322]
[pfDocument p276]
[pfListOf p275]
[$ttok p??]
[$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|)))))
```

7.0.239 defun npItem

[npQualDef p159]
[npEqKey p159]
[npItem1 p157]
[npPop1 p158]
[pfEnSequence p292]
[npPush p158]
[pfNovalue p307]

⟨*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|)))))))
```

7.0.240 defun npItem1

[npQualDef p159]
[npEqKey p159]
[npItem1 p157]
[npPop1 p158]

⟨*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))))
```

7.0.241 defun npFirstTok

Sets the current leaf ($stok) to the next leaf in the input stream. Sets the current token ($ttok) cdr of the leaf. A leaf token looks like [head, token, position] where head is either an id or (id . alist) [tokConstruct p443]
[tokPosn p445]
[tokPart p445]
[$ttok p**??**]
[$stok p**??**]
[$inputStream p**??**]

⟨*defun npFirstTok*⟩≡
```
(defun |npFirstTok| ()
 (declare (special |$ttok| |$stok| |$inputStream|))
 (if (null |$inputStream|)
  (setq |$stok| (|tokConstruct| 'error 'nomore (|tokPosn| |$stok|)))
  (setq |$stok| (car |$inputStream|)))
 (setq |$ttok| (|tokPart| |$stok|)))
```

7.0.242 defun Push one item onto $stack

[$stack p??]

⟨*defun npPush 0*⟩≡
```
(defun |npPush| (x)
 (declare (special |$stack|))
  (push x |$stack|))
```

7.0.243 defun Pop one item off $stack

[$stack p??]

⟨*defun npPop1 0*⟩≡
```
(defun |npPop1| ()
 (declare (special |$stack|))
 (pop |$stack|))
```

7.0.244 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))
```

7.0.245 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))
```

7.0.246 defun npQualDef

[npComma p160]
[npPush p158]
[npPop1 p158]

⟨*defun npQualDef*⟩≡
```
(defun |npQualDef| ()
 (and (|npComma|) (|npPush| (list (|npPop1|)))))
```

7.0.247 defun Advance over a keyword

Test for the keyword, if found advance the token stream [npNext p160]
[$ttok p**??**]
[$stok p**??**]

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

7.0.248 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 p157]
[$inputStream p**??**]

⟨*defun npNext*⟩≡
```
(defun |npNext| ()
 (declare (special |$inputStream|))
  (setq |$inputStream| (cdr |$inputStream|))
  (|npFirstTok|))
```

7.0.249 defun npComma

[npTuple p160]
[npQualifiedDefinition p161]

⟨*defun npComma*⟩≡
```
(defun |npComma| ()
 (|npTuple| #'|npQualifiedDefinition|))
```

7.0.250 defun npTuple

[npListofFun p244]
[npCommaBackSet p161]
[pfTupleListOf p318]

⟨*defun npTuple*⟩≡
```
(defun |npTuple| (|p|)
 (|npListofFun| |p| #'|npCommaBackSet| #'|pfTupleListOf|))
```

7.0.251 defun npCommaBackSet

[npEqKey p159]

⟨*defun npCommaBackSet*⟩≡
```
(defun |npCommaBackSet| ()
 (and
  (|npEqKey| 'comma)
  (or (|npEqKey| 'backset) t)))
```

7.0.252 defun npQualifiedDefinition

[npQualified p161]
[npDefinitionOrStatement p162]

⟨*defun npQualifiedDefinition*⟩≡
```
(defun |npQualifiedDefinition| ()
 (|npQualified| #'|npDefinitionOrStatement|))
```

7.0.253 defun npQualified

[npEqKey p159]
[npDefinition p183]
[npTrap p235]
[npPush p158]
[pfWhere p320]
[npPop1 p158]
[npLetQualified p183]

⟨*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)))
```

7.0.254 defun npDefinitionOrStatement

[npBackTrack p162]
[npGives p162]
[npDef p206]

⟨*defun npDefinitionOrStatement*⟩≡
```
(defun |npDefinitionOrStatement| ()
 (|npBackTrack| #'|npGives| 'def #'|npDef|))
```

7.0.255 defun npBackTrack

[npState p234]
[npEqPeek p166]
[npRestore p166]
[npTrap p235]

⟨*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)))))
```

7.0.256 defun npGives

[npBackTrack p162]
[npExit p239]
[npLambda p163]

⟨*defun npGives*⟩≡
```
(defun |npGives| ()
 (|npBackTrack| #'|npExit| 'gives #'|npLambda|))
```

7.0.257 defun npLambda

[npVariable p236]
[npLambda p163]
[npTrap p235]
[npPush p158]
[pfLam p301]
[npPop2 p158]
[npPop1 p158]
[npEqKey p159]
[npDefinitionOrStatement p162]
[npType p164]
[pfReturnTyped p312]

⟨*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|))))))
```

7.0.258 defun npType

[npMatch p164]
[npPop1 p158]
[npWith p165]
[npPush p158]

⟨*defun npType*⟩≡
```
(defun |npType| ()
 (and
  (|npMatch|)
  (let ((a (|npPop1|)))
   (or
    (|npWith| a)
    (|npPush| a)))))
```

7.0.259 defun npMatch

[npLeftAssoc p228]
[npSuch p164]

⟨*defun npMatch*⟩≡
```
(defun |npMatch| ()
 (|npLeftAssoc| '(is isnt) #'|npSuch|))
```

7.0.260 defun npSuch

[npLeftAssoc p228]
[npLogical p218]

⟨*defun npSuch*⟩≡
```
(defun |npSuch| ()
 (|npLeftAssoc| '(bar) #'|npLogical|))
```

7.0.261 defun npWith

[npEqKey p159]
[npState p234]
[npCategoryL p167]
[npTrap p235]
[npEqPeek p166]
[npRestore p166]
[npVariable p236]
[npCompMissing p165]
[npPush p158]
[pfWith p321]
[npPop2 p158]
[npPop1 p158]
[pfNothing p276]

⟨*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)))))))
```

7.0.262 defun npCompMissing

[npEqKey p159]
[npMissing p166]

⟨*defun npCompMissing*⟩≡
```
(defun |npCompMissing| (s)
 (or (|npEqKey| s) (|npMissing| s)))
```

7.0.263 defun npMissing

[trappoint p??]
[ncSoftError p378]
[tokPosn p445]
[pname p??]
[$stok p??]

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

7.0.264 defun npRestore

[npFirstTok p157]
[$stack p??]
[$inputStream p??]

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

7.0.265 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|)))
```

7.0.266 defun npCategoryL

[npCategory p167]
[npPush p158]
[pfUnSequence p319]
[npPop1 p158]

⟨*defun npCategoryL*⟩≡
```
(defun |npCategoryL| ()
 (and
  (|npCategory|)
  (|npPush| (|pfUnSequence| (|npPop1|)))))
```

7.0.267 defun npCategory

[npPP p232]
[npSCategory p168]

⟨*defun npCategory*⟩≡
```
(defun |npCategory| ()
 (|npPP| #'|npSCategory|))
```

7.0.268 defun npSCategory

[npWConditional p215]
[npCategoryL p167]
[npPush p158]
[npPop1 p158]
[npDefaultValue p215]
[npState p234]
[npPrimary p172]
[npEqPeek p166]
[npRestore p166]
[npSignature p169]
[npApplication p178]
[pfAttribute p284]
[npTrap p235]

⟨*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))))))
```

7.0.269 defun npSignature

[npSigItemlist p169]
[npPush p158]
[pfWDec p319]
[pfNothing p276]
[npPop1 p158]

⟨*defun npSignature*⟩≡
```
(defun |npSignature| ()
 (and (|npSigItemlist|) (|npPush| (|pfWDec| (|pfNothing|) (|npPop1|)))))
```

7.0.270 defun npSigItemlist

[npListing p169]
[npSigItem p170]
[npPush p158]
[pfListOf p275]
[pfAppend p285]
[pfParts p279]
[npPop1 p158]

⟨*defun npSigItemlist*⟩≡
```
(defun |npSigItemlist| ()
 (and
  (|npListing| #'|npSigItem|)
  (|npPush| (|pfListOf| (|pfAppend| (|pfParts| (|npPop1|)))))))
```

7.0.271 defun npListing

[npList p170]
[pfListOf p275]

⟨*defun npListing*⟩≡
```
(defun |npListing| (p)
 (|npList| p 'comma #'|pfListOf|))
```

7.0.272 defun Always produces a list, fn is applied to it

[npEqKey p159]
[npTrap p235]
[npPush p158]
[npPop3 p159]
[npPop2 p158]
[npPop1 p158]
[$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))))))
```

7.0.273 defun npSigItem

[npTypeVariable p171]
[npSigDecl p172]
[npTrap p235]

⟨*defun npSigItem*⟩≡

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

7.0.274 defun npTypeVariable

[npParenthesized p237]
[npTypeVariablelist p171]
[npSignatureDefinee p171]
[npPush p158]
[pfListOf p275]
[npPop1 p158]

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

7.0.275 defun npSignatureDefinee

[npName p224]
[npInfixOperator p176]
[npPrefixColon p177]

⟨*defun npSignatureDefinee*⟩≡
```
(defun |npSignatureDefinee| ()
 (or (|npName|) (|npInfixOperator|) (|npPrefixColon|)))
```

7.0.276 defun npTypeVariablelist

[npListing p169]
[npSignatureDefinee p171]

⟨*defun npTypeVariablelist*⟩≡
```
(defun |npTypeVariablelist| ()
 (|npListing| #'|npSignatureDefinee|))
```

7.0.277 defun npSigDecl

[npEqKey p159]
[npType p164]
[npTrap p235]
[npPush p158]
[pfSpread p268]
[pfParts p279]
[npPop2 p158]
[npPop1 p158]

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

7.0.278 defun npPrimary

[npPrimary1 p180]
[npPrimary2 p173]

⟨*defun npPrimary*⟩≡
```
(defun |npPrimary| ()
 (or (|npPrimary1|) (|npPrimary2|)))
```

7.0.279 defun npPrimary2

[npEncAp p200]
[npAtom2 p175]
[npAdd p174]
[pfNothing p276]
[npWith p165]

⟨*defun npPrimary2*⟩≡
```
(defun |npPrimary2| ()
 (or
  (|npEncAp| #'|npAtom2|)
  (|npAdd| (|pfNothing|))
  (|npWith| (|pfNothing|))))
```

7.0.280 defun npADD

TPDHERE: Note that there is also an npAdd function [npType p164]
[npPop1 p158]
[npAdd p174]
[npPush p158]

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

7.0.281 defun npAdd

TPDHERE: Note that there is also an npADD function [npEqKey p159]
[npState p234]
[npDefinitionOrStatement p162]
[npTrap p235]
[npEqPeek p166]
[npRestore p166]
[npVariable p236]
[npCompMissing p165]
[npDefinitionOrStatement p162]
[npPush p158]
[pfAdd p283]
[npPop2 p158]
[npPop1 p158]
[pfNothing p276]

⟨*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))))))))
```

7.0.282 defun npAtom2

[npInfixOperator p176]
[npAmpersand p224]
[npPrefixColon p177]
[npFromdom p223]

⟨*defun npAtom2*⟩≡

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

7.0.283 defun npInfixOperator

[npInfixOp p177]
[npState p234]
[npEqKey p159]
[npInfixOp p177]
[npPush p158]
[pfSymb p282]
[npPop1 p158]
[tokPosn p445]
[npRestore p166]
[tokConstruct p443]
[tokPart p445]
[$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))))))))
```

7.0.284 defun npInfixOp

[npPushId p231]
[$ttok p**??**]
[$stok p**??**]

⟨*defun npInfixOp*⟩≡
```
(defun |npInfixOp| ()
 (declare (special |$ttok| |$stok|))
  (and
   (eq (caar |$stok|) '|key|)
   (get |$ttok| 'infgeneric)
   (|npPushId|)))
```

7.0.285 defun npPrefixColon

[npEqPeek p166]
[npPush p158]
[tokConstruct p443]
[tokPosn p445]
[npNext p160]
[$stok p**??**]

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

7.0.286 defun npApplication

[npDotted p178]
[npPrimary p172]
[npApplication2 p179]
[npPush p158]
[pfApplication p284]
[npPop2 p158]
[npPop1 p158]

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

7.0.287 defun npDotted

[p??]

⟨*defun npDotted*⟩≡
```
(defun |npDotted| (f)
 (and (apply f nil) (|npAnyNo| #'|npSelector|)))
```

7.0.288 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)
```

7.0.289 defun npSelector

[npEqKey p159]
[npPrimary p172]
[npTrap p235]
[npPush p158]
[pfApplication p284]
[npPop2 p158]
[npPop1 p158]

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

7.0.290 defun npApplication2

[npDotted p178]
[npPrimary1 p180]
[npApplication2 p179]
[npPush p158]
[pfApplication p284]
[npPop2 p158]
[npPop1 p158]

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

7.0.291 defun npPrimary1

[npEncAp p200]
[npAtom1 p201]
[npLet p182]
[npFix p182]
[npMacro p180]
[npBPileDefinition p207]
[npDefn p206]
[npRule p213]

⟨*defun npPrimary1*⟩≡
```
(defun |npPrimary1| ()
 (or
  (|npEncAp| #'|npAtom1|)
  (|npLet|)
  (|npFix|)
  (|npMacro|)
  (|npBPileDefinition|)
  (|npDefn|)
  (|npRule|)))
```

7.0.292 defun npMacro

[npPP p232]
[npMdef p181]

⟨*defun npMacro*⟩≡
```
(defun |npMacro| ()
 (and
  (|npEqKey| 'macro)
  (|npPP| #'|npMdef|)))
```

7.0.293 defun npMdef

TPDHERE: Beware that this function occurs with uppercase also
[npQuiver p218]
[pfCheckMacroOut p270]
[npPop1 p158]
[npDefTail p214]
[npTrap p235]
[npPop1 p158]
[npPush p158]
[pfMacro p305]
[pfPushMacroBody p273]

⟨*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)))))))
```

7.0.294 defun npMDEF

TPDHERE: Beware that this function occurs with lowercase also
[npBackTrack p162]
[npStatement p188]
[npMDEFinition p182]

⟨*defun npMDEF*⟩≡
```
(defun |npMDEF| ()
 (|npBackTrack| #'|npStatement| 'mdef #'|npMDEFinition|))
```

7.0.295 defun npMDEFinition

[npPP p232]
[npMdef p181]

⟨*defun npMDEFinition*⟩≡
```
(defun |npMDEFinition| ()
 (|npPP| #'|npMdef|))
```

7.0.296 defun npFix

[npEqKey p159]
[npDef p206]
[npPush p158]
[pfFix p294]
[npPop1 p158]

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

7.0.297 defun npLet

[npLetQualified p183]
[npDefinitionOrStatement p162]

⟨*defun npLet*⟩≡
```
(defun |npLet| ()
 (|npLetQualified| #'|npDefinitionOrStatement|))
```

7.0.298 defun npLetQualified

[npEqKey p159]
[npDefinition p183]
[npTrap p235]
[npCompMissing p165]
[npPush p158]
[pfWhere p320]
[npPop2 p158]
[npPop1 p158]

⟨*defun npLetQualified*⟩≡
```
(defun |npLetQualified| (f)
 (and
  (|npEqKey| 'let)
  (or (|npDefinition|) (|npTrap|))
  (|npCompMissing| 'in)
  (or #'f (|npTrap|))
  (|npPush| (|pfWhere| (|npPop2|) (|npPop1|)))))
```

7.0.299 defun npDefinition

[npPP p232]
[npDefinitionItem p184]
[npPush p158]
[pfSequenceToList p267]
[npPop1 p158]

⟨*defun npDefinition*⟩≡
```
(defun |npDefinition| ()
 (and
  (|npPP| #'|npDefinitionItem|)
  (|npPush| (|pfSequenceToList| (|npPop1|)))))
```

7.0.300 defun npDefinitionItem

[npTyping p185]
[npImport p199]
[npState p234]
[npStatement p188]
[npEqPeek p166]
[npRestore p166]
[npDef p206]
[npMacro p180]
[npDefn p206]
[npTrap p235]

⟨*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|)))))))
```

7.0.301 defun npTyping

[npEqKey p159]
[npDefaultItemlist p185]
[npTrap p235]
[npPush p158]
[pfTyping p317]
[npPop1 p158]

⟨*defun npTyping*⟩≡
```
(defun |npTyping| ()
 (and
  (|npEqKey| 'default)
  (or (|npDefaultItemlist|) (|npTrap|))
  (|npPush| (|pfTyping| (|npPop1|)))))
```

7.0.302 defun npDefaultItemlist

[npPC p**??**]
[npSDefaultItem p186]
[npPush p158]
[pfUnSequence p319]
[npPop1 p158]

⟨*defun npDefaultItemlist*⟩≡
```
(defun |npDefaultItemlist| ()
 (and
  (|npPC| #'|npSDefaultItem|)
  (|npPush| (|pfUnSequence| (|npPop1|)))))
```

7.0.303 defun npSDefaultItem

[npListing p169]
[npDefaultItem p186]
[npPush p158]
[pfAppend p285]
[pfParts p279]
[npPop1 p158]

⟨*defun npSDefaultItem*⟩≡
```
(defun |npSDefaultItem| ()
 (and
  (|npListing| #'|npDefaultItem|)
  (|npPush| (|pfAppend| (|pfParts| (|npPop1|))))))
```

7.0.304 defun npDefaultItem

[npTypeVariable p171]
[npDefaultDecl p187]
[npTrap p235]

⟨*defun npDefaultItem*⟩≡
```
(defun |npDefaultItem| ()
 (and
  (|npTypeVariable|)
  (or (|npDefaultDecl|) (|npTrap|))))
```

7.0.305 defun npDefaultDecl

[npEqKey p159]
[npType p164]
[npTrap p235]
[npPush p158]
[pfSpread p268]
[pfParts p279]
[npPop2 p158]
[npPop1 p158]

⟨*defun npDefaultDecl*⟩≡

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

7.0.306 defun npStatement

[npExpress p198]
[npLoop p193]
[npIterate p192]
[npReturn p197]
[npBreak p193]
[npFree p192]
[npImport p199]
[npInline p192]
[npLocal p191]
[npExport p189]
[npTyping p185]
[npVoid p197]

⟨*defun npStatement*⟩≡

```
(defun |npStatement| ()
 (or
  (|npExpress|)
  (|npLoop|)
  (|npIterate|)
  (|npReturn|)
  (|npBreak|)
  (|npFree|)
  (|npImport|)
  (|npInline|)
  (|npLocal|)
  (|npExport|)
  (|npTyping|)
  (|npVoid|)))
```

7.0.307 defun npExport

[npEqKey p159]
[npLocalItemlist p189]
[npTrap p235]
[npPush p158]
[pfExport p293]
[npPop1 p158]

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

7.0.308 defun npLocalItemlist

[npPC p??]
[npSLocalItem p190]
[npPush p158]
[pfUnSequence p319]
[npPop1 p158]

⟨*defun npLocalItemlist*⟩≡
```
(defun |npLocalItemlist| ()
 (and
  (|npPC| #'|npSLocalItem|)
  (|npPush| (|pfUnSequence| (|npPop1|)))))
```

7.0.309 defun npSLocalItem

[npListing p169]
[npLocalItem p190]
[npPush p158]
[pfAppend p285]
[pfParts p279]
[npPop1 p158]

⟨*defun npSLocalItem*⟩≡
```
(defun |npSLocalItem| ()
 (and
  (|npListing| #'|npLocalItem|)
  (|npPush| (|pfAppend| (|pfParts| (|npPop1|))))))
```

7.0.310 defun npLocalItem

[npTypeVariable p171]
[npLocalDecl p191]

⟨*defun npLocalItem*⟩≡
```
(defun |npLocalItem| ()
 (and
  (|npTypeVariable|)
  (|npLocalDecl|)))))
```

7.0.311 defun npLocalDecl

[npEqKey p159]
[npType p164]
[npTrap p235]
[npPush p158]
[pfSpread p268]
[pfParts p279]
[npPop2 p158]
[npPop1 p158]
[pfNothing p276]

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

7.0.312 defun npLocal

[npEqKey p159]
[npLocalItemlist p189]
[npTrap p235]
[npPush p158]
[pfLocal p302]
[npPop1 p158]

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

7.0.313 defun npFree

[npEqKey p159]
[npLocalItemlist p189]
[npTrap p235]
[npPush p158]
[pfFree p294]
[npPop1 p158]

⟨*defun npFree*⟩≡
```
(defun |npFree| ()
 (and
  (|npEqKey| 'free)
  (or (|npLocalItemlist|) (|npTrap|))
  (|npPush| (|pfFree| (|npPop1|)))))
```

7.0.314 defun npInline

[npAndOr p200]
[npQualTypelist p199]
[pfInline p300]

⟨*defun npInline*⟩≡
```
(defun |npInline| ()
 (|npAndOr| 'inline #'|npQualTypelist| #'|pfInline|))
```

7.0.315 defun npIterate

[npEqKey p159]
[npPush p158]
[pfIterate p299]
[pfNothing p276]

⟨*defun npIterate*⟩≡
```
(defun |npIterate| ()
 (and (|npEqKey| 'iterate) (|npPush| (|pfIterate| (|pfNothing|)))))
```

7.0.316 defun npBreak

[npEqKey p159]
[npPush p158]
[pfBreak p288]
[pfNothing p276]

⟨*defun npBreak*⟩≡
```
(defun |npBreak| ()
 (and (|npEqKey| 'break) (|npPush| (|pfBreak| (|pfNothing|)))))
```

7.0.317 defun npLoop

[npIterators p194]
[npCompMissing p165]
[npAssign p239]
[npTrap p235]
[npPush p158]
[pfLp p305]
[npPop2 p158]
[npPop1 p158]
[npEqKey p159]
[pfLoop1 p304]

⟨*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|))))))
```

7.0.318 defun npIterators

[npForIn p196]
[npZeroOrMore p195]
[npIterator p194]
[npPush p158]
[npPop2 p158]
[npPop1 p158]
[npWhile p195]
[npIterators p194]

⟨*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|)))))))
```

7.0.319 defun npIterator

[npForIn p196]
[npSuchThat p195]
[npWhile p195]

⟨*defun npIterator*⟩≡
```
(defun |npIterator| ()
 (or
  (|npForIn|)
  (|npSuchThat|)
  (|npWhile|))))
```

7.0.320 defun npSuchThat

[npAndOr p200]
[npLogical p218]
[pfSuchthat p314]

⟨*defun npSuchThat*⟩≡
```
(defun |npSuchThat| ()
 (|npAndOr| 'bar #'|npLogical| #'|pfSuchthat|))
```

7.0.321 defun Apply argument 0 or more times

[npPush p158]
[npPop2 p158]
[npPop1 p158]
[$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)))))
```

7.0.322 defun npWhile

[npAndOr p200]
[npLogical p218]
[pfWhile p321]

⟨*defun npWhile*⟩≡
```
(defun |npWhile| ()
 (|npAndOr| 'while  #'|npLogical| #'|pfWhile|))
```

7.0.323 defun npForIn

[npEqKey p159]
[npVariable p236]
[npTrap p235]
[npCompMissing p165]
[npBy p220]
[npPush p158]
[pfForin p295]
[npPop2 p158]
[npPop1 p158]

⟨*defun npForIn*⟩≡

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

7.0.324 defun npReturn

[npEqKey p159]
[npExpress p198]
[npPush p158]
[pfNothing p276]
[npEqKey p159]
[npName p224]
[npTrap p235]
[pfReturn p311]
[npPop2 p158]
[npPop1 p158]
[pfReturnNoName p311]

⟨*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|))))))
```

7.0.325 defun npVoid

[npAndOr p200]
[npStatement p188]
[pfNovalue p307]

⟨*defun npVoid*⟩≡

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

7.0.326 defun npExpress

[npExpress1 p198]
[npIterators p194]
[npPush p158]
[pfCollect p290]
[npPop2 p158]
[pfListOf p275]
[npPop1 p158]

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

7.0.327 defun npExpress1

[npConditionalStatement p198]
[npADD p173]

⟨*defun npExpress1*⟩≡
```
(defun |npExpress1| ()
 (or (|npConditionalStatement|) (|npADD|)))
```

7.0.328 defun npConditionalStatement

[npConditional p216]
[npQualifiedDefinition p161]

⟨*defun npConditionalStatement*⟩≡
```
(defun |npConditionalStatement| ()
 (|npConditional| #'|npQualifiedDefinition|))
```

7.0.329 defun npImport

[npAndOr p200]
[npQualTypelist p199]
[pfImport p299]

⟨*defun npImport*⟩≡
```
(defun |npImport| ()
 (|npAndOr| 'import #'|npQualTypelist| #'|pfImport|))
```

7.0.330 defun npQualTypelist

[npPC p**??**]
[npSQualTypelist p199]
[npPush p158]
[pfUnSequence p319]
[npPop1 p158]

⟨*defun npQualTypelist*⟩≡
```
(defun |npQualTypelist| ()
 (and
  (|npPC| #'|npSQualTypelist|)
  (|npPush| (|pfUnSequence| (|npPop1|)))))
```

7.0.331 defun npSQualTypelist

[npListing p169]
[npQualType p200]
[npPush p158]
[pfParts p279]
[npPop1 p158]

⟨*defun npSQualTypelist*⟩≡
```
(defun |npSQualTypelist| ()
 (and
  (|npListing| #'|npQualType|)
  (|npPush| (|pfParts| (|npPop1|)))))
```

7.0.332 defun npQualType

[npType p164]
[npPush p158]
[pfQualType p309]
[npPop1 p158]
[pfNothing p276]

⟨*defun npQualType*⟩≡
```
(defun |npQualType| ()
 (and
  (|npType|)
  (|npPush| (|pfQualType| (|npPop1|) (|pfNothing|)))))
```

7.0.333 defun npAndOr

[npEqKey p159]
[npTrap p235]
[npPush p158]
[npPop1 p158]

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

7.0.334 defun npEncAp

[npAnyNo p178]
[npEncl p201]
[npFromdom p223]

⟨*defun npEncAp*⟩≡
```
(defun |npEncAp| (f)
 (and (apply f nil) (|npAnyNo| #'|npEncl|) (|npFromdom|)))
```

7.0.335 defun npEncl

[npBDefinition p204]
[npPush p158]
[pfApplication p284]
[npPop2 p158]
[npPop1 p158]

⟨*defun npEncl*⟩≡
```
(defun |npEncl| ()
 (and
  (|npBDefinition|)
  (|npPush| (|pfApplication| (|npPop2|) (|npPop1|)))))
```

7.0.336 defun npAtom1

[npPDefinition p202]
[npName p224]
[npConstTok p203]
[npDollar p202]
[npBDefinition p204]
[npFromdom p223]

⟨*defun npAtom1*⟩≡
```
(defun |npAtom1| ()
 (or
  (|npPDefinition|)
  (and
   (or (|npName|) (|npConstTok|) (|npDollar|) (|npBDefinition|))
   (|npFromdom|))))
```

7.0.337 defun npPDefinition

[npParenthesized p237]
[npDefinitionlist p212]
[npPush p158]
[pfEnSequence p292]
[npPop1 p158]

⟨*defun npPDefinition*⟩≡
```
(defun |npPDefinition| ()
 (and
  (|npParenthesized| #'|npDefinitionlist|)
  (|npPush| (|pfEnSequence| (|npPop1|)))))
```

7.0.338 defun npDollar

[npEqPeek p166]
[npPush p158]
[tokConstruct p443]
[tokPosn p445]
[npNext p160]
[$stok p**??**]

⟨*defun npDollar*⟩≡
```
(defun |npDollar| ()
 (declare (special |$stok|))
  (and (|npEqPeek| '$)
       (progn
        (|npPush| (|tokConstruct| '|id| '$ (|tokPosn| |$stok|)))
        (|npNext|))))
```

7.0.339 defun npConstTok

[tokType p445]
[npPush p158]
[npNext p160]
[npEqPeek p166]
[npState p234]
[npPrimary1 p180]
[pfSymb p282]
[npPop1 p158]
[tokPosn p445]
[npRestore p166]
[$stok p**??**]

⟨*defun npConstTok*⟩≡

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

7.0.340 defun npBDefinition

[npPDefinition p202]
[npBracketed p204]
[npDefinitionlist p212]

⟨*defun npBDefinition*⟩≡
```
(defun |npBDefinition| ()
 (or
  (|npPDefinition|)
  (|npBracketed| #'|npDefinitionlist|)))
```

7.0.341 defun npBracketed

[npParened p204]
[npBracked p205]
[npBraced p205]
[npAngleBared p205]

⟨*defun npBracketed*⟩≡
```
(defun |npBracketed| (f)
 (or
  (|npParened| f)
  (|npBracked| f)
  (|npBraced| f)
  (|npAngleBared| f)))
```

7.0.342 defun npParened

[npEnclosed p234]
[pfParen p308]

⟨*defun npParened*⟩≡
```
(defun |npParened| (f)
 (or (|npEnclosed| '|(| '|)| #'|pfParen| f)
     (|npEnclosed| '|(\|| '|\|)| #'|pfParen| f)))
```

7.0.343 defun npBracked

[npEnclosed p234]
[pfBracket p287]
[pfBracketBar p288]

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

7.0.344 defun npBraced

[npEnclosed p234]
[pfBrace p287]
[pfBraceBar p287]

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

7.0.345 defun npAngleBared

[npEnclosed p234]
[pfHide p297]

⟨*defun npAngleBared*⟩≡
```
(defun |npAngleBared| (f)
  (|npEnclosed| '|<\|| '|\|>| #'|pfHide| f))
```

7.0.346 defun npDefn

[npEqKey p159]
[npPP p232]
[npDef p206]

⟨*defun npDefn*⟩≡
```
(defun |npDefn| ()
 (and
  (|npEqKey| 'defn)
  (|npPP| #'|npDef|)))
```

7.0.347 defun npDef

[npMatch p164]
[pfCheckItOut p269]
[npPop1 p158]
[npDefTail p214]
[npTrap p235]
[npPop1 p158]
[npPush p158]
[pfDefinition p290]
[pfPushBody p280]

⟨*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)))))))
```

7.0.348 defun npBPileDefinition

[npPileBracketed p207]
[npPileDefinitionlist p208]
[npPush p158]
[pfSequence p313]
[pfListOf p275]
[npPop1 p158]

⟨*defun npBPileDefinition*⟩≡
```
(defun |npBPileDefinition| ()
 (and
  (|npPileBracketed| #'|npPileDefinitionlist|)
  (|npPush| (|pfSequence| (|pfListOf| (|npPop1|))))))
```

7.0.349 defun npPileBracketed

[npEqKey p159]
[npPush p158]
[pfNothing p276]
[npMissing p166]
[pfPile p279]
[npPop1 p158]

⟨*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)))
```

7.0.350 defun npPileDefinitionlist

[npListAndRecover p209]
[npDefinitionlist p212]
[npPush p158]
[pfAppend p285]
[npPop1 p158]

⟨*defun npPileDefinitionlist*⟩≡

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

7.0.351 defun npListAndRecover

[trappoint p??]
[npRecoverTrap p210]
[syGeneralErrorHere p212]
[npEqKey p159]
[npEqPeek p166]
[npNext p160]
[npPop1 p158]
[npPush p158]
[$inputStream p??]
[$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))))
```

7.0.352 defun npRecoverTrap

[npFirstTok p157]
[tokPosn p445]
[npMoveTo p211]
[syIgnoredFromTo p211]
[npPush p158]
[pfWrong p322]
[pfDocument p276]
[pfListOf p275]
[$stok p**??**]

⟨*defun npRecoverTrap*⟩≡

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

7.0.353 defun npMoveTo

[npEqPeek p166]
[npNext p160]
[npMoveTo p211]
[npEqKey p159]
[$inputStream p??]

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

7.0.354 defun syIgnoredFromTo

[pfGlobalLinePosn p263]
[ncSoftError p378]
[FromTo p410]
[From p409]
[To p409]

⟨*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))))
```

7.0.355 defun syGeneralErrorHere

[sySpecificErrorHere p212]

⟨*defun syGeneralErrorHere*⟩≡
```
(defun |syGeneralErrorHere| ()
 (|sySpecificErrorHere| 'S2CY0002 nil))
```

7.0.356 defun sySpecificErrorHere

[sySpecificErrorAtToken p212]
[$stok p**??**]

⟨*defun sySpecificErrorHere*⟩≡
```
(defun |sySpecificErrorHere| (key args)
 (declare (special |$stok|))
 (|sySpecificErrorAtToken| |$stok| key args))
```

7.0.357 defun sySpecificErrorAtToken

[ncSoftError p378]
[tokPosn p445]

⟨*defun sySpecificErrorAtToken*⟩≡
```
(defun |sySpecificErrorAtToken| (tok key args)
 (|ncSoftError| (|tokPosn| tok) key args))
```

7.0.358 defun npDefinitionlist

[npSemiListing p213]
[npQualDef p159]

⟨*defun npDefinitionlist*⟩≡
```
(defun |npDefinitionlist| ()
 (|npSemiListing| #'|npQualDef|))
```

7.0.359 defun npSemiListing

[npListofFun p244]
[npSemiBackSet p213]
[pfAppend p285]

⟨*defun npSemiListing*⟩≡
```
(defun |npSemiListing| (p)
 (|npListofFun| p #'|npSemiBackSet| #'|pfAppend|))
```

7.0.360 defun npSemiBackSet

[npEqKey p159]

⟨*defun npSemiBackSet*⟩≡
```
(defun |npSemiBackSet| ()
 (and (|npEqKey| 'semicolon) (or (|npEqKey| 'backset) t)))
```

7.0.361 defun npRule

[npEqKey p159]
[npPP p232]
[npSingleRule p214]

⟨*defun npRule*⟩≡
```
(defun |npRule| ()
 (and
  (|npEqKey| 'rule)
  (|npPP| #'|npSingleRule|)))
```

7.0.362 defun npSingleRule

[npQuiver p218]
[npDefTail p214]
[npTrap p235]
[npPush p158]
[pfRule p312]
[npPop2 p158]
[npPop1 p158]

⟨*defun npSingleRule*⟩≡
```
(defun |npSingleRule| ()
 (when (|npQuiver|)
  (or (|npDefTail|) (|npTrap|))
  (|npPush| (|pfRule| (|npPop2|) (|npPop1|)))))
```

7.0.363 defun npDefTail

[npEqKey p159]
[npDefinitionOrStatement p162]

⟨*defun npDefTail*⟩≡
```
(defun |npDefTail| ()
 (and
  (or (|npEqKey| 'def) (|npEqKey| 'mdef))
  (|npDefinitionOrStatement|)))
```

7.0.364 defun npDefaultValue

[npEqKey p159]
[npDefinitionOrStatement p162]
[npTrap p235]
[npPush p158]
[pfAdd p283]
[pfNothing p276]
[npPop1 p158]

⟨*defun npDefaultValue*⟩≡
```
(defun |npDefaultValue| ()
 (and
  (|npEqKey| 'default)
  (or (|npDefinitionOrStatement|) (|npTrap|))
  (|npPush| (list (|pfAdd| (|pfNothing|) (|npPop1|) (|pfNothing|))))))
```

7.0.365 defun npWConditional

[npConditional p216]
[npPush p158]
[pfTweakIf p316]
[npPop1 p158]

⟨*defun npWConditional*⟩≡
```
(defun |npWConditional| (f)
 (when (|npConditional| f) (|npPush| (|pfTweakIf| (|npPop1|)))))
```

7.0.366 defun npConditional

[npEqKey p159]
[npLogical p218]
[npTrap p235]
[npMissing p166]
[npElse p217]

⟨*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)))
```

7.0.367 defun npElse

[npState p234]
[npBacksetElse p217]
[npTrap p235]
[npPush p158]
[pfIf p298]
[npPop3 p159]
[npPop2 p158]
[npPop1 p158]
[npRestore p166]
[pfIfThenOnly p298]

⟨*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|)))))))
```

7.0.368 defun npBacksetElse

TPDHERE: Well this makes no sense. [npEqKey p159]

⟨*defun npBacksetElse*⟩≡
```
(defun |npBacksetElse| ()
 (if (|npEqKey| 'backset)
  (|npEqKey| 'else)
  (|npEqKey| 'else)))
```

7.0.369 defun npLogical

[npLeftAssoc p228]
[npDisjand p218]

⟨*defun npLogical*⟩≡
```
(defun |npLogical| ()
 (|npLeftAssoc| '(or) #'|npDisjand|))
```

7.0.370 defun npDisjand

[npLeftAssoc p228]
[npDiscrim p218]

⟨*defun npDisjand*⟩≡
```
(defun |npDisjand| ()
 (|npLeftAssoc| '(and) #'|npDiscrim|))
```

7.0.371 defun npDiscrim

[npLeftAssoc p228]
[npQuiver p218]

⟨*defun npDiscrim*⟩≡
```
(defun |npDiscrim| ()
 (|npLeftAssoc| '(case has) #'|npQuiver|))
```

7.0.372 defun npQuiver

[npRightAssoc p227]
[npRelation p219]

⟨*defun npQuiver*⟩≡
```
(defun |npQuiver| ()
 (|npRightAssoc| '(arrow larrow) #'|npRelation|))
```

7.0.373 defun npRelation

[npLeftAssoc p228]
[npSynthetic p219]

⟨*defun npRelation*⟩≡
```
(defun |npRelation| ()
 (|npLeftAssoc| '(equal notequal lt le gt ge oangle cangle) #'|npSynthetic|))
```

7.0.374 defun npSynthetic

[npBy p220]
[npAmpersandFrom p223]
[npPush p158]
[pfApplication p284]
[npPop2 p158]
[npPop1 p158]
[pfInfApplication p300]

⟨*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)
  (t nil)))
```

7.0.375 defun npBy

[npLeftAssoc p228]
[npInterval p220]

⟨*defun npBy*⟩≡
```
(defun |npBy| ()
 (|npLeftAssoc| '(by) #'|npInterval|))
```

7.0.376 defun

[npArith p221]
[npSegment p221]
[npEqPeek p166]
[npPush p158]
[pfApplication p284]
[npPop1 p158]
[pfInfApplication p300]
[npPop2 p158]

⟨*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)))
```

7.0.377 defun npSegment

[npEqPeek p166]
[npPushId p231]
[npFromdom p223]

⟨*defun npSegment*⟩≡
```
(defun |npSegment| ()
 (and (|npEqPeek| 'seg) (|npPushId|) (|npFromdom|)))
```

7.0.378 defun npArith

[npLeftAssoc p228]
[npSum p221]

⟨*defun npArith*⟩≡
```
(defun |npArith| ()
 (|npLeftAssoc| '(mod) #'|npSum|))
```

7.0.379 defun npSum

[npLeftAssoc p228]
[npTerm p222]

⟨*defun npSum*⟩≡
```
(defun |npSum| ()
 (|npLeftAssoc| '(plus minus) #'|npTerm|))
```

7.0.380 defun npTerm

[npInfGeneric p229]
[npRemainder p222]
[npPush p158]
[pfApplication p284]
[npPop2 p158]
[npPop1 p158]

⟨*defun npTerm*⟩≡
```
(defun |npTerm| ()
 (or
  (and
   (|npInfGeneric| '(minus plus))
   (or
    (and (|npRemainder|) (|npPush| (|pfApplication| (|npPop2|) (|npPop1|))))
    t))
  (|npRemainder|)))
```

7.0.381 defun npRemainder

[npLeftAssoc p228]
[npProduct p222]

⟨*defun npRemainder*⟩≡
```
(defun |npRemainder| ()
 (|npLeftAssoc| '(rem quo) #'|npProduct|))
```

7.0.382 defun npProduct

[npLeftAssoc p228]
[npPower p223]

⟨*defun npProduct*⟩≡
```
(defun |npProduct| ()
 (|npLeftAssoc|
  '(times slash backslash slashslash backslashbackslash
          slashbackslash backslashslash)
    #'|npPower|))
```

7.0.383 defun npPower

[npRightAssoc p227]
[npColon p240]

⟨*defun npPower*⟩≡
```
(defun |npPower| ()
 (|npRightAssoc| '(power carat) #'|npColon|))
```

7.0.384 defun npAmpersandFrom

[npAmpersand p224]
[npFromdom p223]

⟨*defun npAmpersandFrom*⟩≡
```
(defun |npAmpersandFrom| ()
 (and (|npAmpersand|) (|npFromdom|)))
```

7.0.385 defun npFromdom

[npEqKey p159]
[npApplication p178]
[npTrap p235]
[npFromdom1 p224]
[npPop1 p158]
[npPush p158]
[pfFromDom p296]

⟨*defun npFromdom*⟩≡
```
(defun |npFromdom| ()
 (or
  (and
   (|npEqKey| '$)
   (or (|npApplication|) (|npTrap|))
   (|npFromdom1| (|npPop1|))
   (|npPush| (|pfFromDom| (|npPop1|) (|npPop1|))))
  t))
```

7.0.386 defun npFromdom1

[npEqKey p159]
[npApplication p178]
[npTrap p235]
[npFromdom1 p224]
[npPop1 p158]
[npPush p158]
[pfFromDom p296]

⟨*defun npFromdom1*⟩≡
```
(defun |npFromdom1| (c)
 (or
  (and
   (|npEqKey| '$)
   (or (|npApplication|) (|npTrap|))
   (|npFromdom1| (|npPop1|))
   (|npPush| (|pfFromDom| (|npPop1|) c)))
  (|npPush| c)))))
```

7.0.387 defun npAmpersand

[npEqKey p159]
[npName p224]
[npTrap p235]

⟨*defun npAmpersand*⟩≡
```
(defun |npAmpersand| ()
 (and
  (|npEqKey| 'ampersand)
  (or (|npName|) (|npTrap|))))
```

7.0.388 defun npName

[npId p225]
[npSymbolVariable p226]

⟨*defun npName*⟩≡
```
(defun |npName| ()
 (or (|npId|) (|npSymbolVariable|)))
```

7.0.389 defvar $npPParg

⟨*initvars*⟩+≡
```
(defvar |$npTokToNames| (list '~ '|#| '[] '{} '|[\|\|]| '|{\|\|}|))
```

7.0.390 defun npId

[npPush p158]
[npNext p160]
[tokConstruct p443]
[tokPosn p445]
[$npTokToNames p??]
[$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)))
```

7.0.391 defun npSymbolVariable

[npState p234]
[npEqKey p159]
[npId p225]
[npPop1 p158]
[npPush p158]
[tokConstruct p443]
[tokPart p445]
[tokPosn p445]
[npRestore p166]

⟨*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))))
```

7.0.392 defun npRightAssoc

[npState p234]
[npInfGeneric p229]
[npRightAssoc p227]
[npPush p158]
[pfApplication p284]
[npPop2 p158]
[npPop1 p158]
[pfInfApplication p300]
[npRestore p166]

⟨*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))))
```

7.0.393 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 p229]
[npPush p158]
[pfApplication p284]
[npPop2 p158]
[npPop1 p158]
[pfInfApplication p300]

⟨*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))
```

7.0.394 defun npInfGeneric

[npDDInfKey p230]
[npEqKey p159]

⟨*defun npInfGeneric*⟩≡

```
(defun |npInfGeneric| (s)
 (and
  (|npDDInfKey| s)
  (or (|npEqKey| 'backset) t)))
```

7.0.395 defun npDDInfKey

[npInfKey p231]
[npState p234]
[npEqKey p159]
[npPush p158]
[pfSymb p282]
[npPop1 p158]
[tokPosn p445]
[npRestore p166]
[tokConstruct p443]
[tokPart p445]
[$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))))))))
```

7.0.396 defun npInfKey

[npPushId p231]
[$stok p**??**]
[$ttok p**??**]

⟨*defun npInfKey*⟩≡
```
(defun |npInfKey| (s)
 (declare (special |$ttok| |$stok|))
  (and (eq (caar |$stok|) '|key|) (member |$ttok| s) (|npPushId|)))
```

7.0.397 defun npPushId

[tokConstruct p443]
[tokPosn p445]
[npNext p160]
[$stack p**??**]
[$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|)))
```

7.0.398 defvar $npPParg

⟨*initvars*⟩+≡
```
(defvar *npPParg* nil "rewrite npPP without flets, using global scoping")
```

7.0.399 defun npPP

This was rewritten by NAG to remove flet. [npParened p204]
[npPPf p233]
[npPileBracketed p207]
[npPPg p233]
[npPush p158]
[pfEnSequence p292]
[npPop1 p158]
[npPParg p231]

⟨*defun npPP*⟩≡
```
(defun |npPP| (f)
 (declare (special *npPParg*))
  (setq *npPParg* f)
  (or
   (|npParened| #'npPPf)
   (and  (|npPileBracketed| #'npPPg) (|npPush| (|pfEnSequence| (|npPop1|))))
   (funcall f)))
```

7.0.400 defun npPPff

[npPop1 p158]
[npPush p158]
[$npPParg p231]

⟨*defun npPPff*⟩≡
```
(defun npPPff ()
 (and (funcall *npPParg*) (|npPush| (list (|npPop1|)))))
```

7.0.401 defun npPPg

[npListAndRecover p209]
[npPPf p233]
[npPush p158]
[pfAppend p285]
[npPop1 p158]

⟨*defun npPPg*⟩≡
```
(defun npPPg ()
 (and (|npListAndRecover| #'npPPf))
 (|npPush| (|pfAppend| (|npPop1|))))
```

7.0.402 defun npPPf

[npSemiListing p213]
[npPPff p232]

⟨*defun npPPf*⟩≡
```
(defun npPPf ()
 (|npSemiListing| #'npPPff))
```

7.0.403 defun npEnclosed

[npEqKey p159]
[npPush p158]
[pfTuple p318]
[pfListOf p275]
[npMissingMate p238]
[pfEnSequence p292]
[npPop1 p158]
[$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)))))
```

7.0.404 defun npState

[$stack p??]
[$inputStream p??]

⟨*defun npState*⟩≡
```
(defun |npState| ()
 (declare (special |$stack| |$inputStream|))
  (cons |$inputStream| |$stack|))
```

7.0.405 defun npTrap

[trappoint p**??**]
[tokPosn p445]
[ncSoftError p378]
[$stok p**??**]

⟨*defun npTrap*⟩≡
```
(defun |npTrap| ()
 (declare (special |$stok|))
  (|ncSoftError| (|tokPosn| |$stok|) 'S2CY0002 nil)
  (throw 'trappoint 'trapped))
```

7.0.406 defun npTrapForm

[trappoint p**??**]
[pfSourceStok p274]
[syGeneralErrorHere p212]
[ncSoftError p378]
[tokPosn p445]

⟨*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)))))
```

7.0.407 defun npVariable

[npParenthesized p237]
[npVariablelist p236]
[npVariableName p236]
[npPush p158]
[pfListOf p275]
[npPop1 p158]

⟨*defun npVariable*⟩≡
```
(defun |npVariable| ()
 (or
  (|npParenthesized| #'|npVariablelist|)
  (and (|npVariableName|) (|npPush| (|pfListOf| (list (|npPop1|)))))))
```

7.0.408 defun npVariablelist

[npListing p169]
[npVariableName p236]

⟨*defun npVariablelist*⟩≡
```
(defun |npVariablelist| ()
 (|npListing| #'|npVariableName|))
```

7.0.409 defun npVariableName

[npName p224]
[npDecl p237]
[npPush p158]
[pfTyped p317]
[npPop1 p158]
[pfNothing p276]

⟨*defun npVariableName*⟩≡
```
(defun |npVariableName| ()
 (and
  (|npName|)
  (or (|npDecl|) (|npPush| (|pfTyped| (|npPop1|) (|pfNothing|))))))
```

7.0.410 defun npDecl

[npEqKey p159]
[npType p164]
[npTrap p235]
[npPush p158]
[pfTyped p317]
[npPop2 p158]
[npPop1 p158]

⟨*defun npDecl*⟩≡
```
(defun |npDecl| ()
 (and
  (|npEqKey| 'colon)
  (or (|npType|) (|npTrap|))
  (|npPush| (|pfTyped| (|npPop2|) (|npPop1|)))))
```

7.0.411 defun npParenthesized

[npParenthesize p238]

⟨*defun npParenthesized*⟩≡
```
(defun |npParenthesized| (f)
 (or (|npParenthesize| '|(| '|)| f) (|npParenthesize| '|(\|| '|\|)| f)))
```

7.0.412 defun npParenthesize

[npEqKey p159]
[npMissingMate p238]
[npPush p158]
[$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))))
```

7.0.413 defun npMissingMate

[ncSoftError p378]
[tokPosn p445]
[npMissing p166]

⟨*defun npMissingMate*⟩≡

```
(defun |npMissingMate| (close open)
 (|ncSoftError| (|tokPosn| open) 'S2CY0008 nil)
 (|npMissing| close))
```

7.0.414 defun npExit

[npBackTrack p162]
[npAssign p239]
[npPileExit p239]

⟨*defun npExit*⟩≡
```
(defun |npExit| ()
 (|npBackTrack| #'|npAssign| 'exit #'|npPileExit|))
```

7.0.415 defun npPileExit

[npAssign p239]
[npEqKey p159]
[npStatement p188]
[npPush p158]
[pfExit p292]
[npPop2 p158]
[npPop1 p158]

⟨*defun npPileExit*⟩≡
```
(defun |npPileExit| ()
 (and
  (|npAssign|)
  (or (|npEqKey| 'exit) (|npTrap|))
  (or (|npStatement|) (|npTrap|))
  (|npPush| (|pfExit| (|npPop2|) (|npPop1|)))))
```

7.0.416 defun npAssign

[npBackTrack p162]
[npMDEF p181]
[npAssignment p240]

⟨*defun npAssign*⟩≡
```
(defun |npAssign| ()
 (|npBackTrack| #'|npMDEF| 'becomes #'|npAssignment|))
```

7.0.417 defun npAssignment

[npAssignVariable p240]
[npEqKey p159]
[npTrap p235]
[npGives p162]
[npPush p158]
[pfAssign p285]
[npPop2 p158]
[npPop1 p158]

⟨*defun npAssignment*⟩≡
```
(defun |npAssignment| ()
 (and
  (|npAssignVariable|)
  (or (|npEqKey| 'becomes) (|npTrap|))
  (or (|npGives|) (|npTrap|))
  (|npPush| (|pfAssign| (|npPop2|) (|npPop1|)))))
```

7.0.418 defun npAssignVariable

[npColon p240]
[npPush p158]
[pfListOf p275]
[npPop1 p158]

⟨*defun npAssignVariable*⟩≡
```
(defun |npAssignVariable| ()
 (and (|npColon|) (|npPush| (|pfListOf| (list (|npPop1|))))))
```

7.0.419 defun npColon

[npTypified p241]
[npAnyNo p178]
[npTagged p241]

⟨*defun npColon*⟩≡
```
(defun |npColon| ()
 (and (|npTypified|) (|npAnyNo| #'|npTagged|)))
```

7.0.420 defun npTagged

[npTypedForm1 p241]
[pfTagged p315]

⟨*defun npTagged*⟩≡
```
(defun |npTagged| ()
 (|npTypedForm1| 'colon #'|pfTagged|))
```

7.0.421 defun npTypedForm1

[npEqKey p159]
[npType p164]
[npTrap p235]
[npPush p158]
[npPop2 p158]
[npPop1 p158]

⟨*defun npTypedForm1*⟩≡
```
(defun |npTypedForm1| (sy fn)
 (and
  (|npEqKey| sy)
  (or (|npType|) (|npTrap|))
  (|npPush| (funcall fn (|npPop2|) (|npPop1|)))))
```

7.0.422 defun npTypified

[npApplication p178]
[npAnyNo p178]
[npTypeStyle p242]

⟨*defun npTypified*⟩≡
```
(defun |npTypified| ()
 (and (|npApplication|) (|npAnyNo| #'|npTypeStyle|)))
```

7.0.423 defun npTypeStyle

[npCoerceTo p242]
[npRestrict p243]
[npPretend p242]
[npColonQuery p242]

⟨*defun npTypeStyle*⟩≡
```
(defun |npTypeStyle| ()
 (or (|npCoerceTo|) (|npRestrict|) (|npPretend|) (|npColonQuery|)))
```

7.0.424 defun npPretend

[npTypedForm p243]
[pfPretend p309]

⟨*defun npPretend*⟩≡
```
(defun |npPretend| ()
 (|npTypedForm| 'pretend #'|pfPretend|))
```

7.0.425 defun npColonQuery

[npTypedForm p243]
[pfRetractTo p310]

⟨*defun npColonQuery*⟩≡
```
(defun |npColonQuery| ()
 (|npTypedForm| 'atat #'|pfRetractTo|))
```

7.0.426 defun npCoerceTo

[npTypedForm p243]
[pfCoerceto p289]

⟨*defun npCoerceTo*⟩≡
```
(defun |npCoerceTo| ()
 (|npTypedForm| 'coerce #'|pfCoerceto|))
```

7.0.427 defun npTypedForm

[npEqKey p159]
[npApplication p178]
[npTrap p235]
[npPush p158]
[npPop2 p158]
[npPop1 p158]

⟨*defun npTypedForm*⟩≡
```
(defun |npTypedForm| (sy fn)
 (and
  (|npEqKey| sy)
  (or (|npApplication|) (|npTrap|))
  (|npPush| (funcall fn (|npPop2|) (|npPop1|)))))
```

7.0.428 defun npRestrict

[npTypedForm p243]
[pfRestrict p310]

⟨*defun npRestrict*⟩≡
```
(defun |npRestrict| ()
 (|npTypedForm| 'at #'|pfRestrict|))
```

7.0.429 defun npListofFun

[npTrap p235]
[npPush p158]
[npPop3 p159]
[npPop2 p158]
[npPop1 p158]
[$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))))
```

7.1 Macro handling

7.1.1 defun phMacro

TPDHERE: The pform function has a leading percent sign. fix this

```
carrier[ptree,...] -> carrier[ptree, ptreePremacro,...]
```

[ncEltQ p448]
[ncPutQ p449]
[macroExpanded p245]
[intSayKeyedMsg p73]
[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))
```

7.1.2 defun macroExpanded

$macActive is a list of the bodies being expanded. $posActive is a list of the parse forms where the bodies came from. [macExpand p246]
[$posActive p??]
[$macActive p??]

⟨*defun macroExpanded*⟩≡

```
(defun |macroExpanded| (pf)
 (let (|$posActive| |$macActive|)
 (declare (special |$posActive| |$macActive|))
  (setq |$macActive| nil)
  (setq |$posActive| nil)
  (|macExpand| pf)))
```

7.1.3 defun macExpand

[pfWhere? p320]
[macWhere p253]
[pfLambda? p302]
[macLambda p253]
[pfMacro? p305]
[macMacro p255]
[pfId? p277]
[macId p252]
[pfApplication? p285]
[macApplication p247]
[pfMapParts p265]
[macExpand p246]

⟨*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))))
```

7.1.4 defun macApplication

[pfMapParts p265]
[macExpand p246]
[pfApplicationOp p284]
[pfMLambda? p306]
[pf0ApplicationArgs p265]
[mac0MLambdaApply p248]
[$pfMacros p107]

⟨*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|)))))
```

7.1.5 defun mac0MLambdaApply

TPDHERE: The pform function has a leading percent sign. fix this
[pf0MLambdaArgs p306]
[pfMLambdaBody p306]
[pfSourcePosition p267]
[ncHardError p379]
[pfId? p277]
[pform p**??**]
[mac0Define p256]
[mac0ExpandBody p249]
[$pfMacros p107]
[$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))
    (|ncHardError| 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))
          (|ncHardError| 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|)))))
```

7.1.6 defun mac0ExpandBody

[pfSourcePosition p267]
[mac0InfiniteExpansion p250]
[macExpand p246]
[$posActive p**??**]
[$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)))))
```

7.1.7 defun mac0InfiniteExpansion

TPDHERE: The pform function has a leading percent sign. fix this
[mac0InfiniteExpansion,name p250]
[ncSoftError p378]
[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))
```

7.1.8 defun mac0InfiniteExpansion,name

[mac0GetName p251]
[pname p**??**]

⟨*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))))))
```

7.1.9 defun mac0GetName

Returns [state, body] or NIL. Returns [sy, state] or NIL. [pfMLambdaBody p306]
[$pfMacros p107]

⟨*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))
```

7.1.10 defun macId

[pfIdSymbol p277]
[mac0Get p252]
[pfCopyWithPos p264]
[pfSourcePosition p267]
[mac0ExpandBody p249]
[$posActive p??]
[$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))))))))
```

7.1.11 defun mac0Get

[ifcdr p??]
[$pfMacros p107]

⟨*defun mac0Get*⟩≡
```
(defun |mac0Get| (sy)
 (declare (special |$pfMacros|))
 (ifcdr (assoc sy |$pfMacros|)))
```

7.1.12 defun macWhere

[macWhere,mac p253]
[$pfMacros p107]

⟨*defun macWhere*⟩≡
```
(defun |macWhere| (pf)
 (declare (special |$pfMacros|))
 (|macWhere,mac| pf |$pfMacros|))
```

7.1.13 defun macWhere,mac

[pfMapParts p265]
[macExpand p246]
[$pfMacros p107]

⟨*defun macWhere,mac*⟩≡
```
(defun |macWhere,mac| (pf |$pfMacros|)
 (declare (special |$pfMacros|))
 (|pfMapParts| #'|macExpand| pf))
```

7.1.14 defun macLambda

[macLambda,mac p254]
[$pfMacros p107]

⟨*defun macLambda*⟩≡
```
(defun |macLambda| (pf)
 (declare (special |$pfMacros|))
 (|macLambda,mac| pf |$pfMacros|))
```

7.1.15 defun macLambda,mac

[pfMapParts p265]
[macExpand p246]
[$pfMacros p107]

⟨*defun macLambda,mac*⟩≡

```
(defun |macLambda,mac| (pf |$pfMacros|)
 (declare (special |$pfMacros|))
 (|pfMapParts| #'|macExpand| pf))
```

7.1.16 defun Add appropriate definition the a Macro pform

This function adds the appropriate definition and returns the original Macro pform. **TPDHERE: The pform function has a leading percent sign. fix this** [pfMacroLhs p305]
[pfMacroRhs p305]
[pfId? p277]
[ncSoftError p378]
[pfSourcePosition p267]
[pfIdSymbol p277]
[mac0Define p256]
[pform p**??**]
[pfMLambda? p306]
[macSubstituteOuter p256]
[pfNothing? p276]
[pfMacro p305]
[pfNothing p276]

⟨*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|)))))))))
```

7.1.17 defun Add a macro to the global pfMacros list

[$pfMacros p107]

⟨*defun mac0Define 0*⟩≡
```
(defun |mac0Define| (sy state body)
 (declare (special |$pfMacros|))
  (setq |$pfMacros| (cons (list sy state body) |$pfMacros|)))
```

7.1.18 defun macSubstituteOuter

[mac0SubstituteOuter p257]
[macLambdaParameterHandling p258]

⟨*defun macSubstituteOuter*⟩≡
```
(defun |macSubstituteOuter| (pform)
 (|mac0SubstituteOuter| (|macLambdaParameterHandling| nil pform) pform))
```

7.1.19 defun mac0SubstituteOuter

[pfId? p277]
[macSubstituteId p259]
[pfLeaf? p278]
[pfLambda? p302]
[macLambdaParameterHandling p258]
[mac0SubstituteOuter p257]
[pfParts p279]

⟨*defun mac0SubstituteOuter*⟩≡

```
(defun |mac0SubstituteOuter| (replist 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))))
```

7.1.20 defun macLambdaParameterHandling

[pfLeaf? p278]
[pfLambda? p302]
[pfTypedId p317]
[pf0LambdaArgs p302]
[pfIdSymbol p277]
[AlistRemoveQ p??]
[pfMLambda? p306]
[pf0MLambdaArgs p306]
[pfLeaf p277]
[pfAbSynOp p444]
[pfLeafPosition p278]
[pfParts p279]
[macLambdaParameterHandling p258]

⟨*defun macLambdaParameterHandling*⟩≡

```
(defun |macLambdaParameterHandling| (replist 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 (|AlistRemoveQ| par replist)))
    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))))))
```

7.1.21 defun macSubstituteId

[AlistAssocQ p??]
[pfIdSymbol p277]

⟨*defun macSubstituteId*⟩≡

```
(defun |macSubstituteId| (replist pform)
 (let (ex)
  (setq ex (|AlistAssocQ| (|pfIdSymbol| pform) replist))
  (cond
    (ex
     (rplpair pform (cdr ex))
     pform)
    (t pform))))
```

Chapter 8

Pftrees

8.1 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)

8.2 Structure handlers

8.2.1 defun pfGlobalLinePosn

[poGlobalLinePosn p81]

⟨*defun pfGlobalLinePosn*⟩≡
```
(defun |pfGlobalLinePosn| (posn)
 (|poGlobalLinePosn| posn))
```

8.2.2 defun pfCharPosn

[poCharPosn p405]

⟨*defun pfCharPosn*⟩≡
```
(defun |pfCharPosn| (posn)
 (|poCharPosn| posn))
```

8.2.3 defun pfLinePosn

[poLinePosn p389]

⟨*defun pfLinePosn*⟩≡
```
(defun |pfLinePosn| (posn)
 (|poLinePosn| posn))
```

8.2.4 defun pfFileName

[poFileName p388]

⟨*defun pfFileName*⟩≡
```
(defun |pfFileName| (posn)
 (|poFileName| posn))
```

8.2.5 defun pfCopyWithPos

[pfLeaf? p278]
[pfLeaf p277]
[pfAbSynOp p444]
[tokPart p445]
[pfTree p283]
[pfParts p279]
[pfCopyWithPos p264]

⟨*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)))))
```

8.2.6 defun pfMapParts

[pfLeaf? p278]
[pfParts p279]
[pfTree p283]
[pfAbSynOp p444]

⟨*defun pfMapParts*⟩≡
```
(defun |pfMapParts| (f pform)
 (let (same 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))))))
```

8.2.7 defun pf0ApplicationArgs

[pf0FlattenSyntacticTuple p266]
[pfApplicationArg p284]

⟨*defun pf0ApplicationArgs*⟩≡
```
(defun |pf0ApplicationArgs| (pform)
  (|pf0FlattenSyntacticTuple| (|pfApplicationArg| pform)))
```

8.2.8 defun pf0FlattenSyntacticTuple

[pfTuple? p318]
[pf0FlattenSyntacticTuple p266]
[pf0TupleParts p319]

⟨*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)))
```

8.2.9 defun pfSourcePosition

[pfLeaf? p278]
[pfLeafPosition p278]
[poNoPosition? p445]
[pfSourcePosition p267]
[pfParts p279]
[$nopos p27]

⟨*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))))
```

8.2.10 defun Convert a Sequence node to a list

[pfSequence? p313]
[pfSequenceArgs p313]
[pfListOf p275]

⟨*defun pfSequenceToList*⟩≡
```
(defun |pfSequenceToList| (x)
 (if (|pfSequence?| x)
  (|pfSequenceArgs| x)
  (|pfListOf| (list x))))
```

8.2.11 defun pfSpread

[pfTyped p317]

⟨*defun pfSpread*⟩≡

```
(defun |pfSpread| (arg1 arg2)
 (mapcar #'(lambda (i) (|pfTyped| i arg2)) arg1))
```

8.2.12 defun Deconstruct nodes to lists

[pfTagged? p315]
[pfTaggedExpr p315]
[pfNothing p276]
[pfTaggedTag p315]
[pfId? p277]
[pfListOf p275]
[pfTyped p317]
[pfCollect1? p272]
[pfCollectVariable1 p273]
[pfTuple? p318]
[pf0TupleParts p319]
[pfTaggedToTyped p316]
[pfDefinition? p291]
[pfApplication? p285]
[pfFlattenApp p272]
[pfTaggedToTyped1 p275]
[pfTransformArg p274]
[npTrapForm p235]

⟨*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)))))
```

8.2.13 defun pfCheckMacroOut

[pfId? p277]
[pfApplication? p285]
[pfFlattenApp p272]
[pfCheckId p271]
[pfCheckArg p271]
[npTrapForm p235]

⟨*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)))))
```

8.2.14 defun pfCheckArg

[pfTuple? p318]
[pf0TupleParts p319]
[pfListOf p275]
[pfCheckId p271]

⟨*defun pfCheckArg*⟩≡
```
(defun |pfCheckArg| (args)
 (let (argl)
  (if (|pfTuple?| args)
   (setq argl (|pf0TupleParts| args))
   (setq argl (list args)))
  (|pfListOf| (mapcar #'|pfCheckId| argl))))
```

8.2.15 defun pfCheckId

[pfId? p277]
[npTrapForm p235]

⟨*defun pfCheckId*⟩≡
```
(defun |pfCheckId| (form)
 (if (null (|pfId?| form))
  (|npTrapForm| form)
  form))
```

8.2.16 defun pfFlattenApp

[pfApplication? p285]
[pfCollect1? p272]
[pfFlattenApp p272]
[pfApplicationOp p284]
[pfApplicationArg p284]

⟨*defun pfFlattenApp*⟩≡
```
(defun |pfFlattenApp| (x)
 (cond
  ((|pfApplication?| x)
   (cond
    ((|pfCollect1?| x) (LIST x))
    (t
     (append (|pfFlattenApp| (|pfApplicationOp| x))
             (|pfFlattenApp| (|pfApplicationArg| x))))))
  (t (list x))))
```

8.2.17 defun pfCollect1?

[pfApplication? p285]
[pfApplicationOp p284]
[pfId? p277]
[pfIdSymbol p277]

⟨*defun pfCollect1?*⟩≡
```
(defun |pfCollect1?| (x)
 (let (a)
  (when (|pfApplication?| x)
   (setq a (|pfApplicationOp| x))
   (when (|pfId?| a) (eq (|pfIdSymbol| a) '|\||)))))
```

8.2.18 defun pfCollectVariable1

[pfApplicationArg p284]
[pf0TupleParts p319]
[pfTaggedToTyped p316]
[pfTyped p317]
[pfSuch p275]
[pfTypedId p317]
[pfTypedType p317]

⟨*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))))
```

8.2.19 defun pfPushMacroBody

[pfMLambda p306]
[pfPushMacroBody p273]

⟨*defun pfPushMacroBody*⟩≡
```
(defun |pfPushMacroBody| (args body)
 (if (null args)
   body
   (|pfMLambda| (car args) (|pfPushMacroBody| (cdr args) body))))
```

8.2.20 defun pfSourceStok

[pfLeaf? p278]
[pfParts p279]
[pfSourceStok p274]
[pfFirst p294]

⟨*defun pfSourceStok*⟩≡
```
(defun |pfSourceStok| (x)
 (cond
  ((|pfLeaf?| x) x)
  ((null (|pfParts| x)) '|NoToken|)
  (t (|pfSourceStok| (|pfFirst| x)))))
```

8.2.21 defun pfTransformArg

[pfTuple? p318]
[pf0TupleParts p319]
[pfListOf p275]
[pfTaggedToTyped1 p275]

⟨*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)))))
```

8.2.22 defun pfTaggedToTyped1

[pfCollect1? p272]
[pfCollectVariable1 p273]
[pfDefinition? p291]
[pfTyped p317]
[pfNothing p276]
[pfTaggedToTyped p316]

⟨*defun pfTaggedToTyped1*⟩≡
```
(defun |pfTaggedToTyped1| (arg)
 (cond
  ((|pfCollect1?| arg) (|pfCollectVariable1| arg))
  ((|pfDefinition?| arg) (|pfTyped| arg (|pfNothing|)))
  (t (|pfTaggedToTyped| arg))))
```

8.2.23 defun pfSuch

[pfInfApplication p300]
[pfId p276]

⟨*defun pfSuch*⟩≡
```
(defun |pfSuch| (x y)
 (|pfInfApplication| (|pfId| '|\||) x y))
```

8.3 Special Nodes

8.3.1 defun Create a Listof node

[pfTree p283]

⟨*defun pfListOf*⟩≡
```
(defun |pfListOf| (x)
 (|pfTree| '|listOf| x))
```

8.3.2 defun pfNothing

[pfTree p283]

⟨*defun pfNothing*⟩≡
```
(defun |pfNothing| ()
 (|pfTree| '|nothing| nil))
```

8.3.3 defun Is this a Nothing node?

[pfAbSynOp? p444]

⟨*defun pfNothing?*⟩≡
```
(defun |pfNothing?| (form)
 (|pfAbSynOp?| form '|nothing|))
```

8.4 Leaves

8.4.1 defun Create a Document node

[pfLeaf p277]

⟨*defun pfDocument*⟩≡
```
(defun |pfDocument| (strings)
 (|pfLeaf| '|Document| strings))
```

8.4.2 defun Construct an Id node

[pfLeaf p277]

⟨*defun pfId*⟩≡
```
(defun |pfId| (expr)
 (|pfLeaf| '|id| expr))
```

8.4.3 defun Is this an Id node?

[pfAbSynOp? p444]

⟨*defun pfId?*⟩≡
```
(defun |pfId?| (form)
 (or (|pfAbSynOp?| form '|id|) (|pfAbSynOp?| form '|idsy|)))
```

8.4.4 defun Construct an Id leaf node

[pfLeaf p277]

⟨*defun pfIdPos*⟩≡
```
(defun |pfIdPos| (expr pos)
 (|pfLeaf| '|id| expr pos))
```

8.4.5 defun Return the Id part

[tokPart p445]

⟨*defun pfIdSymbol*⟩≡
```
(defun |pfIdSymbol| (form)
 (|tokPart| form))
```

8.4.6 defun Construct a Leaf node

[tokConstruct p443]
[ifcar p**??**]
[pfNoPosition p446]

⟨*defun pfLeaf*⟩≡
```
(defun |pfLeaf| (x y &rest z)
 (|tokConstruct| x y (or (ifcar z) (|pfNoPosition|))))
```

8.4.7 defun Is this a leaf node?

[pfAbSynOp p444]

⟨*defun pfLeaf?*⟩≡
```
(defun |pfLeaf?| (form)
 (member (|pfAbSynOp| form)
   '(|id| |idsy| |symbol| |string| |char| |float| |expression|
     |integer| |Document| |error|)))
```

8.4.8 defun Return the token position of a leaf node

[tokPosn p445]

⟨*defun pfLeafPosition*⟩≡
```
(defun |pfLeafPosition| (form)
 (|tokPosn| form))
```

8.4.9 defun Return the Leaf Token

[tokPart p445]

⟨*defun pfLeafToken*⟩≡
```
(defun |pfLeafToken| (form)
 (|tokPart| form))
```

8.4.10 defun Is this a Literal node?

[pfAbSynOp p444]

⟨*defun pfLiteral? 0*⟩≡
```
(defun |pfLiteral?| (form)
 (member (|pfAbSynOp| form)
  '(|integer| |symbol| |expression| |one| |zero| |char| |string| |float|)))
```

8.4.11 defun Create a LiteralClass node

[pfAbSynOp p444]

⟨*defun pfLiteralClass*⟩≡
```
(defun |pfLiteralClass| (form)
 (|pfAbSynOp| form))
```

8.4.12 defun Return the LiteralString

[tokPart p445]

⟨*defun pfLiteralString*⟩≡
```
(defun |pfLiteralString| (form)
 (|tokPart| form))
```

8.4.13 defun Return the parts of a tree node

⟨*defun pfParts 0*⟩≡
```
(defun |pfParts| (form)
 (cdr form))
```

8.4.14 defun Return the argument unchanged

⟨*defun pfPile 0*⟩≡
```
(defun |pfPile| (part)
 part)
```

8.4.15 defun pfPushBody

[pfLambda p301]
[pfNothing p276]
[pfPushBody p280]

⟨*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)))))
```

8.4.16 defun An S-expression which people can read.

[pfSexpr,strip p281]

⟨*defun pfSexpr*⟩≡
```
(defun |pfSexpr| (pform)
 (|pfSexpr,strip| pform))
```

8.4.17 defun Create a human readable S-expression

[pfId? p277]
[pfIdSymbol p277]
[pfLiteral? p278]
[pfLiteralString p279]
[pfLeaf? p278]
[tokPart p445]
[pfApplication? p285]
[pfApplicationArg p284]
[pfTuple? p318]
[pf0TupleParts p319]
[pfApplicationOp p284]
[pfSexpr,strip p281]
[pfAbSynOp p444]
[pfParts p279]

⟨*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)))))))
```

8.4.18 defun Construct a Symbol or Expression node

[pfLeaf? p278]
[pfSymbol p282]
[tokPart p445]
[ifcar p??]
[pfExpression p293]
[pfSexpr p280]

⟨*defun pfSymb*⟩≡
```
(defun |pfSymb| (expr &REST optpos)
 (if (|pfLeaf?| expr)
  (|pfSymbol| (|tokPart| expr) (ifcar optpos))
  (|pfExpression| (|pfSexpr| expr) (ifcar optpos))))
```

8.4.19 defun Construct a Symbol leaf node

[pfLeaf p277]
[ifcar p??]

⟨*defun pfSymbol*⟩≡
```
(defun |pfSymbol| (expr &rest optpos)
 (|pfLeaf| '|symbol| expr (ifcar optpos)))
```

8.4.20 defun Is this a Symbol node?

[pfAbSynOp? p444]

⟨*defun pfSymbol?*⟩≡
```
(defun |pfSymbol?| (form)
 (|pfAbSynOp?| form '|symbol|))
```

8.4.21 defun Return the Symbol part

[tokPart p445]

⟨*defun pfSymbolSymbol*⟩≡
```
(defun |pfSymbolSymbol| (form)
 (|tokPart| form))
```

8.5 Trees

8.5.1 defun Construct a tree node

⟨*defun pfTree 0*⟩≡
```
(defun |pfTree| (x y)
 (cons x y))))
```

8.5.2 defun Construct an Add node

[pfNothing p276]
[pfTree p283]

⟨*defun pfAdd*⟩≡
```
(defun |pfAdd| (pfbase pfaddin &rest addon)
 (let (lhs)
  (if addon
   (setq lhs addon)
   (setq lhs (|pfNothing|)))
  (|pfTree| '|Add| (list pfbase pfaddin lhs))))
```

8.5.3 defun Construct an And node

[pfTree p283]

⟨*defun pfAnd*⟩≡
```
(defun |pfAnd| (pfleft pfright)
 (|pfTree| '|And| (list pfleft pfright)))
```

8.5.4 defun pfAttribute

[pfTree p283]

⟨*defun pfAttribute*⟩≡
```
(defun |pfAttribute| (pfexpr)
 (|pfTree| '|Attribute| (list pfexpr)))
```

8.5.5 defun Return an Application node

[pfTree p283]

⟨*defun pfApplication*⟩≡
```
(defun |pfApplication| (pfop pfarg)
 (|pfTree| '|Application| (list pfop pfarg)))
```

8.5.6 defun Return the Arg part of an Application node

⟨*defun pfApplicationArg 0*⟩≡
```
(defun |pfApplicationArg| (pf)
 (caddr pf))
```

8.5.7 defun Return the Op part of an Application node

⟨*defun pfApplicationOp 0*⟩≡
```
(defun |pfApplicationOp| (pf)
 (cadr pf))
```

8.5.8 defun Is this an And node?

[pfAbSynOp? p444]

⟨*defun pfAnd?*⟩≡
```
(defun |pfAnd?| (pf)
 (|pfAbSynOp?| pf '|And|))
```

8.5.9 defun Return the Left part of an And node

⟨*defun pfAndLeft 0*⟩≡
```
(defun |pfAndLeft| (pf)
 (cadr pf))
```

8.5.10 defun Return the Right part of an And node

⟨*defun pfAndRight 0*⟩≡
```
(defun |pfAndRight| (pf)
 (caddr pf))
```

8.5.11 defun Flatten a list of lists

⟨*defun pfAppend 0*⟩≡
```
(defun |pfAppend| (list)
 (apply #'append list))
```

8.5.12 defun Is this an Application node?

[pfAbSynOp? p444]

⟨*defun pfApplication?*⟩≡
```
(defun |pfApplication?| (pf)
  (|pfAbSynOp?| pf '|Application|))
```

8.5.13 defun Create an Assign node

[pfTree p283]

⟨*defun pfAssign*⟩≡
```
(defun |pfAssign| (pflhsitems pfrhs)
 (|pfTree| '|Assign| (list pflhsitems pfrhs)))
```

8.5.14 defun Is this an Assign node?

[pfAbSynOp? p444]

⟨*defun pfAssign?*⟩≡
```
(defun |pfAssign?| (pf)
 (|pfAbSynOp?| pf '|Assign|))
```

8.5.15 defun Return the parts of an LhsItem of an Assign node

[pfParts p279]
[pfAssignLhsItems p286]

⟨*defun pf0AssignLhsItems 0*⟩≡
```
(defun |pf0AssignLhsItems| (pf)
 (|pfParts| (|pfAssignLhsItems| pf)))
```

8.5.16 defun Return the LhsItem of an Assign node

⟨*defun pfAssignLhsItems 0*⟩≡
```
(defun |pfAssignLhsItems| (pf)
 (cadr pf))
```

8.5.17 defun Return the RHS of an Assign node

⟨*defun pfAssignRhs 0*⟩≡
```
(defun |pfAssignRhs| (pf)
 (caddr pf))
```

8.5.18 defun Construct an application node for a brace

[pfApplication p284]
[pfIdPos p277]
[tokPosn p445]

⟨*defun pfBrace*⟩≡
```
(defun |pfBrace| (a part)
 (|pfApplication| (|pfIdPos| '{} (|tokPosn| a)) part))
```

8.5.19 defun Construct an Application node for brace-bars

[pfApplication p284]
[pfIdPos p277]
[tokPosn p445]

⟨*defun pfBraceBar*⟩≡
```
(defun |pfBraceBar| (a part)
 (|pfApplication| (|pfIdPos| '|{\|\|}| (|tokPosn| a)) part))
```

8.5.20 defun Construct an Application node for a bracket

[pfApplication p284]
[pfIdPos p277]
[tokPosn p445]

⟨*defun pfBracket*⟩≡
```
(defun |pfBracket| (a part)
 (|pfApplication| (|pfIdPos| '[] (|tokPosn| a)) part))
```

8.5.21 defun Construct an Application node for bracket-bars

[pfApplication p284]
[pfIdPos p277]
[tokPosn p445]

⟨*defun pfBracketBar*⟩≡
```
(defun |pfBracketBar| (a part)
 (|pfApplication| (|pfIdPos| '|[\|\|]| (|tokPosn| a)) part))
```

8.5.22 defun Create a Break node

[pfTree p283]

⟨*defun pfBreak*⟩≡
```
(defun |pfBreak| (pffrom)
 (|pfTree| '|Break| (list pffrom)))
```

8.5.23 defun Is this a Break node?

[pfAbSynOp? p444]

⟨*defun pfBreak?*⟩≡
```
(defun |pfBreak?| (pf)
 (|pfAbSynOp?| pf '|Break|))
```

8.5.24 defun Return the From part of a Break node

⟨*defun pfBreakFrom 0*⟩≡
```
(defun |pfBreakFrom| (pf)
 (cadr pf))
```

8.5.25 defun Construct a Coerceto node

[pfTree p283]

⟨*defun pfCoerceto*⟩≡
```
(defun |pfCoerceto| (pfexpr pftype)
 (|pfTree| '|Coerceto| (list pfexpr pftype)))
```

8.5.26 defun Is this a CoerceTo node?

[pfAbSynOp? p444]

⟨*defun pfCoerceto?*⟩≡
```
(defun |pfCoerceto?| (pf)
 (|pfAbSynOp?| pf '|Coerceto|))
```

8.5.27 defun Return the Expression part of a CoerceTo node

⟨*defun pfCoercetoExpr 0*⟩≡
```
(defun |pfCoercetoExpr| (pf)
 (cadr pf))
```

8.5.28 defun Return the Type part of a CoerceTo node

⟨*defun pfCoercetoType 0*⟩≡
```
(defun |pfCoercetoType| (pf)
 (caddr pf))
```

8.5.29 defun Return the Body of a Collect node

⟨*defun pfCollectBody 0*⟩≡
```
(defun |pfCollectBody| (pf)
 (cadr pf))
```

8.5.30 defun Return the Iterators of a Collect node

⟨*defun pfCollectIterators 0*⟩≡
```
(defun |pfCollectIterators| (pf)
 (caddr pf))
```

8.5.31 defun Create a Collect node

[pfTree p283]

⟨*defun pfCollect*⟩≡
```
(defun |pfCollect| (pfbody pfiterators)
 (|pfTree| '|Collect| (list pfbody pfiterators)))
```

8.5.32 defun Is this a Collect node?

[pfAbSynOp? p444]

⟨*defun pfCollect?*⟩≡
```
(defun |pfCollect?| (pf)
 (|pfAbSynOp?| pf '|Collect|))
```

8.5.33 defun pfDefinition

[pfTree p283]

⟨*defun pfDefinition*⟩≡
```
(defun |pfDefinition| (pflhsitems pfrhs)
 (|pfTree| '|Definition| (list pflhsitems pfrhs)))
```

8.5.34 defun Return the Lhs of a Definition node

⟨*defun pfDefinitionLhsItems 0*⟩≡
```
(defun |pfDefinitionLhsItems| (pf)
 (cadr pf))
```

8.5.35 defun Return the Rhs of a Definition node

⟨*defun pfDefinitionRhs 0*⟩≡
```
(defun |pfDefinitionRhs| (pf)
 (caddr pf))
```

8.5.36 defun Is this a Definition node?

[pfAbSynOp? p444]

⟨*defun pfDefinition?*⟩≡
```
(defun |pfDefinition?| (pf)
 (|pfAbSynOp?| pf '|Definition|))
```

8.5.37 defun Return the parts of a Definition node

[pfParts p279]
[pfDefinitionLhsItems p290]

⟨*defun pf0DefinitionLhsItems*⟩≡
```
(defun |pf0DefinitionLhsItems| (pf)
 (|pfParts| (|pfDefinitionLhsItems| pf)))
```

8.5.38 defun Create a Do node

[pfTree p283]

⟨*defun pfDo*⟩≡
```
(defun |pfDo| (pfbody)
 (|pfTree| '|Do| (list pfbody)))
```

8.5.39 defun Is this a Do node?

[pfAbSynOp? p444]

⟨*defun pfDo?*⟩≡
```
(defun |pfDo?| (pf)
 (|pfAbSynOp?| pf '|Do|))
```

8.5.40 defun Return the Body of a Do node

⟨*defun pfDoBody 0*⟩≡
```
(defun |pfDoBody| (pf)
 (cadr pf))
```

8.5.41 defun Construct a Sequence node

[pfTuple p318]
[pfListOf p275]
[pfSequence p313]

⟨*defun pfEnSequence*⟩≡
```
(defun |pfEnSequence| (a)
 (cond
  ((null a) (|pfTuple| (|pfListOf| a)))
  ((null (cdr a)) (car a))
  (t (|pfSequence| (|pfListOf| a)))))
```

8.5.42 defun Construct an Exit node

[pfTree p283]

⟨*defun pfExit*⟩≡
```
(defun |pfExit| (pfcond pfexpr)
 (|pfTree| '|Exit| (list pfcond pfexpr)))
```

8.5.43 defun Is this an Exit node?

[pfAbSynOp? p444]

⟨*defun pfExit?*⟩≡
```
(defun |pfExit?| (pf)
 (|pfAbSynOp?| pf '|Exit|))
```

8.5.44 defun Return the Cond part of an Exit

⟨*defun pfExitCond 0*⟩≡
```
(defun |pfExitCond| (pf)
 (cadr pf))
```

8.5.45 defun Return the Expression part of an Exit

⟨*defun pfExitExpr 0*⟩≡
```
(defun |pfExitExpr| (pf)
 (caddr pf))
```

8.5.46 defun Create an Export node

[pfTree p283]

⟨*defun pfExport*⟩≡
```
(defun |pfExport| (pfitems)
 (|pfTree| '|Export| (list pfitems)))
```

8.5.47 defun Construct an Expression leaf node

[pfLeaf p277]
[ifcar p**??**]

⟨*defun pfExpression*⟩≡
```
(defun |pfExpression| (expr &rest optpos)
 (|pfLeaf| '|expression| expr (ifcar optpos)))
```

8.5.48 defun pfFirst

⟨*defun pfFirst 0*⟩≡
```
(defun |pfFirst| (form)
 (cadr form))
```

8.5.49 defun Create an Application Fix node

[pfApplication p284]
[pfId p276]

⟨*defun pfFix*⟩≡
```
(defun |pfFix| (pf)
 (|pfApplication| (|pfId| 'Y) pf))
```

8.5.50 defun Create a Free node

[pfTree p283]

⟨*defun pfFree*⟩≡
```
(defun |pfFree| (pfitems)
 (|pfTree| '|Free| (list pfitems)))
```

8.5.51 defun Is this a Free node?

[pfAbSynOp? p444]

⟨*defun pfFree?*⟩≡
```
(defun |pfFree?| (pf)
 (|pfAbSynOp?| pf '|Free|))
```

8.5.52 defun Return the parts of the Items of a Free node

[pfParts p279]
[pfFreeItems p295]

⟨*defun pf0FreeItems*⟩≡
```
(defun |pf0FreeItems| (pf)
 (|pfParts| (|pfFreeItems| pf)))
```

8.5.53 defun Return the Items of a Free node

⟨*defun pfFreeItems 0*⟩≡
```
(defun |pfFreeItems| (pf)
 (cadr pf))
```

8.5.54 defun Construct a Forin node

[pfTree p283]

⟨*defun pfForin*⟩≡
```
(defun |pfForin| (pflhs pfwhole)
 (|pfTree| '|Forin| (list pflhs pfwhole)))
```

8.5.55 defun Is this a ForIn node?

[pfAbSynOp? p444]

⟨*defun pfForin?*⟩≡
```
(defun |pfForin?| (pf)
 (|pfAbSynOp?| pf '|Forin|))
```

8.5.56 defun Return all the parts of the LHS of a ForIn node

[pfParts p279]
[pfForinLhs p296]

⟨*defun pf0ForinLhs*⟩≡
```
(defun |pf0ForinLhs| (pf)
 (|pfParts| (|pfForinLhs| pf)))
```

8.5.57 defun Return the LHS part of a ForIn node

⟨*defun pfForinLhs 0*⟩≡
```
(defun |pfForinLhs| (pf)
 (cadr pf))
```

8.5.58 defun Return the Whole part of a ForIn node

⟨*defun pfForinWhole 0*⟩≡
```
(defun |pfForinWhole| (pf)
 (caddr pf))
```

8.5.59 defun pfFromDom

[pfApplication? p285]
[pfApplication p284]
[pfApplicationOp p284]
[pfApplicationArg p284]
[pfFromdom p297]

⟨*defun pfFromDom*⟩≡
```
(defun |pfFromDom| (dom expr)
 (cond
  ((|pfApplication?| expr)
   (|pfApplication|
    (|pfFromdom| (|pfApplicationOp| expr) dom)
    (|pfApplicationArg| expr)))
  (t (|pfFromdom| expr dom))))
```

8.5.60 defun Construct a Fromdom node

[pfTree p283]

⟨*defun pfFromdom*⟩≡
```
(defun |pfFromdom| (pfwhat pfdomain)
 (|pfTree| '|Fromdom| (list pfwhat pfdomain)))
```

8.5.61 defun Is this a Fromdom mode?

[pfAbSynOp? p444]

⟨*defun pfFromdom?*⟩≡
```
(defun |pfFromdom?| (pf)
 (|pfAbSynOp?| pf '|Fromdom|))
```

8.5.62 defun Return the What part of a Fromdom node

⟨*defun pfFromdomWhat 0*⟩≡
```
(defun |pfFromdomWhat| (pf)
 (cadr pf))
```

8.5.63 defun Return the Domain part of a Fromdom node

⟨*defun pfFromdomDomain 0*⟩≡
```
(defun |pfFromdomDomain| (pf)
 (caddr pf))
```

8.5.64 defun Construct a Hide node

[pfTree p283]

⟨*defun pfHide*⟩≡
```
(defun |pfHide| (a part)
 (declare (ignore a))
 (|pfTree| '|Hide| (list part)))
```

8.5.65 defun pfIf

[pfTree p283]

⟨*defun pfIf*⟩≡
```
(defun |pfIf| (pfcond pfthen pfelse)
 (|pfTree| '|If| (list pfcond pfthen pfelse)))
```

8.5.66 defun Is this an If node?

[pfAbSynOp? p444]

⟨*defun pfIf?*⟩≡
```
(defun |pfIf?| (pf)
  (|pfAbSynOp?| pf '|If|))
```

8.5.67 defun Return the Cond part of an If

⟨*defun pfIfCond 0*⟩≡
```
(defun |pfIfCond| (pf)
 (cadr pf))
```

8.5.68 defun Return the Then part of an If

⟨*defun pfIfThen 0*⟩≡
```
(defun |pfIfThen| (pf)
 (caddr pf))
```

8.5.69 defun pfIfThenOnly

[pfIf p298]
[pfNothing p276]

⟨*defun pfIfThenOnly*⟩≡
```
(defun |pfIfThenOnly| (pred cararg)
 (|pfIf| pred cararg (|pfNothing|)))
```

8.5.70 defun Return the Else part of an If

⟨*defun pfIfElse 0*⟩≡
```
(defun |pfIfElse| (pf)
 (cadddr pf))
```

8.5.71 defun Construct an Import node

[pfTree p283]

⟨*defun pfImport*⟩≡
```
(defun |pfImport| (pfitems)
 (|pfTree| '|Import| (list pfitems)))
```

8.5.72 defun Construct an Iterate node

[pfTree p283]

⟨*defun pfIterate*⟩≡
```
(defun |pfIterate| (pffrom)
 (|pfTree| '|Iterate| (list pffrom)))
```

8.5.73 defun Is this an Iterate node?

[pfAbSynOp? p444]

⟨*defun pfIterate?*⟩≡
```
(defun |pfIterate?| (pf)
 (|pfAbSynOp?| pf '|Iterate|))
```

8.5.74 defun Handle an infix application

[pfListOf p275]
[pfIdSymbol p277]
[pfAnd p283]
[pfOr p308]
[pfApplication p284]
[pfTuple p318]

⟨*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)))))))
```

8.5.75 defun Create an Inline node

[pfTree p283]

⟨*defun pfInline*⟩≡
```
(defun |pfInline| (pfitems)
 (|pfTree| '|Inline| (list pfitems)))
```

8.5.76 defun pfLam

[pfAbSynOp? p444]
[pfFirst p294]
[pfNothing p276]
[pfSecond p313]
[pfLambda p301]

⟨*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)))
```

8.5.77 defun pfLambda

[pfTree p283]

⟨*defun pfLambda*⟩≡
```
(defun |pfLambda| (pfargs pfrets pfbody)
 (|pfTree| '|Lambda| (list pfargs pfrets pfbody)))
```

8.5.78 defun Return the Body part of a Lambda node

⟨*defun pfLambdaBody 0*⟩≡
```
(defun |pfLambdaBody| (pf)
 (cadddr pf))
```

8.5.79 defun Return the Rets part of a Lambda node

⟨*defun pfLambdaRets 0*⟩≡
```
(defun |pfLambdaRets| (pf)
 (caddr pf))
```

8.5.80 defun Is this a Lambda node?

[pfAbSynOp? p444]

⟨*defun pfLambda?*⟩≡
```
(defun |pfLambda?| (pf)
 (|pfAbSynOp?| pf '|Lambda|))
```

8.5.81 defun Return the Args part of a Lambda node

⟨*defun pfLambdaArgs 0*⟩≡
```
(defun |pfLambdaArgs| (pf)
 (cadr pf))
```

8.5.82 defun Return the Args of a Lambda Node

[pfParts p279]
[pfLambdaArgs p302]

⟨*defun pf0LambdaArgs*⟩≡
```
(defun |pf0LambdaArgs| (pf)
 (|pfParts| (|pfLambdaArgs| pf)))
```

8.5.83 defun Construct a Local node

[pfTree p283]

⟨*defun pfLocal*⟩≡
```
(defun |pfLocal| (pfitems)
 (|pfTree| '|Local| (list pfitems)))
```

8.5.84 defun Is this a Local node?

[pfAbSynOp? p444]

⟨*defun pfLocal?*⟩≡
```
(defun |pfLocal?| (pf)
 (|pfAbSynOp?| pf '|Local|))
```

8.5.85 defun Return the parts of Items of a Local node

[pfParts p279]
[pfLocalItems p303]

⟨*defun pf0LocalItems*⟩≡
```
(defun |pf0LocalItems| (pf)
 (|pfParts| (|pfLocalItems| pf)))
```

8.5.86 defun Return the Items of a Local node

⟨*defun pfLocalItems 0*⟩≡
```
(defun |pfLocalItems| (pf)
 (cadr pf))
```

8.5.87 defun Construct a Loop node

[pfTree p283]

⟨*defun pfLoop*⟩≡
```
(defun |pfLoop| (pfiterators)
 (|pfTree| '|Loop| (list pfiterators)))
```

8.5.88 defun pfLoop1

[pfLoop p303]
[pfListOf p275]
[pfDo p291]

⟨*defun pfLoop1*⟩≡
```
(defun |pfLoop1| (body)
 (|pfLoop| (|pfListOf| (list (|pfDo| body)))))
```

8.5.89 defun Is this a Loop node?

[pfAbSynOp? p444]

⟨*defun pfLoop?*⟩≡
```
(defun |pfLoop?| (pf)
 (|pfAbSynOp?| pf '|Loop|))
```

8.5.90 defun Return the Iterators of a Loop node

⟨*defun pfLoopIterators 0*⟩≡
```
(defun |pfLoopIterators| (pf)
 (cadr pf))
```

8.5.91 defun pf0LoopIterators

[pfParts p279]
[pf0LoopIterators p304]

⟨*defun pf0LoopIterators*⟩≡
```
(defun |pf0LoopIterators| (pf)
 (|pfParts| (|pfLoopIterators| pf)))
```

8.5.92 defun pfLp

[pfLoop p303]
[pfListOf p275]
[pfDo p291]

⟨*defun pfLp*⟩≡
```
(defun |pfLp| (iterators body)
 (|pfLoop| (|pfListOf| (append iterators (list (|pfDo| body))))))
```

8.5.93 defun Create a Macro node

[pfTree p283]

⟨*defun pfMacro*⟩≡
```
(defun |pfMacro| (pflhs pfrhs)
 (|pfTree| '|Macro| (list pflhs pfrhs)))
```

8.5.94 defun Is this a Macro node?

[pfAbSynOp? p444]

⟨*defun pfMacro?*⟩≡
```
(defun |pfMacro?| (pf)
 (|pfAbSynOp?| pf '|Macro|))
```

8.5.95 defun Return the Lhs of a Macro node

⟨*defun pfMacroLhs 0*⟩≡
```
(defun |pfMacroLhs| (pf)
 (cadr pf))
```

8.5.96 defun Return the Rhs of a Macro node

⟨*defun pfMacroRhs 0*⟩≡
```
(defun |pfMacroRhs| (pf)
 (caddr pf))
```

8.5.97 defun Construct an MLambda node

[pfTree p283]

⟨*defun pfMLambda*⟩≡
```
(defun |pfMLambda| (pfargs pfbody)
 (|pfTree| '|MLambda| (list pfargs pfbody)))
```

8.5.98 defun Is this an MLambda node?

[pfAbSynOp? p444]

⟨*defun pfMLambda?*⟩≡
```
(defun |pfMLambda?| (pf)
 (|pfAbSynOp?| pf '|MLambda|))
```

8.5.99 defun Return the Args of an MLambda

⟨*defun pfMLambdaArgs 0*⟩≡
```
(defun |pfMLambdaArgs| (pf)
 (cadr pf))
```

8.5.100 defun Return the parts of an MLambda argument

[pfParts p279]

⟨*defun pf0MLambdaArgs*⟩≡
```
(defun |pf0MLambdaArgs| (pf)
 (|pfParts| (|pfMLambdaArgs| pf)))
```

8.5.101 defun pfMLambdaBody

⟨*defun pfMLambdaBody 0*⟩≡
```
(defun |pfMLambdaBody| (pf)
 (caddr pf))
```

8.5.102 defun Is this a Not node?

[pfAbSynOp? p444]

⟨*defun pfNot?*⟩≡
```
(defun |pfNot?| (pf)
 (|pfAbSynOp?| pf '|Not|))
```

8.5.103 defun Return the Arg part of a Not node

⟨*defun pfNotArg 0*⟩≡
```
(defun |pfNotArg| (pf)
 (cadr pf))
```

8.5.104 defun Construct a NoValue node

[pfTree p283]

⟨*defun pfNovalue*⟩≡
```
(defun |pfNovalue| (pfexpr)
 (|pfTree| '|Novalue| (list pfexpr)))
```

8.5.105 defun Is this a Novalue node?

[pfAbSynOp? p444]

⟨*defun pfNovalue?*⟩≡
```
(defun |pfNovalue?| (pf)
 (|pfAbSynOp?| pf '|Novalue|))
```

8.5.106 defun Return the Expr part of a Novalue node

⟨*defun pfNovalueExpr 0*⟩≡
```
(defun |pfNovalueExpr| (pf)
 (cadr pf))
```

8.5.107 defun Construct an Or node

[pfTree p283]

⟨*defun pfOr*⟩≡
```
(defun |pfOr| (pfleft pfright)
 (|pfTree| '|Or| (list pfleft pfright)))
```

8.5.108 defun Is this an Or node?

[pfAbSynOp? p444]

⟨*defun pfOr?*⟩≡
```
(defun |pfOr?| (pf)
 (|pfAbSynOp?| pf '|Or|))
```

8.5.109 defun Return the Left part of an Or node

⟨*defun pfOrLeft 0*⟩≡
```
(defun |pfOrLeft| (pf)
 (cadr pf))
```

8.5.110 defun Return the Right part of an Or node

⟨*defun pfOrRight 0*⟩≡
```
(defun |pfOrRight| (pf)
 (caddr pf))
```

8.5.111 defun Return the part of a parenthesised expression

⟨*defun pfParen*⟩≡
```
(defun |pfParen| (a part)
 part)
```

8.5.112 defun pfPretend

[pfTree p283]

⟨*defun pfPretend*⟩≡
```
(defun |pfPretend| (pfexpr pftype)
 (|pfTree| '|Pretend| (list pfexpr pftype)))
```

8.5.113 defun Is this a Pretend node?

[pfAbSynOp? p444]

⟨*defun pfPretend?*⟩≡
```
(defun |pfPretend?| (pf)
 (|pfAbSynOp?| pf '|Pretend|))
```

8.5.114 defun Return the Expression part of a Pretend node

⟨*defun pfPretendExpr 0*⟩≡
```
(defun |pfPretendExpr| (pf)
 (cadr pf))
```

8.5.115 defun Return the Type part of a Pretend node

⟨*defun pfPretendType 0*⟩≡
```
(defun |pfPretendType| (pf)
 (caddr pf))
```

8.5.116 defun Construct a QualType node

[pfTree p283]

⟨*defun pfQualType*⟩≡
```
(defun |pfQualType| (pftype pfqual)
 (|pfTree| '|QualType| (list pftype pfqual)))
```

8.5.117 defun Construct a Restrict node

[pfTree p283]

⟨*defun pfRestrict*⟩≡
```
(defun |pfRestrict| (pfexpr pftype)
 (|pfTree| '|Restrict| (list pfexpr pftype)))
```

8.5.118 defun Is this a Restrict node?

[pfAbSynOp? p444]

⟨*defun pfRestrict?*⟩≡
```
(defun |pfRestrict?| (pf)
 (|pfAbSynOp?| pf '|Restrict|))
```

8.5.119 defun Return the Expr part of a Restrict node

⟨*defun pfRestrictExpr 0*⟩≡
```
(defun |pfRestrictExpr| (pf)
 (cadr pf))
```

8.5.120 defun Return the Type part of a Restrict node

⟨*defun pfRestrictType 0*⟩≡
```
(defun |pfRestrictType| (pf)
 (caddr pf))
```

8.5.121 defun Construct a RetractTo node

[pfTree p283]

⟨*defun pfRetractTo*⟩≡
```
(defun |pfRetractTo| (pfexpr pftype)
 (|pfTree| '|RetractTo| (list pfexpr pftype)))
```

8.5.122 defun Construct a Return node

[pfTree p283]

⟨*defun pfReturn*⟩≡
```
(defun |pfReturn| (pfexpr pffrom)
 (|pfTree| '|Return| (list pfexpr pffrom)))
```

8.5.123 defun Is this a Return node?

[pfAbSynOp? p444]

⟨*defun pfReturn?*⟩≡
```
(defun |pfReturn?| (pf)
 (|pfAbSynOp?| pf '|Return|))
```

8.5.124 defun Return the Expr part of a Return node

⟨*defun pfReturnExpr 0*⟩≡
```
(defun |pfReturnExpr| (pf)
 (cadr pf))
```

8.5.125 defun pfReturnNoName

[pfReturn p311]
[pfNothing p276]

⟨*defun pfReturnNoName*⟩≡
```
(defun |pfReturnNoName| (|value|)
 (|pfReturn| |value| (|pfNothing|)))
```

8.5.126 defun Construct a ReturnTyped node

[pfTree p283]

⟨*defun pfReturnTyped*⟩≡
```
(defun |pfReturnTyped| (type body)
 (|pfTree| '|returntyped| (list type body)))
```

8.5.127 defun Construct a Rule node

[pfTree p283]

⟨*defun pfRule*⟩≡
```
(defun |pfRule| (pflhsitems pfrhs)
 (|pfTree| '|Rule| (list pflhsitems pfrhs)))
```

8.5.128 defun Return the Lhs of a Rule node

⟨*defun pfRuleLhsItems 0*⟩≡
```
(defun |pfRuleLhsItems| (pf)
 (cadr pf))
```

8.5.129 defun Return the Rhs of a Rule node

⟨*defun pfRuleRhs 0*⟩≡
```
(defun |pfRuleRhs| (pf)
 (caddr pf))
```

8.5.130 defun Is this a Rule node?

[pfAbSynOp? p444]

⟨*defun pfRule?*⟩≡
```
(defun |pfRule?| (pf)
 (|pfAbSynOp?| pf '|Rule|))
```

8.5.131 defun pfSecond

⟨*defun pfSecond 0*⟩≡
```
(defun |pfSecond| (form)
 (caddr form))
```

8.5.132 defun Construct a Sequence node

[pfTree p283]

⟨*defun pfSequence*⟩≡
```
(defun |pfSequence| (pfargs)
 (|pfTree| '|Sequence| (list pfargs)))
```

8.5.133 defun Return the Args of a Sequence node

⟨*defun pfSequenceArgs 0*⟩≡
```
(defun |pfSequenceArgs| (pf)
 (cadr pf))
```

8.5.134 defun Is this a Sequence node?

[pfAbSynOp? p444]

⟨*defun pfSequence?*⟩≡
```
(defun |pfSequence?| (pf)
 (|pfAbSynOp?| pf '|Sequence|))
```

8.5.135 defun Return the parts of the Args of a Sequence node

[pfParts p279]
[pfSequenceArgs p313]

⟨*defun pf0SequenceArgs*⟩≡
```
(defun |pf0SequenceArgs| (pf)
 (|pfParts| (|pfSequenceArgs| pf)))
```

8.5.136 defun Create a Suchthat node

[pfTree p283]

⟨*defun pfSuchthat*⟩≡
```
(defun |pfSuchthat| (pfcond)
 (|pfTree| '|Suchthat| (list pfcond)))
```

8.5.137 defun Is this a SuchThat node?

[pfAbSynOp? p444]

⟨*defun pfSuchthat?*⟩≡
```
(defun |pfSuchthat?| (pf)
 (|pfAbSynOp?| pf '|Suchthat|))
```

8.5.138 defun Return the Cond part of a SuchThat node

⟨*defun pfSuchthatCond 0*⟩≡
```
(defun |pfSuchthatCond| (pf)
 (cadr pf))
```

8.5.139 defun Create a Tagged node

[pfTree p283]

⟨*defun pfTagged*⟩≡
```
(defun |pfTagged| (pftag pfexpr)
 (|pfTree| '|Tagged| (list pftag pfexpr)))
```

8.5.140 defun Is this a Tagged node?

[pfAbSynOp? p444]

⟨*defun pfTagged?*⟩≡
```
(defun |pfTagged?| (pf)
 (|pfAbSynOp?| pf '|Tagged|))
```

8.5.141 defun Return the Expression portion of a Tagged node

⟨*defun pfTaggedExpr 0*⟩≡
```
(defun |pfTaggedExpr| (pf)
 (caddr pf))
```

8.5.142 defun Return the Tag of a Tagged node

⟨*defun pfTaggedTag 0*⟩≡
```
(defun |pfTaggedTag| (pf)
 (cadr pf))
```

8.5.143 defun pfTaggedToTyped

[pfTagged? p315]
[pfTaggedExpr p315]
[pfNothing p276]
[pfTaggedTag p315]
[pfId? p277]
[pfId p276]
[pfTyped p317]
[pfSuch p275]
[pfInfApplication p300]

⟨*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)))))
```

8.5.144 defun pfTweakIf

[pfIfElse p299]
[pfNothing? p276]
[pfListOf p275]
[pfTree p283]
[pfIfCond p298]
[pfIfThen p298]

⟨*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))))
```

8.5.145 defun Construct a Typed node

[pfTree p283]

⟨*defun pfTyped*⟩≡
```
(defun |pfTyped| (pfid pftype)
 (|pfTree| '|Typed| (list pfid pftype)))
```

8.5.146 defun Is this a Typed node?

[pfAbSynOp? p444]

⟨*defun pfTyped?*⟩≡
```
(defun |pfTyped?| (pf)
 (|pfAbSynOp?| pf '|Typed|))
```

8.5.147 defun Return the Type of a Typed node

⟨*defun pfTypedType 0*⟩≡
```
(defun |pfTypedType| (pf)
 (caddr pf))
```

8.5.148 defun Return the Id of a Typed node

⟨*defun pfTypedId 0*⟩≡
```
(defun |pfTypedId| (pf)
 (cadr pf))
```

8.5.149 defun Construct a Typing node

[pfTree p283]

⟨*defun pfTyping*⟩≡
```
(defun |pfTyping| (pfitems)
 (|pfTree| '|Typing| (list pfitems)))
```

8.5.150 defun Return a Tuple node

[pfTree p283]

⟨*defun pfTuple*⟩≡
```
(defun |pfTuple| (pfparts)
 (|pfTree| '|Tuple| (list pfparts)))
```

8.5.151 defun Return a Tuple from a List

[pfTuple p318]
[pfListOf p275]

⟨*defun pfTupleListOf*⟩≡
```
(defun |pfTupleListOf| (pfparts)
 (|pfTuple| (|pfListOf| pfparts)))
```

8.5.152 defun Is this a Tuple node?

[pfAbSynOp? p444]

⟨*defun pfTuple?*⟩≡
```
(defun |pfTuple?| (pf)
 (|pfAbSynOp?| pf '|Tuple|))
```

8.5.153 defun Return the Parts of a Tuple node

⟨*defun pfTupleParts 0*⟩≡
```
(defun |pfTupleParts| (pf)
 (cadr pf))
```

8.5.154 defun Return the parts of a Tuple

[pfParts p279]
[pfTupleParts p318]

⟨*defun pf0TupleParts*⟩≡
```
(defun |pf0TupleParts| (pf)
 (|pfParts| (|pfTupleParts| pf)))
```

8.5.155 defun Return a list from a Sequence node

[pfSequence? p313]
[pfAppend p285]
[pf0SequenceArgs p314]
[pfListOf p275]

⟨*defun pfUnSequence*⟩≡
```
(defun |pfUnSequence| (x)
 (if (|pfSequence?| x)
  (|pfListOf| (|pfAppend| (|pf0SequenceArgs| x)))
  (|pfListOf| x)))
```

8.5.156 defun The comment is attached to all signatutres

[pfWDeclare p319]
[pfParts p279]

⟨*defun pfWDec*⟩≡
```
(defun |pfWDec| (doc name)
 (mapcar #'(lambda (i) (|pfWDeclare| i doc)) (|pfParts| name)))
```

8.5.157 defun Construct a WDeclare node

[pfTree p283]

⟨*defun pfWDeclare*⟩≡
```
(defun |pfWDeclare| (pfsignature pfdoc)
 (|pfTree| '|WDeclare| (list pfsignature pfdoc)))
```

8.5.158 defun Construct a Where node

[pfTree p283]

⟨*defun pfWhere*⟩≡
```
(defun |pfWhere| (pfcontext pfexpr)
 (|pfTree| '|Where| (list pfcontext pfexpr)))
```

8.5.159 defun Is this a Where node?

[pfAbSynOp? p444]

⟨*defun pfWhere?*⟩≡
```
(defun |pfWhere?| (pf)
 (|pfAbSynOp?| pf '|Where|))
```

8.5.160 defun Return the parts of the Context of a Where node

[pfParts p279]
[pfWhereContext p320]

⟨*defun pf0WhereContext*⟩≡
```
(defun |pf0WhereContext| (pf)
 (|pfParts| (|pfWhereContext| pf)))
```

8.5.161 defun Return the Context of a Where node

⟨*defun pfWhereContext 0*⟩≡
```
(defun |pfWhereContext| (pf)
 (cadr pf))
```

8.5.162 defun Return the Expr part of a Where node

⟨*defun pfWhereExpr 0*⟩≡
```
(defun |pfWhereExpr| (pf)
 (caddr pf))
```

8.5.163 defun Construct a While node

[pfTree p283]

⟨*defun pfWhile*⟩≡
```
(defun |pfWhile| (pfcond)
 (|pfTree| '|While| (list pfcond)))
```

8.5.164 defun Is this a While node?

[pfAbSynOp? p444]

⟨*defun pfWhile?*⟩≡
```
(defun |pfWhile?| (pf)
 (|pfAbSynOp?| pf '|While|))
```

8.5.165 defun Return the Cond part of a While node

⟨*defun pfWhileCond 0*⟩≡
```
(defun |pfWhileCond| (pf)
 (cadr pf))
```

8.5.166 defun Construct a With node

[pfTree p283]

⟨*defun pfWith*⟩≡
```
(defun |pfWith| (pfbase pfwithin pfwithon)
 (|pfTree| '|With| (list pfbase pfwithin pfwithon)))
```

8.5.167 defun Create a Wrong node

[pfTree p283]

⟨*defun pfWrong*⟩≡
```
(defun |pfWrong| (pfwhy pfrubble)
 (|pfTree| '|Wrong| (list pfwhy pfrubble)))
```

8.5.168 defun Is this a Wrong node?

[pfAbSynOp? p444]

⟨*defun pfWrong?*⟩≡
```
(defun |pfWrong?| (pf)
 (|pfAbSynOp?| pf '|Wrong|))
```

Chapter 9

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.

9.0.169 defun Pftree to s-expression translation

[pf2Sex1 p324]
[$insideSEQ p??]
[$insideApplication p??]
[$insideRule p??]
[$QuietCommand p50]

⟨*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)))
```

9.0.170 defun Pftree to s-expression translation inner function

[pfNothing? p276]
[pfSymbol? p282]
[pfSymbolSymbol p283]
[pfLiteral? p278]
[pfLiteral2Sex p329]
[pfIdSymbol p277]
[pfApplication? p285]
[pfApplication2Sex p331]
[pfTuple? p318]
[pf2Sex1 p324]
[pf0TupleParts p319]
[pfIf? p298]
[pfIfCond p298]
[pfIfThen p298]
[pfIfElse p299]
[pfTagged? p315]
[pfTaggedTag p315]
[pfTaggedExpr p315]
[pfCoerceto? p289]
[pfCoercetoExpr p289]
[pfCoercetoType p289]
[pfPretend? p309]
[pfPretendExpr p309]
[pfPretendType p309]
[pfFromdom? p297]
[opTran p352]
[pfFromdomWhat p297]
[pfFromdomDomain p297]
[pfSequence? p313]
[pfSequence2Sex p336]
[pfExit? p293]
[pfExitCond p293]
[pfExitExpr p293]
[pfLoop? p304]
[loopIters2Sex p339]
[pf0LoopIterators p304]
[pfCollect? p290]
[pfCollect2Sex p342]
[pfForin? p295]
[pf0ForinLhs p296]
[pfForinWhole p296]
[pfWhile? p321]

[pfWhereExpr p321]
[pfAbSynOp p444]
[tokPart p445]
[$insideSEQ p??]
[$insideRule p??]
[$QuietCommand p50]

⟨*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"))))))
```

9.0.171 defun Convert a Literal to an S-expression

[pfLiteralClass p279]
[pfLiteralString p279]
[float2Sex p330]
[pfSymbolSymbol p283]
[pfLeafToken p278]
[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"))))))
```

9.0.172 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 (cddr bfForm))
    (list (list '|$elt| (list '|Float|) '|float|) frac exp 10))
   bfForm)))
```

9.0.173 defun Change an Application node to an S-expression

[pfOp2Sex p334]
[pfApplicationOp p284]
[opTran p352]
[pf0TupleParts p319]
[pfApplicationArg p284]
[pfTuple? p318]
[pf2Sex1 p324]
[pf2Sex p323]
[pfSuchThat2Sex p333]
[hasOptArgs? p335]
[$insideApplication p**??**]
[$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 'and) (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)))
    ((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))))))))
```

9.0.174 defun Convert a SuchThat node to an S-expression

[pf0TupleParts p319]
[pf2Sex1 p324]
[pf2Sex p323]
[$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))
```

9.0.175 defun pfOp2Sex

[pf2Sex1 p324]
[pmDontQuote? p335]
[pfSymbol? p282]
[$quotedOpList p??]
[$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))))
```

9.0.176 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|)))
```

9.0.177 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)))))))
```

9.0.178 defun Convert a Sequence node to an S-expression

[pf2Sex1 p324]
[pf0SequenceArgs p314]
[$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))))
```

9.0.179 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 p337]

⟨*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))))))
              (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)))))))
```

9.0.180 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]]] =>
;      result := [ ['STEP, var, i, incr], :result]
;    sex is ['IN, var, ["BY", ['SEGMENT, i, j], incr]] =>
;      result := [ ['STEP, var, i, incr, j], :result]
;    sex is ['IN, var, ['SEGMENT, i, j]] =>
;      result := [ ['STEP, var, i, 1, j], :result]
;    result := [sex, :result]
;  nreverse result
```

[pf2Sex1 p324]

⟨*defun loopIters2Sex*⟩≡

```
(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) '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)))))))
```

9.0.181 defun Change a Collect node to an S-expression

[loopIters2Sex p339]
[pfParts p279]
[pfCollectIterators p290]
[pf2Sex1 p324]
[pfCollectBody p289]

⟨*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))))
```

9.0.182 defun Convert a Definition node to an S-expression

[pf2Sex1 p324]
[pf0DefinitionLhsItems p291]
[pfDefinitionRhs p291]
[systemError p**??**]
[pfLambdaTran p344]
[$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))))))))
```

9.0.183 defun Convert a Lambda node to an S-expression

[pfLambda? p302]
[pf0LambdaArgs p302]
[pfTyped? p317]
[pfCollectArgTran p345]
[pfTypedId p317]
[pfNothing? p276]
[pfTypedType p317]
[pf2Sex1 p324]
[systemError p??]
[pfLambdaRets p301]
[pfLambdaBody p301]

⟨*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)))))))
```

9.0.184 defun pfCollectArgTran

[pfCollect? p290]
[pf2sex1 p??]
[pfParts p279]
[pfCollectIterators p290]
[pfCollectBody p289]

⟨*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)))))
```

9.0.185 defun Convert a Lambda node to an S-expression

[pfLambdaTran p344]

⟨*defun pfLambda2Sex*⟩≡
```
(defun |pfLambda2Sex| (pf)
 (let (body argList tmp1)
  (setq tmp1 (|pfLambdaTran| pf))
  (setq argList (car tmp1))
  (setq body (cdr tmp1))
  (cons 'adef (cons argList body))))
```

9.0.186 defun Convert a Rule node to an S-expression

[pfLhsRule2Sex p347]
[pfRuleLhsItems p312]
[pfRhsRule2Sex p347]
[pfRuleRhs p312]
[ruleLhsTran p351]
[rulePredicateTran p348]
[$multiVarPredicateList p??]
[$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)))))
```

9.0.187 defun Convert the Lhs of a Rule to an S-expression

[pf2Sex1 p324]
[$insideRule p??]

⟨*defun pfLhsRule2Sex*⟩≡
```
(defun |pfLhsRule2Sex| (lhs)
 (let (|$insideRule|)
 (declare (special |$insideRule|))
  (setq |$insideRule| '|left|)
  (|pf2Sex1| lhs)))
```

9.0.188 defun Convert the Rhs of a Rule to an S-expression

[pf2Sex1 p324]
[$insideRule p??]

⟨*defun pfRhsRule2Sex*⟩≡
```
(defun |pfRhsRule2Sex| (rhs)
 (let (|$insideRule|)
 (declare (special |$insideRule|))
  (setq |$insideRule| '|right|)
  (|pf2Sex1| rhs)))
```

9.0.189 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 p350]
[pvarPredTran p350]
[$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)))))
      (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 'adef '(|predicateVariable|)
                   '(((|Boolean|)
                     (|List| (|Expression| (|Integer|))))
                   '(nil nil) predBody))))))
```

9.0.190 defun patternVarsOf

[patternVarsOf1 p350]

⟨*defun patternVarsOf*⟩≡
```
(defun |patternVarsOf| (expr)
 (|patternVarsOf1| expr nil))
```

9.0.191 defun patternVarsOf1

[patternVarsOf1 p350]

⟨*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 argl (cdr expr))
          t))
         (progn
           (dolist (arg argl)
            (setq varList (|patternVarsOf1| arg varList)))
           varList))
   (t varList))))
```

9.0.192 defun pvarPredTran

⟨*defun pvarPredTran*⟩≡
```
(defun |pvarPredTran| (rhs varList)
 (let ((i 0))
  (dolist (var varList rhs)
   (setq rhs (nsubst (list '|elt| '|predicateVariable| (incf i)) var rhs)))))
```

9.0.193 defun Convert the Lhs of a Rule node to an S-expression

[patternVarsOf p350]
[nsubst p**??**]
[$predicateList p**??**]
[$multiVarPredicateList p**??**]

⟨*defun ruleLhsTran*⟩≡
```
(defun |ruleLhsTran| (ruleLhs)
 (let (predicate var vars predRhs predLhs name)
 (declare (special |$predicateList| |$multiVarPredicateList|))
 (dolist (pred |$predicateList|)
  (setq name (car pred))
  (setq predLhs (cadr pred))
  (setq predRhs (cddr pred))
  (setq vars (|patternVarsOf| predRhs))
  (cond
   ((cdr vars)
    (setq ruleLhs (nsubst predLhs name ruleLhs))
    (setq |$multiVarPredicateList| (cons pred |$multiVarPredicateList|)))
   (t
    (setq var (cadr predLhs))
    (setq predicate
      (list '|suchThat| predLhs (list 'adef (list var)
            '((|Boolean|) (|Expression| (|Integer|))) '(nil nil) predRhs)))
    (setq ruleLhs (nsubst predicate name ruleLhs)))))
  ruleLhs))
```

9.0.194 defvar $dotdot

⟨*initvars*⟩+≡
```
(defvar |$dotdot| '|..|)
```

9.0.195 defun Translate ops into internal symbols

[$dotdot p351]

⟨*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 10

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.

10.0.196 defvar $cacheMessages

This is used for debugging

⟨*initvars*⟩+≡

```
(defvar |$cacheMessages| t)
```

10.0.197 defvar $msgAlist

⟨*initvars*⟩+≡

```
(defvar |$msgAlist| nil)
```

10.0.198 defvar $msgDatabaseName

⟨*initvars*⟩+≡

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

10.0.199 defvar $testingErrorPrefix

⟨*initvars*⟩+≡

```
(defvar |$testingErrorPrefix| "Daly Bug")
```

10.0.200 defvar $texFormatting

⟨*initvars*⟩+≡
```
(defvar |$texFormatting| nil)
```

10.0.201 defvar $*msghash*

⟨*initvars*⟩+≡
```
(defvar *msghash* nil "hash table keyed by msg number")
```

10.0.202 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"))
```

10.0.203 defvar $msgdbPunct

⟨*initvars*⟩+≡
```
(defvar |$msgdbPunct|
  '(|.| |,| ! |:| |;| ? ] |)| "." "," "!" ":" ";" "?" "]" ")"))
```

10.0.204 defvar $msgdbNoBlanksBeforeGroup

⟨*initvars*⟩+≡
```
(defvar |$msgdbNoBlanksBeforeGroup|
 `(" " | | "%" % ,@|$msgdbPrims| ,@|$msgdbPunct|))
```

10.0.205 defvar $msgdbNoBlanksAfterGroup

⟨*initvars*⟩+≡
```
(defvar |$msgdbNoBlanksAfterGroup|
 `(" " | | "%" % ,@|$msgdbPrims| [ |(| "[" "("))
```

10.0.206 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 p356]
[$defaultMsgDatabaseName p8]
[*msghash* p355]

⟨*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*))
```

10.0.207 defun Cache messages read from message database

[done p??]
[done p??]
[*msghash* p355]

⟨*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)))))))))
```

10.0.208 defun getKeyedMsg

[fetchKeyedMsg p356]

⟨*defun getKeyedMsg*⟩≡
```
(defun |getKeyedMsg| (key) (|fetchKeyedMsg| key nil))
```

10.0.209 defun Say a message using a keyed lookup

[sayKeyedMsgLocal p358]
[$texFormatting p355]

⟨*defun sayKeyedMsg*⟩≡
```
(defun |sayKeyedMsg| (key args)
 (let (|$texFormatting|)
 (declare (special |$texFormatting|))
  (setq |$texFormatting| nil)
  (|sayKeyedMsgLocal| key args)))
```

10.0.210 defun Handle msg formatting and print to file

[segmentKeyedMsg p358]
[getKeyedMsg p357]
[substituteSegmentedMsg p??]
[flowSegmentedMsg p??]
[sayMSG2File p359]
[sayMSG p359]
[$printMsgsToFile p777]
[$linelength p817]
[$margin p816]
[$displayMsgNumber p784]

⟨*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)))
```

10.0.211 defun Break a message into words

[string2Words p??]

⟨*defun segmentKeyedMsg*⟩≡
```
(defun |segmentKeyedMsg| (msg) (|string2Words| msg))
```

10.0.212 defun Write a msg into spadmsg.listing file

[makePathname p1108]
[defiostream p1038]
[sayBrightly1 p1114]
[shut p1039]

⟨*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)))
```

10.0.213 defun sayMSG

[saybrightly1 p**??**]
[$algebraOutputStream p802]

⟨*defun sayMSG*⟩≡
```
(defun |sayMSG| (x)
 (declare (special |$algebraOutputStream|))
 (when x (sayBrightly1 x |$algebraOutputStream|)))
```

Chapter 11

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).

11.0.214 defun npNull

[StreamNull p362]

⟨*defun npNull*⟩≡
```
(defun |npNull| (x) (|StreamNull| x))
```

11.0.215 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 12

Code Piles

The insertpiles 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 ¿1-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

12.0.216 defun insertpile

[npNull p361]
[pilePlusComment p364]
[pilePlusComments p364]
[pileTree p365]
[pileCforest p368]

⟨*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))))))))
```

12.0.217 defun pilePlusComment

[tokType p445]
[npNull p361]
[pilePlusComment p364]
[pilePlusComments p364]

⟨*defun pilePlusComment*⟩≡

```
(defun |pilePlusComment| (arg)
 (eq (|tokType| (caar arg)) '|comment|))
```

12.0.218 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)))))))
```

12.0.219 defun pileTree

[npNull p361]
[pileColumn p365]
[pileForests p366]

⟨*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)))))))
```

12.0.220 defun pileColumn

[tokPosn p445]

⟨*defun pileColumn*⟩≡
```
(defun |pileColumn| (arg)
 (cdr (|tokPosn| (caar arg))))
```

12.0.221 defun pileForests

[pileForest p366]
[npNull p361]
[pileForests p366]
[pileCtree p368]

⟨*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)))))
```

12.0.222 defun pileForest

[pileTree p365]
[pileForest1 p367]

⟨*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 (cadddr 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)))))
```

12.0.223 defun pileForest1

[eqpileTree p367]
[pileForest1 p367]

⟨*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 (cadddr 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)))))
```

12.0.224 defun eqpileTree

[npNull p361]
[pileColumn p365]
[pileForests p366]

⟨*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)))))))
```

12.0.225 defun pileCtree

[dqAppend p372]
[pileCforest p368]

⟨*defun pileCtree*⟩≡
```
(defun |pileCtree| (x y)
 (|dqAppend| x (|pileCforest| y)))
```

12.0.226 defun pileCforest

Only enpiles forests with >= 2 trees [tokPart p445]
[enPile p369]
[separatePiles p370]

⟨*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))))))
```

12.0.227 defun enPile

[dqConcat p371]
[dqUnit p371]
[tokConstruct p443]
[firstTokPosn p369]
[lastTokPosn p369]

⟨*defun enPile*⟩≡
```
(defun |enPile| (x)
 (|dqConcat|
  (list
   (|dqUnit| (|tokConstruct| '|key| 'settab (|firstTokPosn| x)))
   x
   (|dqUnit| (|tokConstruct| '|key| 'backtab (|lastTokPosn| x))))))
```

12.0.228 defun firstTokPosn

[tokPosn p445]

⟨*defun firstTokPosn*⟩≡
```
(defun |firstTokPosn| (arg) (|tokPosn| (caar arg)))
```

12.0.229 defun lastTokPosn

[tokPosn p445]

⟨*defun lastTokPosn*⟩≡
```
(defun |lastTokPosn| (arg) (|tokPosn| (cadr arg)))
```

12.0.230 defun separatePiles

[dqUnit p371]
[tokConstruct p443]
[lastTokPosn p369]
[dqConcat p371]
[separatePiles p370]

⟨*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 13

Dequeue Functions

The dqUnit makes a unit dq i.e. a dq with one item, from the item

13.0.231 defun dqUnit

⟨*defun dqUnit 0*⟩≡
```
(defun |dqUnit| (s)
 (let (a)
  (setq a (list s))
  (cons a a)))
```

13.0.232 defun dqConcat

The dqConcat function concatenates a list of dq's, destroying all but the last
[dqAppend p372]
[dqConcat p371]

⟨*defun dqConcat*⟩≡
```
(defun |dqConcat| (ld)
 (cond
  ((null ld) nil)
  ((null (cdr ld)) (car ld))
  (t (|dqAppend| (car ld) (|dqConcat| (cdr ld))))))
```

13.0.233 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)))
```

13.0.234 defun dqToList

⟨*defun dqToList 0*⟩≡

```
(defun |dqToList| (s)
 (when s (car s)))
```

Chapter 14

Message Handling

14.1 The Line Object

14.1.1 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)))
```

14.1.2 defun Line element 0; Extra blanks

⟨*defun lnExtraBlanks 0*⟩≡
```
(defun |lnExtraBlanks| (lineObject) (elt lineObject 0))
```

14.1.3 defun Line element 1; String

⟨*defun lnString 0*⟩≡
```
(defun |lnString| (lineObject) (elt lineObject 1))
```

14.1.4 defun Line element 2; Globlal number

⟨*defun lnGlobalNum 0*⟩≡
```
(defun |lnGlobalNum| (lineObject) (elt lineObject 2))
```

14.1.5 defun Line element 2; Set Global number

⟨*defun lnSetGlobalNum 0*⟩≡
```
(defun |lnSetGlobalNum| (lineObject num)
 (setf (elt lineObject 2) num))
```

14.1.6 defun Line elemnt 3; Local number

⟨*defun lnLocalNum 0*⟩≡
```
(defun |lnLocalNum| (lineObject) (elt lineObject 3))
```

14.1.7 defun Line element 4; Place of origin

⟨*defun lnPlaceOfOrigin 0*⟩≡
```
(defun |lnPlaceOfOrigin| (lineObject) (elt lineObject 4))
```

14.1.8 defun Line element 4: Is it a filename?

[lnFileName? p374]

⟨*defun lnImmediate? 0*⟩≡
```
(defun |lnImmediate?| (lineObject) (null (|lnFileName?| lineObject)))
```

14.1.9 defun Line element 4: Is it a filename?

⟨*defun lnFileName? 0*⟩≡
```
(defun |lnFileName?| (lineObject)
 (let (filename)
  (when (consp (setq filename (elt lineObject 4))) filename)))
```

14.1.10 defun Line element 4; Get filename

[lnFileName? p374]
[ncBug p396]

⟨*defun lnFileName*⟩≡
```
(defun |lnFileName| (lineObject)
 (let (fN)
  (if (setq fN (|lnFileName?| lineObject))
   fN
   (|ncBug| "there is no file name in %1" (list lineObject)))))
```

14.2 Messages

14.2.1 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 p391]
[putDatabaseStuff p393]
[initImPr p395]
[initToWhere p396]

⟨*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))
```

14.2.2 defun getMsgPosTagOb

⟨*defun getMsgPosTagOb 0*⟩≡
```
(defun |getMsgPosTagOb| (msg) (elt msg 1))
```

14.2.3 defun getMsgKey

⟨*defun getMsgKey 0*⟩≡
```
(defun |getMsgKey| (msg)  (elt msg 2))
```

14.2.4 defun getMsgArgL

⟨*defun getMsgArgL 0*⟩≡
```
(defun |getMsgArgL| (msg) (elt msg 3))
```

14.2.5 defun getMsgPrefix

⟨*defun getMsgPrefix 0*⟩≡
```
(defun |getMsgPrefix| (msg) (elt msg 4))
```

14.2.6 defun setMsgPrefix

⟨*defun setMsgPrefix 0*⟩≡
```
(defun |setMsgPrefix| (msg val) (setf (elt msg 4) val))
```

14.2.7 defun getMsgText

⟨*defun getMsgText 0*⟩≡
```
(defun |getMsgText| (msg) (elt msg 5))
```

14.2.8 defun setMsgText

⟨*defun setMsgText 0*⟩≡
```
(defun |setMsgText| (msg val)
  (setf (elt msg 5) val))
```

14.2.9 defun getMsgPrefix?

⟨*defun getMsgPrefix? 0*⟩≡
```
(defun |getMsgPrefix?| (msg)
 (let ((pre (|getMsgPrefix| msg)))
  (unless (eq pre '|noPre|) pre)))
```

14.2.10 defun getMsgTag

The valid message tags are: line, old, error, warn, bug, unimple, remark, stat, say, debug [ncTag p447]

⟨*defun getMsgTag 0*⟩≡
```
(defun |getMsgTag| (msg) (|ncTag| msg))
```

14.2.11 defun getMsgTag?

[IFCAR p**??**]
[getMsgTag p377]

⟨*defun getMsgTag? 0*⟩≡
```
(defun |getMsgTag?| (|msg|)
 (ifcar (member (|getMsgTag| |msg|)
         (list '|line| '|old| '|error| '|warn| '|bug|
               '|unimple| '|remark| '|stat| '|say| '|debug|))))
```

14.2.12 defun line?

[getMsgTag p377]

⟨*defun line?*⟩≡
```
(defun |line?| (msg) (eq (|getMsgTag| msg) '|line|))
```

14.2.13 defun leader?

[getMsgTag p377]

⟨*defun leader?*⟩≡
```
(defun |leader?| (msg) (eq (|getMsgTag| msg) '|leader|))
```

14.2.14 defun toScreen?

[getMsgToWhere p391]

⟨*defun toScreen?*⟩≡
```
(defun |toScreen?| (msg) (not (eq (|getMsgToWhere| msg) '|fileOnly|)))
```

14.2.15 defun ncSoftError

Messages for the USERS of the compiler. The program being compiled has a minor error. Give a message and continue processing. [desiredMsg p379]
[processKeyedError p380]
[msgCreate p375]
[$newcompErrorCount p27]

⟨*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))))
```

14.2.16 defun ncHardError

The program being compiled is seriously incorrect. Give message and throw to a recovery point. [desiredMsg p379]
[processKeyedError p380]
[msgCreate p375]
[ncError p77]
[$newcompErrorCount p27]

⟨*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|))))
```

14.2.17 defun desiredMsg

⟨*defun desiredMsg 0*⟩≡
```
(defun |desiredMsg| (erMsgKey &rest optCatFlag)
 (cond
  ((null (null optCatFlag)) (car optCatFlag))
  (t t)))
```

14.2.18 defun processKeyedError

[getMsgTag? p377]
[getMsgKey p376]
[getMsgPrefix? p377]
[sayBrightly p**??**]
[CallerName p**??**]
[msgImPr? p386]
[msgOutputter p381]
[$ncMsgList p27]

⟨*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|))))))
```

14.2.19 defun msgOutputter

[getStFromMsg p382]
[leader? p378]
[line? p378]
[toScreen? p378]
[flowSegmentedMsg p**??**]
[sayBrightly p**??**]
[toFile? p391]
[alreadyOpened? p391]
[$linelength p817]

⟨*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)))))
```

14.2.20 defun listOutputter

[msgOutputter p381]

⟨*defun listOutputter*⟩≡
```
(defun |listOutputter| (outputList)
 (dolist (msg outputList)
  (|msgOutputter| msg)))
```

14.2.21 defun getStFromMsg

[getPreStL p383]
[getMsgPrefix? p377]
[getMsgTag p377]
[getMsgText p376]
[getPosStL p384]
[getMsgKey? p390]
[pname p**??**]
[getMsgLitSym p390]
[tabbing p390]

⟨*defun getStFromMsg*⟩≡

```
(defun |getStFromMsg| (msg)
 (let (st msgKey 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)))))))))))
```

14.2.22 defvar $preLength

⟨*initvars*⟩+≡

```
(defvar |$preLength| 11)
```

14.2.23 defun getPreStL

[size p1110]
[$preLength p382]

⟨*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|)))))
```

14.2.24 defun getPosStL

[showMsgPos? p386]
[getMsgPos p387]
[msgImPr? p386]
[decideHowMuch p387]
[listDecideHowMuch p389]
[ppos p385]
[remLine p389]
[remFile p385]
[$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|
        (cons ""
```

```
          (append printedLineNum
           (cons '|%l| nil)))))))
      (t "")))))))
```

14.2.25 defun ppos

[pfNoPosition? p444]
[pfImmediate? p??]
[pfCharPosn p263]
[pfLinePosn p263]
[porigin p97]
[pfFileName p264]

⟨*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)))))
```

14.2.26 defun remFile

[IFCDR p??]
[IFCAR p??]

⟨*defun remFile*⟩≡

```
(defun |remFile| (positionList) (ifcdr (ifcdr positionList)))
```

14.2.27 defun showMsgPos?

[msgImPr? p386]
[leader? p378]
[$erMsgToss p??]

⟨*defun showMsgPos? 0*⟩≡
```
(defun |showMsgPos?| (msg)
 (declare (special |$erMsgToss|))
 (or |$erMsgToss| (and (null (|msgImPr?| msg)) (null (|leader?| msg)))))
```

14.2.28 defvar $imPrGuys

⟨*initvars*⟩+≡
```
(defvar |$imPrGuys| (list '|imPr|))
```

14.2.29 defun msgImPr?

[getMsgCatAttr p386]

⟨*defun msgImPr?*⟩≡
```
(defun |msgImPr?| (msg)
 (eq (|getMsgCatAttr| msg '|$imPrGuys|) '|imPr|))
```

14.2.30 defun getMsgCatAttr

[ifcdr p??]
[qassq p??]
[ncAlist p448]

⟨*defun getMsgCatAttr*⟩≡
```
(defun |getMsgCatAttr| (msg cat)
 (ifcdr (qassq cat (|ncAlist| msg))))
```

14.2.31 defun getMsgPos

[getMsgFTTag? p387]
[getMsgPosTagOb p376]

⟨*defun getMsgPos*⟩≡
```
(defun |getMsgPos| (msg)
 (if (|getMsgFTTag?| msg)
  (cadr (|getMsgPosTagOb| msg))
  (|getMsgPosTagOb| msg)))
```

14.2.32 defun getMsgFTTag?

[ifcar p**??**]
[getMsgPosTagOb p376]

⟨*defun getMsgFTTag?*⟩≡
```
(defun |getMsgFTTag?| (msg)
 (ifcar (member (ifcar (|getMsgPosTagOb| msg)) (list 'from 'to 'fromto))))
```

14.2.33 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 noposition or console [poNopos? p388]
[poPosImmediate? p388]
[poFileName p388]
[poLinePosn p389]

⟨*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)))
```

14.2.34 defun poNopos?

⟨*defun poNopos? 0*⟩≡
```
(defun |poNopos?| (posn)
 (equal posn (list '|noposition|)))
```

14.2.35 defun poPosImmediate?

[poNopos? p388]
[lnImmediate? p374]
[poGetLineObject p388]

⟨*defun poPosImmediate?*⟩≡
```
(defun |poPosImmediate?| (txp)
 (unless (|poNopos?| txp) (|lnImmediate?| (|poGetLineObject| txp))))
```

14.2.36 defun poFileName

[lnFileName p375]
[poGetLineObject p388]

⟨*defun poFileName*⟩≡
```
(defun |poFileName| (posn)
 (if posn
  (|lnFileName| (|poGetLineObject| posn))
  (caar posn)))
```

14.2.37 defun poGetLineObject

⟨*defun poGetLineObject 0*⟩≡
```
(defun |poGetLineObject| (posn)
 (car posn))
```

14.2.38 defun poLinePosn

[lnLocalNum p374]
[poGetLineObject p388]

⟨*defun poLinePosn*⟩≡
```
(defun |poLinePosn| (posn)
 (if posn
  (|lnLocalNum| (|poGetLineObject| posn))
  (cdar posn)))
```

14.2.39 defun listDecideHowMuch

[poNopos? p388]
[poPosImmediate? p388]
[poGlobalLinePosn p81]

⟨*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)))
```

14.2.40 defun remLine

⟨*defun remLine 0*⟩≡
```
(defun |remLine| (positionList) (list (ifcar positionList)))
```

14.2.41 defun getMsgKey?

[identp p1111]

⟨*defun getMsgKey? 0*⟩≡
```
(defun |getMsgKey?| (msg)
 (let ((val (|getMsgKey| msg)))
  (when (identp val) val)))
```

14.2.42 defun getMsgLitSym

[getMsgKey? p390]

⟨*defun getMsgLitSym*⟩≡
```
(defun |getMsgLitSym| (msg)
 (if (|getMsgKey?| msg) " " "*"))
```

14.2.43 defun tabbing

[getMsgPrefix? p377]
[$preLength p382]

⟨*defun tabbing*⟩≡
```
(defun |tabbing| (msg)
 (let (chPos)
 (declare (special |$preLength|))
  (setq chPos 2)
  (when (|getMsgPrefix?| msg) (setq chPos (- (+ chPos |$preLength|) 1)))
  (cons '|%t| chPos)))
```

14.2.44 defvar $toWhereGuys

⟨*initvars*⟩+≡
```
(defvar |$toWhereGuys| (list '|fileOnly| '|screenOnly|))
```

14.2.45 defun getMsgToWhere

[getMsgCatAttr p386]

⟨*defun getMsgToWhere*⟩≡
```
(defun |getMsgToWhere| (msg) (|getMsgCatAttr| msg '|$toWhereGuys|))
```

14.2.46 defun toFile?

[getMsgToWhere p391]
[$fn p**??**]

⟨*defun toFile?*⟩≡
```
(defun |toFile?| (msg)
 (declare (special |$fn|))
 (and (consp |$fn|) (not (eq (|getMsgToWhere| msg) '|screenOnly|))))
```

14.2.47 defun alreadyOpened?

[msgImPr? p386]

⟨*defun alreadyOpened?*⟩≡
```
(defun |alreadyOpened?| (msg) (null (|msgImPr?| msg)))
```

14.2.48 defun setMsgForcedAttrList

[setMsgForcedAttr p392]
[whichCat p392]

⟨*defun setMsgForcedAttrList*⟩≡
```
(defun |setMsgForcedAttrList| (msg attrlist)
 (dolist (attr attrlist)
  (|setMsgForcedAttr| msg (|whichCat| attr) attr)))
```

14.2.49 defun setMsgForcedAttr

[setMsgCatlessAttr p393]
[ncPutQ p449]

⟨*defun setMsgForcedAttr*⟩≡
```
(defun |setMsgForcedAttr| (msg cat attr)
 (if (eq cat '|catless|)
  (|setMsgCatlessAttr| msg attr)
  (|ncPutQ| msg cat attr)))
```

14.2.50 defvar $attrCats

⟨*initvars*⟩+≡
```
(defvar |$attrCats| (list '|$imPrGuys| '|$toWhereGuys| '|$repGuys|))
```

14.2.51 defun whichCat

[ListMember? p**??**]
[$attrCats p392]

⟨*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))
```

14.2.52 defun setMsgCatlessAttr

TPDHERE: Changed from —catless— to '—catless— [ncPutQ p449]
[ifcdr p**??**]
[qassq p**??**]
[ncAlist p448]

⟨*defun setMsgCatlessAttr*⟩≡
```
(defun |setMsgCatlessAttr| (msg attr)
 (|ncPutQ| msg '|catless|
  (cons attr (ifcdr (qassq |catless| (|ncAlist| msg))))))
```

14.2.53 defun putDatabaseStuff

TPDHERE: The variable al is undefined [getMsgInfoFromKey p394]
[setMsgUnforcedAttrList p394]
[setMsgText p377]

⟨*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)))
```

14.2.54 defun getMsgInfoFromKey

[getMsgKey? p390]
[getErFromDbL p??]
[getMsgKey p376]
[segmentKeyedMsg p358]
[removeAttributes p??]
[substituteSegmentedMsg p??]
[getMsgArgL p376]
[$msgDatabaseName p354]

⟨*defun getMsgInfoFromKey*⟩≡

```
(defun |getMsgInfoFromKey| (msg)
 (let (|$msgDatabaseName| attributes tmp msgText dbl msgKey)
 (declare (special |$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)))
```

14.2.55 defun setMsgUnforcedAttrList

[setMsgUnforcedAttr p395]
[whichCat p392]

⟨*defun setMsgUnforcedAttrList*⟩≡

```
(defun |setMsgUnforcedAttrList| (msg attrlist)
 (dolist (attr attrlist)
  (|setMsgUnforcedAttr| msg (|whichCat| attr) attr)))
```

14.2.56 defun setMsgUnforcedAttr

[setMsgCatlessAttr p393]
[qassq p??]
[ncAlist p448]
[ncPutQ p449]

⟨*defun setMsgUnforcedAttr*⟩≡
```
(defun |setMsgUnforcedAttr| (msg cat attr)
 (cond
  ((eq cat '|catless|) (|setMsgCatlessAttr| msg attr))
  ((null (qassq cat (|ncAlist| msg))) (|ncPutQ| msg cat attr))))
```

14.2.57 defvar $imPrTagGuys

⟨*initvars*⟩+≡
```
(defvar |$imPrTagGuys| (list '|unimple| '|bug| '|debug| '|say| '|warn|))
```

14.2.58 defun initImPr

[getMsgTag p377]
[setMsgUnforcedAttr p395]
[$imPrTagGuys p395]
[$erMsgToss p??]

⟨*defun initImPr*⟩≡
```
(defun |initImPr| (msg)
 (declare (special |$imPrTagGuys| |$erMsgToss|))
 (when (or |$erMsgToss| (member (|getMsgTag| msg) |$imPrTagGuys|))
   (|setMsgUnforcedAttr| msg '|$imPrGuys| '|imPr|)))
```

14.2.59 defun initToWhere

[getMsgCatAttr p386]
[setMsgUnforcedAttr p395]

⟨*defun initToWhere*⟩≡
```
(defun |initToWhere| (msg)
 (if (member '|trace| (|getMsgCatAttr| msg '|catless|))
   (|setMsgUnforcedAttr| msg '|$toWhereGuys| '|screenOnly|)))
```

14.2.60 defun ncBug

Bug in the compiler: something which shouldn't have happened did. [processKeyedError p380]
[msgCreate p375]
[enable-backtrace p??]
[ncAbort p??]
[$nopos p27]
[$newcompErrorCount p27]

⟨*defun ncBug*⟩≡
```
(defun |ncBug| (erMsgKey erArgL &rest optAttr)
 (let (erMsg)
 (declare (special |$nopos| |$newcompErrorCount|))
  (setq |$newcompErrorCount| (+ |$newcompErrorCount| 1))
  (setq erMsg
   (|processKeyedError|
    (|msgCreate| '|bug| |$nopos| erMsgKey erArgL "Bug!" optAttr)))
  (enable-backtrace nil)
  (break)
  (|ncAbort|)))
```

14.2.61 defun processMsgList

[erMsgSort p397]
[makeMsgFromLine p399]
[poGlobalLinePosn p81]
[getMsgPos p387]
[queueUpErrors p401]
[listOutputter p381]
[$noRepList p??]
[$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|))))
```

14.2.62 defun erMsgSort

[erMsgSep p398]
[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)))
```

14.2.63 defun erMsgCompare

[compareposns p398]
[getMsgPos p387]

⟨*defun erMsgCompare*⟩≡
```
(defun |erMsgCompare| (ob1 ob2)
 (|compareposns| (|getMsgPos| ob2) (|getMsgPos| ob1)))
```

14.2.64 defun compareposns

[poGlobalLinePosn p81]
[poCharPosn p405]

⟨*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)))))
```

14.2.65 defun erMsgSep

[poNopos? p388]
[getMsgPos p387]

⟨*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)))
```

14.2.66 defun makeMsgFromLine

[getLinePos p399]
[getLineText p400]
[poGlobalLinePosn p81]
[stringimage p??]
[poLinePosn p389]
[strconc p??]
[rep p399]
[char p??]
[size p1110]
[$preLength p382]

⟨*defun makeMsgFromLine*⟩≡
```
(defun |makeMsgFromLine| (line)
 (let (localNumOfLine stNum globalNumOfLine textOfLine posOfLine)
 (declare (special |$preLength|))
  (setq posOfLine (|getLinePos| line))
  (setq textOfLine (|getLineText| line))
  (setq globalNumOfLine (|poGlobalLinePosn| posOfLine))
  (setq stNum (stringimage (|poLinePosn| posOfLine)))
  (setq localNumOfLine
    (strconc (|rep| #\space (- |$preLength| 7 (size stNum))) stNum))
  (list '|line| posOfLine nil nil (strconc "Line" localNumOfLine) textOfLine)))
```

14.2.67 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))
  ""))
```

14.2.68 defun getLinePos

⟨*defun getLinePos 0*⟩≡
```
(defun |getLinePos| (line) (car line))
```

14.2.69 defun getLineText

⟨*defun getLineText 0*⟩≡

```
(defun |getLineText| (line) (cdr line))
```

14.2.70 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 p405]
[$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|))))
```

14.2.71 defun thisPosIsLess

[poNopos? p388]
[poGlobalLinePosn p81]

⟨*defun thisPosIsLess*⟩≡

```
(defun |thisPosIsLess| (pos num)
 (unless (|poNopos?| pos) (< (|poGlobalLinePosn| pos) num)))
```

14.2.72 defun thisPosIsEqual

[poNopos? p388]
[poGlobalLinePosn p81]

⟨*defun thisPosIsEqual*⟩≡
```
(defun |thisPosIsEqual| (pos num)
 (unless (|poNopos?| pos) (equal (|poGlobalLinePosn| pos) num)))
```

14.2.73 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? p404]
[sameMsg? p404]
[$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))))))
```

14.2.74 defvar $repGuys

⟨*initvars*⟩+≡
```
(defvar |$repGuys| (list '|noRep| '|rep|))
```

14.2.75 defun msgNoRep?

[getMsgCatAttr p386]

⟨*defun msgNoRep?*⟩≡
```
(defun |msgNoRep?| (msg) (eq (|getMsgCatAttr| msg '|$repGuys|) '|noRep|))
```

14.2.76 defun sameMsg?

[getMsgKey p376]
[getMsgArgL p376]

⟨*defun sameMsg?*⟩≡
```
(defun |sameMsg?| (msg1 msg2)
 (and (equal (|getMsgKey| msg1) (|getMsgKey| msg2))
      (equal (|getMsgArgL| msg1) (|getMsgArgL| msg2))))
```

14.2.77 defun processChPosesForOneLine

[posPointers p407]
[getMsgFTTag? p387]
[putFTText p409]
[poCharPosn p405]
[getMsgPos p387]
[getMsgPrefix p376]
[setMsgPrefix p376]
[strconc p??]
[size p1110]
[makeLeaderMsg p406]
[$preLength p382]

⟨*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))))
```

14.2.78 defun poCharPosn

⟨*defun poCharPosn 0*⟩≡

```
(defun |poCharPosn| (posn)
 (cdr posn))
```

14.2.79 defun makeLeaderMsg

```
makeLeaderMsg chPosList ==
    st := MAKE_-FULL_-CVEC ($preLength- 3)
    oldPos := -1
    for [posNum,:posLetter] in reverse chPosList repeat
        st := STRCONC(st, _
            rep(char ".", (posNum - oldPos - 1)),posLetter)
        oldPos := posNum
    ['leader,$nopos,'nokey,NIL,NIL,[st] ]
```

[$nopos p27]
[$preLength p382]

⟨*defun makeLeaderMsg*⟩≡

```
(defun |makeLeaderMsg| (chPosList)
 (let (posLetter posNum oldPos st)
 (declare (special |$nopos| |$preLength|))
  (setq st (make-string (- |$preLength| 3)))
  (setq oldPos -1)
  ((lambda (Var15 Var14)
   (loop
    (cond
     ((or (atom Var15) (progn (setq Var14 (car Var15)) nil))
       (return nil))
     (t
      (and (consp Var14)
           (progn
            (setq posNum (car Var14))
            (setq posLetter (cdr Var14))
            t)
           (progn
            (setq st
             (strconc st (|rep| (|char| '|.|) (- posNum oldPos 1)) posLetter))
            (setq oldPos posNum)))))
    (setq Var15 (cdr Var15))))
   (reverse chPosList) nil)
  (list '|leader| |$nopos| '|nokey| nil nil (list st))))
```

14.2.80 defun posPointers

TPDHERE: getMsgFTTag is nonsense [poCharPosn p405]
[getMsgPos p387]
[IFCAR p**??**]
[getMsgPos2 p407]
[insertPos p408]

⟨*defun posPointers*⟩≡
```
(defun |posPointers| (msgList)
 (let (posLetterList pos ftPosList posList increment pointers)
  (setq pointers "ABCDEFGHIJKLMONPQRS")
  (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))
```

14.2.81 defun getMsgPos2

[getMsgFTTag? p387]
[getMsgPosTagOb p376]
[ncBug p396]

⟨*defun getMsgPos2*⟩≡
```
(defun |getMsgPos2| (msg)
 (if (|getMsgFTTag?| msg)
  (caddr (|getMsgPosTagOb| msg))
  (|ncBug| "not a from to" nil)))
```

14.2.82 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)))
```

14.2.83 defun putFTText

[getMsgFTTag? p387]
[poCharPosn p405]
[getMsgPos p387]
[setMsgText p377]
[getMsgText p376]
[getMsgPos2 p407]

⟨*defun putFTText*⟩≡
```
(defun |putFTText| (msg chPosList)
 (let (charMarker2 pos2 markingText charMarker pos tag)
  (setq tag (|getMsgFTTag?| 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)))))))
```

14.2.84 defun From

This is called from parameter list of nc message functions

⟨*defun From 0*⟩≡
```
(defun |From| (pos) (list 'from pos))
```

14.2.85 defun To

This is called from parameter list of nc message functions

⟨*defun To 0*⟩≡
```
(defun |To| (pos) (list 'to pos))
```

14.2.86 defun FromTo

This is called from parameter list of nc message functions

⟨*defun FromTo 0*⟩≡

```
(defun |FromTo| (pos1 pos2) (list 'fromto pos1 pos2))
```

Chapter 15

The Interpreter Syntax

15.1 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, yieldig 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.

15.2 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 consituent 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]

15.3 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.
^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.
```

[1] "if" (15.6 p 426) "repeat" (15.10 p 434) "while" (65.1.1 p 1105) "for" (15.5 p 421) "suchthat" (15.11 p 439) "parallel" (15.9 p 431) "lists" (**??** p **??**)

```
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
```

15.4 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 immedidately 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.

15.5 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
evaluted 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
```

15.6 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 piles 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))
```

15.7 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
```

15.8 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:

```
  i := 1                        i := 1
  repeat                        repeat
    i := i + 1                    i := i + 1
    i > 3 => i                    if i > 3 then leave
    output(i)                     output(i)
```

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 clase with the "=>" lets you simulate the action of leave.

15.9 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 exhaused, 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 | ood? (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..01 | 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 (somthing 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.
```

15.10 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
foreer. 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 attemp to step through and interpret the code

It is still possible that Axiom can evalute 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:

```
i := 1                      i := 1
```

```
  repeat                        repeat
    i := i + 1                    i := i + 1
    i > 3 => i                    if i > 3 then leave
    output(i)                     output(i)
```

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 clase 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

- `)help lists`

[2]

15.11 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
```

[2] "blocks" (15.2 p 415) "if" (15.6 p 426) "while" (65.1.1 p 1105) "for" (15.5 p 421) "suchthat" (15.11 p 439) "parallel" (15.9 p 431) "lists" (**??** p **??**)

15.12 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
```

15.13 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 evaluted. 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 16

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)
```

16.0.1 defun Construct a leaf token

The tokConstruct function is a constructer 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? p444]
[ncPutQ p449]

⟨*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))))
```

16.0.2 defun Return a part of a node

[ifcar p**??**]

⟨*defun pfAbSynOp*⟩≡
```
(defun |pfAbSynOp| (form)
 (let (hd)
  (setq hd (car form))
  (or (ifcar hd) hd)))
```

16.0.3 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))))
```

16.0.4 defun pfNoPosition?

[poNoPosition? p445]

⟨*defun pfNoPosition?*⟩≡
```
(defun |pfNoPosition?| (pos)
 (|poNoPosition?| pos))
```

16.0.5 defun poNoPosition?

[eqcar p??]

⟨*defun poNoPosition? 0*⟩≡
```
(defun |poNoPosition?| (pos)
 (eqcar pos '|noposition|))
```

16.0.6 defun tokType

[ncTag p447]

⟨*defun tokType*⟩≡
```
(defun |tokType| (x) (|ncTag| x))
```

16.0.7 defun tokPart

⟨*defun tokPart 0*⟩≡
```
(defun |tokPart| (x) (cdr x))
```

16.0.8 defun tokPosn

[qassq p??]
[ncAlist p448]
[pfNoPosition p446]

⟨*defun tokPosn*⟩≡
```
(defun |tokPosn| (x)
 (let (a)
  (setq a (qassq '|posn| (|ncAlist| x)))
  (cond
   (a (cdr a))
   (t (|pfNoPosition|)))))
```

16.0.9 defun pfNoPosition

[poNoPosition p446]

⟨*defun pfNoPosition*⟩≡
```
(defun |pfNoPosition| () (|poNoPosition|))
```

16.0.10 defun poNoPosition

[$nopos p27]

⟨*defun poNoPosition 0*⟩≡
```
(defun |poNoPosition| ()
 (declare (special |$nopos|))
 |$nopos|)
```

Chapter 17

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.

17.0.11 defun ncTag

Pick off the tag [ncBug p396]
[qcar p**??**]
[identp p1111]

⟨*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))))))
```

17.0.12 defun ncAlist

Pick off the property list [ncBug p396]
[qcar p**??**]
[identp p1111]
[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))))))
```

17.0.13 defun ncEltQ

Get the entry for key k on x's association list [qassq p**??**]
[ncAlist p448]
[ncBug p396]

⟨*defun ncEltQ*⟩≡
```
(defun |ncEltQ| (x k)
 (let (r)
  (setq r (qassq k (|ncAlist| x)))
  (cond
   ((null r) (|ncBug| 's2cb0007 (list k)))
   (t (cdr r)))))
```

17.0.14 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 p448]
[ncTag p447]

⟨*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 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" (19.2.1 p 501) command
- The "boot" (5.1.8 p 24) command
- The "browse" (?? p ??) command
- The "cd" (?? p ??) command
- The "clear" (23.3.1 p 517) command
- The "close" (24.2.2 p 529) command
- The "compile" (?? p ??) command
- The "copyright" (26.2.1 p 541) command
- The "credits" (27.3.1 p 543) command
- The "display" (29.2.1 p 553) command
- The "edit" (30.2.1 p 564) command

- The “fin” (31.1.1 p 568) command
- The “frame” (32.5.16 p 588) command
- The “help” (33.2.1 p 596) command
- The “history” (34.4.7 p 606) command
- The “lisp” (**??** p **??**) command
- The “library” (63.1.34 p 1075) command
- The “load” (38.1.1 p 661) command
- The “ltrace” (39.1.1 p 664) command
- The “pquit” (40.2.1 p 666) command
- The “quit” (41.2.1 p 670) command
- The “read” (42.1.1 p 674) command
- The “savesystem” (43.1.1 p 678) command
- The “set” (44.37.1 p 857) command
- The “show” (45.1.1 p 864) command
- The “spool” (**??** p **??**) command
- The “summary” (47.1.1 p 880) command
- The “synonym” (48.1.1 p 882) command
- The “system” (**??** p **??**) command
- The “trace” (50.1.7 p 895) command
- The “trademark” (26.2.2 p 541) command
- The “undo” (51.3.6 p 975) command
- The “what” (52.1.2 p 997) command
- The “with” (53.1.1 p 1005) command
- The “workfiles” (54.1.1 p 1007) command
- The “zsystemdevelopment” (55.1.1 p 1011) command

18.1 Variables Used

18.1.1 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|)
   (|savesystem|                   . |interpreter|)
   (|set|                          . |interpreter|)
   (|show|                         . |interpreter|)
   (|spool|                        . |interpreter|)
   (|summary|                      . |interpreter|)
   (|synonym|                      . |interpreter|)
   (|system|                       . |interpreter|)
   (|trace|                        . |interpreter|)
   (|trademark|                    . |interpreter|)
   (|undo|                         . |interpreter|)
   (|what|                         . |interpreter|)
   (|with|                         . |interpreter|)
   (|workfiles|                    . |development|)
   (|zsystemdevelopment|           . |interpreter|)
 )))
```

18.1.2 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|)))
```

18.1.3 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

18.2.1 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.

18.2.2 defun Handle a top level command

[concat p1112]
[expand-tabs p**??**]
[processSynonyms p34]
[substring p**??**]
[getFirstWord p485]
[unAbbreviateKeyword p485]
[member p1113]
[handleNoParseCommands p456]

[splitIntoOptionBlocks p458]
[handleTokensizeSystemCommands p458]
[handleParsedSystemCommands p484]
[$tokenCommands p493]
[$noParseCommands p455]
[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))))))
```

18.2.3 defun Split block into option block

[stripSpaces p488]

⟨*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)))
```

18.2.4 defun Tokenize a system command

[dumbTokenize p483]
[tokTran p483]
[systemCommand p459]

⟨*defun handleTokensizeSystemCommands*⟩≡
```
(defun |handleTokensizeSystemCommands| (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))))
```

18.2.5 defun Handle system commands

You can type ")?" and see trivial help information. You can type ")? compile" and see compiler related information [selectOptionLC p498]
[helpSpad2Cmd p596]
[selectOption p498]
[commandsForUserLevel p460]
[$options p??]
[$e p??]
[$systemCommands p453]
[$syscommands p455]
[$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 $syscommands '|commandError|))
  (if (and argl (eq (elt argl 0) '?) (nequal fun '|synonym|))
   (|helpSpad2Cmd| (cons fun nil))
   (progn
    (setq fun
     (|selectOption| fun (|commandsForUserLevel| |$systemCommands|)
                         '|commandUserLevelError|))
    (funcall fun argl)))))
```

18.2.6 defun Select commands matching this user level

The `$UserLevel` variable contains one of three values: `compiler`, `development`, or `interpreter`. This variable is used to select a subset of commands from the list stored in `$systemCommands`, representing all of the commands that are valid for this level. [satisfiesUserLevel p462]

⟨*defun commandsForUserLevel*⟩≡
```
(defun |commandsForUserLevel| (arg)
 (let (c)
  (dolist (pair arg)
   (when (|satisfiesUserLevel| (cdr pair))
    (setq c (cons (car pair) c))))
  (nreverse c)))
```

18.2.7 defun No command begins with this string

[commandErrorMessage p461]

⟨*defun commandError*⟩≡
```
(defun |commandError| (x u)
 (|commandErrorMessage| '|command| x u))
```

18.2.8 defun No option begins with this string

[commandErrorMessage p461]

⟨*defun optionError*⟩≡
```
(defun |optionError| (x u)
 (|commandErrorMessage| '|option| x u))
```

18.2.9 defvar $oldline

⟨*initvars*⟩+≡
```
(defvar $oldline nil "used to output command lines")
```

18.2.10 defun No command/option begins with this string

[commandAmbiguityError p464]
[sayKeyedMsg p357]
[terminateSystemCommand p463]
[$oldline p460]
[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|))))
```

18.2.11 defun Option not available at this user level

[userLevelErrorMessage p462]

⟨*defun optionUserLevelError*⟩≡
```
(defun |optionUserLevelError| (x u)
 (|userLevelErrorMessage| '|option| x u))
```

18.2.12 defun Command not available at this user level

[userLevelErrorMessage p462]

⟨*defun commandUserLevelError*⟩≡
```
(defun |commandUserLevelError| (x u)
 (|userLevelErrorMessage| '|command| x u))
```

18.2.13 defun Command not available error message

[commandAmbiguityError p464]
[sayKeyedMsg p357]
[terminateSystemCommand p463]
[$UserLevel p856]

⟨*defun userLevelErrorMessage*⟩≡
```
(defun |userLevelErrorMessage| (kind x u)
 (declare (special |$UserLevel|))
 (if u
  (|commandAmbiguityError| kind x u)
  (progn
   (|sayKeyedMsg| 'S2IZ0007 (list |$UserLevel| kind))
   (|terminateSystemCommand|))))
```

18.2.14 defun satisfiesUserLevel

[$UserLevel p856]

⟨*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)))
```

18.2.15 defun hasOption

[stringPrefix? p**??**]
[pname p**??**]

⟨*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))
```

18.2.16 defun terminateSystemCommand

[tersyscommand p463]

⟨*defun terminateSystemCommand*⟩≡
```
(defun |terminateSystemCommand| nil (tersyscommand))
```

18.2.17 defun Terminate a system command

[spadThrow p**??**]

⟨*defun tersyscommand*⟩≡
```
(defun tersyscommand ()
  (fresh-line)
  (setq chr 'endoflinechr)
  (setq tok 'end_unit)
  (|spadThrow|))
```

18.2.18 defun commandAmbiguityError

[sayKeyedMsg p357]
[sayMSG p359]
[bright p**??**]
[terminateSystemCommand p463]

⟨*defun commandAmbiguityError*⟩≡
```
(defun |commandAmbiguityError| (kind x u)
 (|sayKeyedMsg| 's2iz0009 (list kind x))
 (dolist (a u) (|sayMSG| (cons "     " (|bright| a))))
 (|terminateSystemCommand|))
```

18.2.19 defun getParserMacroNames

The `$pfMacros` is a list of all of the user-defined macros. [$pfMacros p107]

⟨*defun getParserMacroNames 0*⟩≡
```
(defun |getParserMacroNames| ()
 (declare (special |$pfMacros|))
 (remove-duplicates (mapcar #'car |$pfMacros|)))
```

18.2.20 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 p107]

⟨*defun clearParserMacro*⟩≡

```
(defun |clearParserMacro| (macro)
 (declare (special |$pfMacros|))
 (when (ifcdr (|assoc| macro |$pfMacros|))
  (setq |$pfMacros| (remalist |$pfMacros| macro))))
```

18.2.21 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)))))))
```

18.2.22 defun displayWorkspaceNames

[getInterpMacroNames p**??**]
[getParserMacroNames p464]
[sayMessage p**??**]
[msort p**??**]
[getWorkspaceNames p468]
[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)))))
```

18.2.23 defun getWorkspaceNames

```
;getWorkspaceNames() ==
;  NMSORT [n for [n,:.] in CAAR $InteractiveFrame |
;    (n ^= "--macros--" and n^= "--flags--")]
```

[nequal p??]
[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))
                            (NREVERSE0 G166322))
                         (SEQ (EXIT (COND
                                      ((AND (NEQUAL n '|--macros--|)
                                            (NEQUAL n '|--flags--|))
                                       (SETQ G166322
                                        (CONS n G166322))))))))))))))
```

18.2.24 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 p1113]
[strconc p??]
[pname p??]
[$msgdbPrims p355]

⟨*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))))
```

18.2.25 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 vl =>
;    null $frameMessages => sayKeyedMsg("S2IZ0066",NIL)
;    sayKeyedMsg("S2IZ0067",[$interpreterFrameName])
;  interpFunctionDepAlists()
;  for v in vl 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 p359]
[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))))))
```

18.2.26 defun displayValue

[sayMSG p359]
[fixObjectForPrinting p469]
[pname p??]
[objValUnwrap p??]
[objMode p??]
[displayRule p??]
[strconc p??]
[prefix2String p??]
[objMode p??]
[getdatabase p1071]
[concat p1112]
[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 (pairp 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))))))
```

18.2.27 defun displayType

[sayMSG p359]
[fixObjectForPrinting p469]
[pname p**??**]
[prefix2String p**??**]
[objMode p**??**]
[concat p1112]
[$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))))
```

18.2.28 defun getAndSay

[getI p**??**]
[sayMSG p359]

⟨*defun getAndSay*⟩≡

```
(defun |getAndSay| (v prop)
 (let (val)
  (if (setq val (|getI| v prop))
   (|sayMSG| (cons '|    | (cons val (cons '|%l| nil))))
   (|sayMSG| (cons '|    none| (cons '|%l| nil))))))
```

18.2.29 defun displayProperties

[getInterpMacroNames p??]
[getParserMacroNames p464]
[remdup p??]
[pairp p??]
[qcdr p??]
[qcar p??]
[msort p??]
[getWorkspaceNames p468]
[sayKeyedMsg p357]
[interpFunctionDepAlists p481]
[isInternalMapName p??]
[getIProplist p??]
[getAndSay p475]
[displayValue p473]
[getI p??]
[displayCondition p480]
[displayMode p482]
[displayType p474]
[fixObjectForPrinting p469]
[sayMSG p359]
[bright p??]
[prefix2String p??]
[member p1113]
[displayParserMacro p479]
[isInterpMacro p??]
[displayMacro p466]
[displayProperties,sayFunctionDeps p470]
[displayModemap p482]
[exit p??]
[seq p??]
[terminateSystemCommand p463]
[$dependentAlist p??]
[$dependeeAlist p??]
[$frameMessages p778]
[$interpreterFrameName p??]

⟨*defun displayProperties*⟩≡

```
(defun |displayProperties| (option al)
 (let (|$dependentAlist| |$dependeeAlist| tmp1 opt imacs pmacs macros vl pl
       tmp2 vone prop val propsSeen)
 (declare (special |$dependentAlist| |$dependeeAlist| |$frameMessages|
                   |$interpreterFrameName|))
  (setq |$dependentAlist| nil)
```

```
(setq |$dependeeAlist| nil)
(setq tmp1 (or al (cons '|properties| nil)))
(setq opt (car tmp1))
(setq vl (cdr tmp1))
(setq imacs (|getInterpMacroNames|))
(setq pmacs (|getParserMacroNames|))
(setq macros (remdup (append imacs pmacs)))
(when (or
       (and (pairp vl) (eq (qcdr vl) nil) (eq (qcar vl) '|all|))
       (null vl))
  (setq vl (msort (append (|getWorkspaceNames|) macros))))
 (when |$frameMessages|
  (|sayKeyedMsg| 'S2IZ0065 (cons |$interpreterFrameName| nil)))
 (cond
  ((null vl)
   (if (null |$frameMessages|)
    (|sayKeyedMsg| 'S2IZ0066 nil))
    (|sayKeyedMsg| 'S2IZ0067 (cons |$interpreterFrameName| nil)))
  (t
   (|interpFunctionDepAlists|)
   (do ((G166440 vl (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 (pairp pl)
                 (progn
                  (setq tmp2 (qcar pl))
                  (and (pairp 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
              (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 '|mode|)
                    (|displayMode| 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|)))))
```

18.2.30 defun displayParserMacro

[pfPrintSrcLines p**??**]
[$pfMacros p107]

⟨*defun displayParserMacro*⟩≡

```
(defun |displayParserMacro| (m)
 (let ((m (assq m |$pfMacros|)))
 (declare (special |$pfMacros|))
  (when m (|pfPrintSrcLines| (caddr m)))))
```

18.2.31 defun displayCondition

[bright p??]
[sayBrightly p??]
[concat p1112]
[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)))))
```

18.2.32 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|))))
```

18.2.33 defun displayModemap

[bright p??]
[sayBrightly p??]
[concat p1112]
[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)))
```

18.2.34 defun displayMode

[bright p??]
[fixObjectForPrinting p469]
[sayBrightly p??]
[concat p1112]
[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))))))
```

18.2.35 defun Split into tokens delimted by spaces

[stripSpaces p488]

⟨*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)))
```

18.2.36 defun Convert string tokens to their proper type

[isIntegerString p484]

⟨*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)))
```

18.2.37 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)))
```

18.2.38 defun Handle parsed system commands

[dumbTokenize p483]
[parseSystemCmd p484]
[tokTran p483]
[systemCommand p459]

⟨*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)))))
```

18.2.39 defun Parse a system command

[tokTran p483]
[stripSpaces p488]
[parseFromString p52]
[dumbTokenize p483]

⟨*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)))))
```

18.2.40 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)))
```

18.2.41 defun Unabbreviate keywords in commands

[selectOptionLC p498]
[selectOption p498]
[commandsForUserLevel p460]
[$systemCommands p453]
[$currentLine p??]
[$syscommands p455]
[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|)))
```

18.2.42 defun The command is ambiguous error

[commandAmbiguityError p464]
[$oldline p460]
[line p**??**]

⟨*defun commandErrorIfAmbiguous*⟩≡

```
(defun |commandErrorIfAmbiguous| (x u)
 (declare (special $oldline line))
 (when u
   (setq $oldline line)
   (|commandAmbiguityError| '|command| x u)))
```

[stripSpaces p488]
[nplisp p488]
[stripLisp p488]
[sayKeyedMsg p357]
[npboot p488]
[npsystem p489]
[npsynonym p489]
[member p1113]
[concat p1112]

⟨*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)))))))
```

18.2.43 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))
```

18.2.44 defun Remove the lisp command prefix

⟨*defun stripLisp 0*⟩≡
```
(defun |stripLisp| (str)
 (if (string= (subseq str 0 4) "lisp")
  (subseq str 4)
  str))
```

18.2.45 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|))
```

18.2.46 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~%"))
```

18.2.47 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 p357]

⟨*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)))))))
```

18.2.48 defun Handle the)synonym command

[npProcessSynonym p490]

⟨*defun npsynonym*⟩≡
```
(defun |npsynonym| (unab str)
 (declare (ignore unab))
 (|npProcessSynonym| str))
```

18.2.49 defun Handle the synonym system command

[printSynonyms p491]
[processSynonymLine p885]
[putalist p**??**]
[terminateSystemCommand p463]
[$CommandSynonymAlist p496]

⟨*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|)))
```

18.2.50 defun printSynonyms

[centerAndHighlight p??]
[specialChar p1036]
[filterListOfStringsWithFn p1001]
[synonymsForUserLevel p884]
[stringimage p??]
[printLabelledList p492]
[$CommandSynonymAlist p496]
[$linelength p817]

⟨*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 (stringimage (caar t2)) (cdar t2)) t1))
    (|function| car)))
  (|printLabelledList| ls "user" "synonyms" ")" patterns)))
```

18.2.51 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 p1112]
[fillerSpaces p19]

⟨*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| ""))))))
```

18.2.52 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|
    |savesystem|
    |set|
    |spool|
    |undo|
    |what|
    |with|
    |workfiles|
    |zsystemdevelopment|
    )))
```

18.2.53 defvar $InitialCommandSynonymAlist

Axiom can create "synonyms" for commands. We create an initial table of synonyms which are in common use.

⟨*initvars*⟩+≡
```
(defvar |$InitialCommandSynonymAlist| nil)
```

18.2.54 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")
       (|co|         . "compiler")
       (|d|          . "display")
       (|dep|        . "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")
))))
```

18.2.55 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|)))
```

18.2.56 defun ncloopCommand

The $systemCommandFunction is set in SpadInterpretStream to point to the function InterpExecuteSpadSystemCommand. The system commands are handled by the function kept in the "hook" variable `$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.
[ncloopPrefix? p497]
[ncloopInclude1 p654]
[$systemCommandFunction p**??**]
[$systemCommandFunction p**??**]

⟨*defun ncloopCommand*⟩≡
```
(defun |ncloopCommand| (line n)
 (let (a)
 (declare (special |$systemCommandFunction|))
  (if (setq a (|ncloopPrefix?| ")include" line))
   (|ncloopInclude1| a n)
   (progn
    (funcall |$systemCommandFunction| line)
    n))))
```

18.2.57 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))))
```

18.2.58 defun selectOptionLC

[selectOption p498]
[downcase p??]
[object2Identifier p??]

⟨*defun selectOptionLC*⟩≡
```
(defun |selectOptionLC| (x l errorFunction)
 (|selectOption| (downcase (|object2Identifier| x)) l errorFunction))
```

18.2.59 defun selectOption

[member p1113]
[identp p1111]
[stringPrefix? p??]
[pname p??]
[pairp p??]
[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 (pairp 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

19.2.1 defun abbreviations

[abbreviationsSpad2Cmd p502]

⟨*defun abbreviations*⟩≡
```
(defun |abbreviations| (l)
 (|abbreviationsSpad2Cmd| l))
```

19.2.2 defun abbreviationsSpad2Cmd

[listConstructorAbbreviations p504]
[abbreviation? p??]
[abbQuery p555]
[deldatabase p1070]
[size p1110]
[sayKeyedMsg p357]
[mkUserConstructorAbbreviation p??]
[setdatabase p1070]
[seq p??]
[exit p??]
[opOf p??]
[helpSpad2Cmd p596]
[selectOptionLC p498]
[pairp p??]
[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 (pairp 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))))))))))))
```

19.2.3 defun listConstructorAbbreviations

[upcase p**??**]
[queryUserKeyedMsg p**??**]
[string2id-n p**??**]
[whatSpad2Cmd p998]
[sayKeyedMsg p357]

⟨*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` 18.1.3 which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` 18.2.1

[1] "fin" (31.1.1 p 568) "lisp" (?? p ??) "set" (44.37.1 p 857) "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 XMLHttpRequest handling. 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 = commandline(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.nrlib/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 p857]
[loadLib p**??**]
[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" (30.2.1 p 564) "history" (34.4.7 p 606) "library" (63.1.34 p 1075) "read" (42.1.1 p 674) "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

23.2.1 defvar $clearOptions

⟨*initvars*⟩+≡
```
(defvar |$clearOptions| '(|modes| |operations| |properties| |types| |values|))
```

23.3 Functions

23.3.1 defun clear

[clearSpad2Cmd p518]

⟨*defun clear*⟩≡
```
(defun |clear| (l)
 (|clearSpad2Cmd| l))
```

23.3.2 defvar $clearExcept

⟨*initvars*⟩+≡
```
(defvar |$clearExcept| nil)
```

[1] "display" (29.2.1 p 553) "history" (34.4.7 p 606) "undo" (51.3.6 p 975)

23.3.3 defun clearSpad2Cmd

TPDHERE: Note that this function also seems to parse out)except)completely and)scaches which don't seem to be documented. [selectOptionLC p498]
[sayKeyedMsg p357]
[clearCmdAll p522]
[clearCmdCompletely p521]
[clearCmdSortedCaches p519]
[clearCmdExcept p523]
[clearCmdParts p524]
[updateCurrentInterpreterFrame p580]
[$clearExcept p517]
[$options p**??**]
[$clearOptions p517]

⟨*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 '(|%l| "       " ,x)))))))
    (|sayKeyedMsg| 's2iz0010 (list optlist)))
   (t
    (setq arg
     (|selectOptionLC| (car l) '(|all| |completely| |scaches|) nil))
    (cond
     ((eq arg '|all|)        (|clearCmdAll|))
     ((eq arg '|completely|) (|clearCmdCompletely|))
     ((eq arg '|scaches|)    (|clearCmdSortedCaches|))
     (|$clearExcept|         (|clearCmdExcept| l))
     (t
      (|clearCmdParts| l)
      (|updateCurrentInterpreterFrame|)))))))
```

23.3.4 defun clearCmdSortedCaches

[compiledLookupCheck p??]
[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))))
```

23.3.5 defvar $functionTable

⟨*initvars*⟩+≡

```
(defvar |$functionTable| nil)
```

23.3.6 defun clearCmdCompletely

[clearCmdAll p522]
[sayKeyedMsg p357]
[clearClams p??]
[clearConstructorCaches p??]
[reclaim p41]
[$localExposureData p729]
[$xdatabase p??]
[$CatOfCatDatabase p??]
[$DomOfCatDatabase p??]
[$JoinOfCatDatabase p??]
[$JoinOfDomDatabase p??]
[$attributeDb p??]
[$functionTable p520]
[$existingFiles p??]
[$localExposureDataDefault p729]

⟨*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))
```

23.3.7 defun clearCmdAll

[clearCmdSortedCaches p519]
[untraceMapSubNames p928]
[resetInCoreHist p614]
[deleteFile p1108]
[histFileName p604]
[updateCurrentInterpreterFrame p580]
[clearMacroTable p523]
[sayKeyedMsg p357]
[$frameRecord p973]
[$previousBindings p974]
[$variableNumberAlist p**??**]
[$InteractiveFrame p**??**]
[$useInternalHistoryTable p604]
[$internalHistoryTable p**??**]
[$frameMessages p778]
[$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)))
```

23.3.8 defun clearMacroTable

[$pfMacros p107]

⟨*defun clearMacroTable 0*⟩≡
```
(defun |clearMacroTable| ()
  (declare (special |$pfMacros|))
  (setq |$pfMacros| nil))
```

23.3.9 defun clearCmdExcept

Clear all the options except the argument. [stringPrefix? p**??**]
[object2String p**??**]
[clearCmdParts p524]
[$clearOptions p517]

⟨*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))))))
```

23.3.10 defun clearCmdParts

[selectOptionLC p498]
[pname p??]
[types p??]
[modes p??]
[values p??]
[boot-equal p??]
[assocleft p??]
[remdup p??]
[assoc p??]
[isMap p??]
[get p??]
[pairp p??]
[exit p??]
[untraceMapSubNames p928]
[seq p??]
[recordOldValue p618]
[recordNewValue p617]
[deleteAssoc p??]
[sayKeyedMsg p357]
[getParserMacroNames p464]
[getInterpMacroNames p??]
[clearDependencies p??]
[member p1113]
[clearParserMacro p465]
[sayMessage p??]
[fixObjectForPrinting p469]
[$e p??]
[$InteractiveFrame p??]
[$clearOptions p517]

⟨*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|))
   (setq vl (assocleft (caar |$InteractiveFrame|)))
   (setq vl (remdup (append vl pmacs)))))
 (setq |$e| |$InteractiveFrame|)
 (do ((t0 vl (cdr t0)) (x nil))
     ((or (atom t0) (progn (setq x (car t0)) nil)) nil)
   (|clearDependencies| x t)
   (when (and (eq option '|properties|) (|member| x pmacs))
     (|clearParserMacro| x))
   (when (and (eq option '|properties|)
              (|member| x imacs)
              (null (|member| x pmacs)))
     (|sayMessage| (cons
      "   You cannot clear the definition of the system-defined macro "
       (cons (|fixObjectForPrinting| x)
             (cons (intern "." "BOOT") nil)))))
   (cond
    ((setq p1 (|assoc| x (caar |$InteractiveFrame|)))
     (cond
      ((eq option '|properties|)
       (cond
        ((|isMap| x)
         (seq
          (cond
           ((setq lm
             (|get| x '|localModemap| |$InteractiveFrame|))
            (cond
             ((pairp lm)
              (exit (|untraceMapSubNames| (cons (cadar lm) nil))))))
           (t nil)))))
       (dolist (p2 (cdr p1))
         (setq prop (car p2))
         (|recordOldValue| x prop (cdr p2))
         (|recordNewValue| x prop nil))
       (setf (caar |$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

24.2.1 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|))
```

[1] "quit" (41.2.1 p 670) "pquit" (40.2.1 p 666)

24.2.2 defun close

[throwKeyedMsg p??]
[sockSendInt p??]
[closeInterpreterFrame p584]
[selectOptionLC p498]
[upcase p??]
[queryUserKeyedMsg p??]
[string2id-n p??]
[queryClients p528]
[$SpadServer p11]
[$SessionManager p??]
[$CloseClient p??]
[$currentFrameNum p45]
[$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 intepreter 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

25.2.1 defvar $/editfile

⟨*initvars*⟩+≡
```
(defvar /editfile nil)
```

[1] "abbreviation" (?? p ??) "edit" (30.2.1 p 564) "library" (63.1.34 p 1075)

Chapter 26

)copyright help page Command

26.1 copyright help page man page

⟨*copyright.help*⟩≡
```
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26.2 Functions

26.2.1 defun copyright

[obey p??]
[concat p1112]
[getenviron p31]

⟨*defun copyright*⟩≡
```
(defun |copyright| ()
 (obey (concat "cat " (getenviron "AXIOM") "/doc/spadhelp/copyright.help")))
```

26.2.2 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` 18.1.3 which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` 18.2.1

Chapter 27

)credits help page Command

27.1 credits help page man page

27.2 Variables Used

27.3 Functions

27.3.1 defun credits

[credits p543]

⟨*defun credits 0*⟩≡
```
(defun |credits| ()
 (declare (special credits))
 (mapcar #'(lambda (x) (princ x) (terpri)) credits))
```

This command is in the list of `$noParseCommands` 18.1.3 which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` 18.2.1

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.
```

28.1.1 defvar $describeOptions

The current value of $describeOptions is

⟨*initvars*⟩+≡

```
(defvar $describeOptions '(|category| |domain| |package|))
```

28.2 Functions

28.2.1 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. [describespad2cmd p**??**]

⟨*defun describe*⟩≡

```
(defun |describe| (l)
 (describeSpad2Cmd l))
```

28.2.2 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 p498]
[flatten p550]
[cleanline p549]
[getdatabase p1071]
[sayMessage p**??**]
[$e p**??**]
[$EmptyEnvironment p**??**]
[$describeOptions p546]

⟨*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 (pairp 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")))))))
```

28.2.3 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)))
```

28.2.4 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]

29.1.1 defvar $displayOptions

The current value of $displayOptions is

⟨*initvars*⟩+≡

```
(defvar |$displayOptions|
 '(|abbreviations| |all| |macros| |modes| |names| |operations|
   |properties| |types| |values|))
```

29.2 Functions

29.2.1 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))
```

[1] "clear" (23.3.1 p 517) "history" (34.4.7 p 606) "set" (44.37.1 p 857) "show" (45.1.1 p 864) "what" (52.1.2 p 997)

29.2.2 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 $displayOptions list to construct a list of strings for the sayMessage function and tell the user what options are available.
[abbQuery p555]
[opOf p**??**]
[listConstructorAbbreviations p504]
[displayOperations p556]
[displayMacros p557]
[displayWorkspaceNames p467]
[displayProperties p476]
[PAIRP p**??**]
[selectOptionLC p498]
[sayMessage p**??**]
[$e p**??**]
[$EmptyEnvironment p**??**]
[$displayOptions p553]

⟨*defun displaySpad2Cmd*⟩≡

```
(defun displaySpad2Cmd (l)
 (let ((|$e| |$EmptyEnvironment|) (opt (car l)) (vl (cdr l)) option)
  (declare (special |$e| |$EmptyEnvironment| |$displayOptions|))
  (if (and (pairp l) (not (eq opt '?)))
   (progn
    (setq option (|selectOptionLC| opt |$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"))))))
```

29.2.3 defun abbQuery

[getdatabase p1071]
[sayKeyedMsg p357]

⟨*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))))))
```

29.2.4 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 p556]
[sayKeyedMsg p357]

⟨*defun displayOperations*⟩≡
```
(defun |displayOperations| (l)
 (if l
  (dolist (op l) (|reportOpSymbol| op))
  (if (yesanswer)
   (dolist (op (|allOperations|)) (|reportOpSymbol| op))
   (|sayKeyedMsg| 's2iz0059 nil))))
```

29.2.5 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)))
```

29.2.6 defun displayMacros

[getInterpMacroNames p**??**]
[getParserMacroNames p464]
[remdup p**??**]
[sayBrightly p**??**]
[member p1113]
[displayParserMacro p479]
[seq p**??**]
[exit p**??**]
[displayMacro p466]

⟨*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 '|%l|
            (cons "System-defined macros:" nil))) (setq first nil)))
        (|displayMacro| macro))))
    ((|member| macro pmacs) '|iterate|)))))
nil))))
```

29.2.7 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|))))
```

29.2.8 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

30.2.1 defun edit

[editSpad2Cmd p565]

⟨*defun edit*⟩≡

```
(defun |edit| (l) (|editSpad2Cmd| l))
```

[1] "system" (?? p ??) "read" (42.1.1 p 674)

30.2.2 defun editSpad2Cmd

[pathname p1108]
[pathnameDirectory p1107]
[pathnameType p1106]
[$FINDFILE p??]
[pathnameName p1106]
[editFile p566]
[updateSourceFiles p566]
[/editfile p534]

⟨*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))
```

30.2.3 defun Implement the)edit command

[strconc p**??**]
[namestring p1106]
[pathname p1108]
[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/SPADEDIT " (|namestring| (|pathname| file)))))))
```

30.2.4 defun updateSourceFiles

[pathname p1108]
[pathnameName p1106]
[pathnameType p1106]
[makeInputFilename p1040]
[member p1113]
[pathnameTypeId p1107]
[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]

31.1.1 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` 18.1.3 which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` 18.2.1

[1] "pquit" (40.2.1 p 666) "quit" (41.2.1 p 670)

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.axh 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.axh 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.

32.2.1 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
```

Setting frame messages on will output a line detailing the current frame after every output is complete.

32.2.2 Used variables

The frame collects and uses a few top level variables. These are: $Interactive-Frame, $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.

[1] "history" (34.4.7 p 606) "set" (44.37.1 p 857)

32.3 Data Structures

32.3.1 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.

32.4.1 0th Frame Component – frameName

32.4.2 defun frameName

⟨*defun frameName 0*⟩≡

```
(defun frameName (frame)
 (car frame))
```

32.4.3 1st Frame Component – frameInteractive

⟨*defun frameInteractive 0*⟩≡

```
(defun frameInteractive (frame)
 (nth 1 frame))
```

32.4.4 2nd Frame Component – frameIOIndex

⟨*defun frameIOIndex 0*⟩≡
```
(defun frameIOIndex (frame)
 (nth 2 frame))
```

32.4.5 3rd Frame Component – frameHiFiAccess

⟨*defun frameHiFiAccess 0*⟩≡
```
(defun frameHiFiAccess (frame)
 (nth 3 frame))
```

32.4.6 4th Frame Component – frameHistList

⟨*defun frameHistList 0*⟩≡
```
(defun frameHistList (frame)
 (nth 4 frame))
```

32.4.7 5th Frame Component – frameHistListLen

⟨*defun frameHistListLen 0*⟩≡
```
(defun frameHistListLen (frame)
 (nth 5 frame))
```

32.4.8 6th Frame Component – frameHistListAct

⟨*defun frameHistListAct 0*⟩≡
```
(defun frameHistListAct (frame)
 (nth 6 frame))
```

32.4.9 7th Frame Component – frameHistRecord

⟨*defun frameHistRecord 0*⟩≡
```
(defun frameHistRecord (frame)
 (nth 7 frame))
```

32.4.10 8th Frame Component – frameHistoryTable

⟨*defun frameHistoryTable 0*⟩≡
```
(defun frameHistoryTable (frame)
 (nth 8 frame))
```

32.4.11 9th Frame Component – frameExposureData

⟨*defun frameExposureData 0*⟩≡
```
(defun frameExposureData (frame)
 (nth 9 frame))
```

32.5 Functions

32.5.1 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 p577]
[updateFromCurrentInterpreterFrame p579]
[$interpreterFrameName p**??**]
[$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)
```

32.5.2 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|))
```

32.5.3 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)))))
```

32.5.4 Create a new, empty Interpreter Frame

[$HiFiAccess p770]
[$HistList p??]
[$HistListLen p??]
[$HistListAct p??]
[$HistRecord p??]
[$localExposureDataDefault p729]

⟨*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
```

32.5.5 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**??**]
[$IOindex p**??**]
[$HiFiAccess p770]
[$HistList p**??**]
[$HistListLen p**??**]
[$HistListAct p**??**]
[$HistRecord p**??**]
[$internalHistoryTable p**??**]
[$localExposureData p729]

⟨*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|))
```

32.5.6 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 p**??**]
[$HiFiAccess p770]
[$HistList p**??**]
[$HistListLen p**??**]
[$HistListAct p**??**]
[$HistRecord p**??**]
[$internalHistoryTable p**??**]
[$localExposureData p729]
[$frameMessages p778]

⟨*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|))))))
```

32.5.7 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 p573]
[$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))
```

32.5.8 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 p578]
[updateFromCurrentInterpreterFrame p579]
[$interpreterFrameRing p**??**]

⟨*defun updateCurrentInterpreterFrame*⟩≡
```
(defun |updateCurrentInterpreterFrame| ()
  "Update the Current Interpreter Frame"
  (declare (special |$interpreterFrameRing|))
  (rplaca |$interpreterFrameRing| (|createCurrentInterpreterFrame|))
  (|updateFromCurrentInterpreterFrame|))
```

32.5.9 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). Note: the nconc2 function destructively inserts the second list at the end of the first.
[nconc2 p??]
[updateFromCurrentInterpreterFrame p579]
[$interpreterFrameRing p??]

⟨*defun nextInterpreterFrame*⟩≡
```
(defun |nextInterpreterFrame| ()
  "Move to the next Interpreter Frame in Ring"
  (declare (special |$interpreterFrameRing|))
  (when (cdr |$interpreterFrameRing|)
   (setq |$interpreterFrameRing|
    (nconc2 (cdr |$interpreterFrameRing|)
      (list (car |$interpreterFrameRing|))))
   (|updateFromCurrentInterpreterFrame|)))
```

32.5.10 Change to the Named Interpreter Frame

[updateCurrentInterpreterFrame p580]
[findFrameInRing p580]
[nremove p??]
[updateFromCurrentInterpreterFrame p579]
[$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|))))
```

32.5.11 Move to the previous Interpreter Frame in Ring

[updateCurrentInterpreterFrame p580]
[nconc2 p??]
[updateFromCurrentInterpreterFrame p579]
[$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| (nconc2 (cons l nil) b))
    (|updateFromCurrentInterpreterFrame|))))
```

32.5.12 Add a New Interpreter Frame

[boot-equal p??]
[framename p??]
[throwKeyedMsg p??]
[updateCurrentInterpreterFrame p580]
[initHistList p606]
[emptyInterpreterFrame p577]
[updateFromCurrentInterpreterFrame p579]
[$erase p??]
[histFileName p604]
[$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|)))))
```

32.5.13 Close an Interpreter Frame

[nequal p??]
[framename p??]
[throwKeyedMsg p??]
[$erase p??]
[makeHistFileName p604]
[updateFromCurrentInterpreterFrame p579]
[$interpreterFrameRing p??]
[$interpreterFrameName p??]

⟨*defun closeInterpreterFrame*⟩≡

```
(defun |closeInterpreterFrame| (name)
 "Close an Interpreter Frame"
 (declare (special |$interpreterFrameRing| |$interpreterFrameName|))
 (let (ifr found)
    (if (null (cdr |$interpreterFrameRing|))
     (if (and name (nequal name |$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 (nequal 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|)))))
```

32.5.14 Display the Frame Names

[bright p??]
[framename p??]
[sayKeyedMsg p357]
[$interpreterFrameRing p??]

⟨*defun displayFrameNames*⟩≡

```
(defun |displayFrameNames| ()
 "Display the Frame Names"
 (declare (special |$interpreterFrameRing|))
 (let (t1)
  (setq t1
   (mapcar #'(lambda (f) `(|%l| "     " ,@(|bright| (frameName f))))
   |$interpreterFrameRing|))
 (|sayKeyedMsg| 's2iz0024 (list (apply #'append t1)))))
```

32.5.15 Import items from another frame

[member p1113]
[frameNames p576]
[throwKeyedMsg p??]
[boot-equal p??]
[framename p??]
[frameEnvironment p576]
[upcase p??]
[queryUserKeyedMsg p??]
[string2id-n p??]
[importFromFrame p586]
[sayKeyedMsg p357]
[clearCmdParts p524]
[seq p??]
[exit p??]
[putHist p617]
[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)
            (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)))))))))
```

32.5.16 The top level frame command

[frameSpad2Cmd p589]

⟨*defun frame*⟩≡

```
(defun |frame| (l)
 "The top level frame command"
 (|frameSpad2Cmd| l))
```

32.5.17 The top level frame command handler

[throwKeyedMsg p??]
[helpSpad2Cmd p596]
[selectOptionLC p498]
[pairp p??]
[qcdr p??]
[qcar p??]
[object2Identifier p??]
[drop p??]
[closeInterpreterFrame p584]
[import p??]
[importFromFrame p586]
[last p??]
[previousInterpreterFrame p582]
[names p??]
[displayFrameNames p585]
[new p??]
[addNewInterpreterFrame p583]
[next p39]
[nextInterpreterFrame p581]
[$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 (pairp 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 (pairp args))
```

```
    (|throwKeyedMsg| 'S2IZ0017 ; not a valid frame name
       (cons args nil))
    (|closeInterpreterFrame| args)))
(|import| (|importFromFrame| args))
(|last|   (|previousInterpreterFrame|))
(|names|  (|displayFrameNames|))
(|new|
  (if (and args (pairp 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 %l
  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

33.2.1 The top level help command

[helpSpad2Cmd p596]

⟨*defun help*⟩≡
```
  (defun |help| (l)
   "The top level help command"
   (|helpSpad2Cmd| l))
```

33.2.2 The top level help command handler

[newHelpSpad2Cmd p597]
[sayKeyedMsg p357]

⟨*defun helpSpad2Cmd*⟩≡
```
  (defun |helpSpad2Cmd| (args)
   "The top level help command handler"
   (unless (|newHelpSpad2Cmd| args)
    (|sayKeyedMsg| 's2iz0025 (cons args nil))))
```

33.2.3 defun newHelpSpad2Cmd

[makeInputFilename p1040]
[obey p??]
[concat p1112]
[namestring p1106]
[make-instream p1037]
[say p??]
[poundsign p??]
[sayKeyedMsg p357]
[pname p??]
[selectOptionLC p498]
[$syscommands p455]
[$useFullScreenHelp p769]

⟨*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/SPADEDIT " (|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.axh 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 kept 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`.

34.2.1 defvar $oldHistoryFileName

⟨*initvars*⟩+≡
```
(defvar |$oldHistoryFileName| '|last| "vm/370 filename name component")
```

34.2.2 defvar $historyFileType

⟨*initvars*⟩+≡
```
(defvar |$historyFileType| '|axh|     "vm/370 filename type component")
```

34.2.3 defvar $historyDirectory

⟨*initvars*⟩+≡
```
(defvar |$historyDirectory| 'A        "vm/370 filename disk component")
```

[1] "frame" (32.5.16 p 588) "read" (42.1.1 p 674) "set" (44.37.1 p 857) "undo" (51.3.6 p 975)

34.2.4 defvar $useInternalHistoryTable

⟨*initvars*⟩+≡
```
(defvar |$useInternalHistoryTable| t  "t means keep history in core")
```

34.3 Data Structures

34.4 Functions

34.4.1 defun makeHistFileName

[makePathname p1108]

⟨*defun makeHistFileName*⟩≡
```
(defun |makeHistFileName| (fname)
 (|makePathname| fname |$historyFileType| |$historyDirectory|))
```

34.4.2 defun oldHistFileName

[makeHistFileName p604]
[$oldHistoryFileName p603]

⟨*defun oldHistFileName*⟩≡
```
(defun |oldHistFileName| ()
 (declare (special |$oldHistoryFileName|))
 (|makeHistFileName| |$oldHistoryFileName|))
```

34.4.3 defun histFileName

[makeHistFileName p604]
[$interpreterFrameName p**??**]

⟨*defun histFileName*⟩≡
```
(defun |histFileName| ()
 (declare (special |$interpreterFrameName|))
 (|makeHistFileName| |$interpreterFrameName|))
```

34.4.4 defun histInputFileName

[makePathname p1108]
[$interpreterFrameName p??]
[$historyDirectory p603]

⟨*defun histInputFileName*⟩≡
```
(defun |histInputFileName| (fn)
 (declare (special |$interpreterFrameName| |$historyDirectory|))
 (if (null fn)
   (|makePathname| |$interpreterFrameName| 'input |$historyDirectory|)
   (|makePathname| fn 'input |$historyDirectory|)))
```

34.4.5 defun initHist

[initHistList p606]
[oldHistFileName p604]
[histFileName p604]
[histFileErase p650]
[makeInputFilename p1040]
[$replace p??]
[$useInternalHistoryTable p604]
[$HiFiAccess p770]

⟨*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|)))))
```

34.4.6 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)))
```

34.4.7 The top level history command

[sayKeyedMsg p357]
[historySpad2Cmd p607]
[$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|)))
```

34.4.8 The top level history command handler

[selectOptionLC p498]
[member p1113]
[sayKeyedMsg p357]
[initHistList p606]
[upcase p??]
[queryUserKeyedMsg p??]
[string2id-n p??]
[histFileErase p650]
[histFileName p604]
[clearSpad2Cmd p518]
[disableHist p634]
[setHistoryCore p610]
[resetInCoreHist p614]
[saveHistory p624]
[showHistory p??]
[changeHistListLen p615]
[restoreHistory p626]
[writeInputLines p613]
[seq p??]
[exit p??]
[$options p??]
[$HiFiAccess p770]
[$IOindex p??]

⟨*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
           (|$HiFiAccess|
             (|sayKeyedMsg| 'S2IH0007 nil)) ; history already on
           ((eql |$IOindex| 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|))
```

34.4.9 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 maintining 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 p357]
[nequal p**??**]
[rkeyids p**??**]
[histFileName p604]
[readHiFi p632]
[disableHist p634]
[histFileErase p650]
[rdefiostream p**??**]
[spadrwrite p636]
[object2Identifier p**??**]
[rshut p**??**]
[$useInternalHistoryTable p604]
[$internalHistoryTable p**??**]
[$HiFiAccess p770]
[$IOindex p**??**]

⟨*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 |$internalHistoryTable| nil)
  (cond
   ((nequal |$IOindex| 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
```

34.4.10 defvar $underbar

Also used in the output routines.

⟨*initvars*⟩+≡

```
(defvar underbar "_")
```

34.4.11 defun writeInputLines

[sayKeyedMsg p357]
[throwKeyedMsg p??]
[size p1110]
[spaddifference p??]
[concat p1112]
[substring p??]
[readHiFi p632]
[histInputFileName p605]
[histFileErase p650]
[defiostream p1038]
[nequal p??]
[namestring p1106]
[shut p1039]
[underbar p612]
[$HiFiAccess p770]
[$IOindex p??]

⟨*defun writeInputLines*⟩≡

```
(defun |writeInputLines| (fn initial)
 (let (maxn breakChars vecl 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 vecl (car (|readHiFi| i)))
       (when (stringp vecl) (setq vecl (cons vecl nil)))
       (dolist (vec vecl)
         (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
     ((nequal fn '|redo|)
       (|sayKeyedMsg| 's2ih0014 ; edit this file to see input lines
         (list (|namestring| file)))))
    (shut inp)
    nil))))
```

34.4.12 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)))
```

34.4.13 defun changeHistListLen

[sayKeyedMsg p357]
[spaddifference p??]
[$HistListLen p??]
[$HistList p??]
[$HistListAct p??]

⟨*defun changeHistListLen*⟩≡

```
(defun |changeHistListLen| (n)
 (let (dif l)
 (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|))))
```

34.4.14 defun updateHist

[startTimingProcess p??]
[updateInCoreHist p617]
[writeHiFi p633]
[disableHist p634]
[updateCurrentInterpreterFrame p580]
[stopTimingProcess p??]
[$IOindex p??]
[$HiFiAccess p770]
[$HistRecord p??]
[$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|)))
```

34.4.15 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|))))
```

34.4.16 defun putHist

[recordOldValue p618]
[get p??]
[recordNewValue p617]
[putIntSymTab p??]
[$HiFiAccess p770]

⟨*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))
```

34.4.17 defun recordNewValue

[startTimingProcess p??]
[recordNewValue0 p618]
[stopTimingProcess p??]

⟨*defun recordNewValue*⟩≡
```
(defun |recordNewValue| (x prop val)
  (|startTimingProcess| '|history|)
  (|recordNewValue0| x prop val)
  (|stopTimingProcess| '|history|))
```

34.4.18 defun recordNewValue0

[assq p1115]
[$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|))))))
```

34.4.19 defun recordOldValue

[startTimingProcess p??]
[recordOldValue0 p619]
[stopTimingProcess p??]
[assq p1115]

⟨*defun recordOldValue*⟩≡
```
(defun |recordOldValue| (x prop val)
  (|startTimingProcess| '|history|)
  (|recordOldValue0| x prop val)
  (|stopTimingProcess| '|history|))
```

34.4.20 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|)))))
```

34.4.21 defun undoInCore

[undoChanges p621]
[spaddifference p??]
[readHiFi p632]
[disableHist p634]
[assq p1115]
[sayKeyedMsg p357]
[putHist p617]
[updateHist p616]
[$HistList p??]
[$HistListLen p??]
[$IOindex p??]
[$HiFiAccess p770]
[$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|)))
```

34.4.22 defun undoChanges

[boot-equal p**??**]
[undoChanges p621]
[putHist p617]
[$HistList p**??**]
[$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|)))))
```

34.4.23 defun undoFromFile

[seq p**??**]
[exit p**??**]
[recordOldValue p618]
[recordNewValue p617]
[readHiFi p632]
[disableHist p634]
[putHist p617]
[assq p1115]
[updateHist p616]
[$InteractiveFrame p**??**]
[$HiFiAccess p770]

⟨*defun undoFromFile*⟩≡

```
(defun |undoFromFile| (n)
 (let (varl prop vec x p p1 val)
 (declare (special |$InteractiveFrame| |$HiFiAccess|))
  (do ((tmp0 (caar |$InteractiveFrame|) (cdr tmp0)) (tmp1 nil))
      ((or (atom tmp0)
           (progn (setq tmp1 (car tmp0)) nil)
           (progn
             (progn
              (setq x (car tmp1))
              (setq varl (cdr tmp1))
              tmp1)
              nil))
            nil)
   (seq
    (exit
     (do ((tmp2 varl (cdr tmp2)) (p nil))
         ((or (atom tmp2) (progn (setq p (car tmp2)) nil)) nil)
      (seq
       (exit
        (progn
         (setq prop (car p))
         (setq val (cdr p))
         (when val
           (progn
             (when (null (eq x '%))
               (|recordOldValue| x prop val))
             (when |$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|)))
```

34.4.24 defun saveHistory

[sayKeyedMsg p357]
[makeInputFilename p1040]
[histFileName p604]
[throwKeyedMsg p??]
[makeHistFileName p604]
[histInputFileName p605]
[writeInputLines p613]
[histFileErase p650]
[rdefiostream p??]
[spadrwrite0 p635]
[object2Identifier p??]
[rshut p??]
[namestring p1106]
[$seen p??]
[$HiFiAccess p770]
[$useInternalHistoryTable p604]
[$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))))
```

34.4.25 defun restoreHistory

[pairp p??]
[qcdr p??]
[qcar p??]
[identp p1111]
[throwKeyedMsg p??]
[makeHistFileName p604]
[putHist p617]
[makeInputFilename p1040]
[sayKeyedMsg p357]
[namestring p1106]
[clearSpad2Cmd p518]
[histFileName p604]
[histFileErase p650]
[$fcopy p??]
[rkeyids p??]
[readHiFi p632]
[disableHist p634]
[updateInCoreHist p617]
[get p??]
[rempropI p??]
[clearCmdSortedCaches p519]
[$options p??]
[$internalHistoryTable p??]
[$HiFiAccess p770]
[$e p??]
[$useInternalHistoryTable p604]
[$InteractiveFrame p??]
[$oldHistoryFileName p603]

⟨*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 (pairp 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 |$IOindex| (1+ l))
    (setq |$useInternalHistoryTable| oldInternal)
    (|sayKeyedMsg| 'S2IH0025 ; workspace restored
      (cons (|namestring| restfile) nil))
    (|clearCmdSortedCaches|)
     nil))))
```

34.4.26 defun setIOindex

[$IOindex p**??**]

⟨*defun setIOindex*⟩≡

```
(defun |setIOindex| (n)
  (declare (special |$IOindex|))
  (setq |$IOindex| n))
```

34.4.27 defun showInput

[tab p??]
[readHiFi p632]
[disableHist p634]
[sayMSG p359]

⟨*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 l (cdr tmp0)) (ln nil))
           ((or (atom tmp0) (progn (setq ln (car tmp0)) nil)) nil)
         (|sayMSG| (list "      " ln))))))))
```

34.4.28 defun showInOut

[assq p1115]
[spadPrint p**??**]
[objValUnwrap p**??**]
[objMode p**??**]
[readHiFi p632]
[disableHist p634]
[sayMSG p359]

⟨*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 |$IOindex| ind)
      (|spadPrint| (|objValUnwrap| triple) (|objMode| triple)))))))
```

34.4.29 defun fetchOutput

[boot-equal p??]
[spaddifference p??]
[getI p??]
[throwKeyedMsg p??]
[readHiFi p632]
[disableHist p634]
[assq p1115]

⟨*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
```

34.4.30 Read the history file using index n

[assoc p??]
[keyedSystemError p??]
[qcdr p??]
[rdefiostream p??]
[histFileName p604]
[spadrread p636]
[object2Identifier p??]
[rshut p??]
[$useInternalHistoryTable p604]
[$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))
```

34.4.31 Write information of the current step to history file

[rdefiostream p**??**]
[histFileName p604]
[spadrwrite p636]
[object2Identifier p**??**]
[rshut p**??**]
[$useInternalHistoryTable p604]
[$internalHistoryTable p**??**]
[$IOindex p**??**]
[$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)))))
```

34.4.32 Disable history if an error occurred

[histFileErase p650]
[histFileName p604]
[$HiFiAccess p770]

⟨*defun disableHist*⟩≡
```
(defun |disableHist| ()
 "Disable history if an error occurred"
 (declare (special |$HiFiAccess|))
 (cond
  ((null |$HiFiAccess|)
    (|histFileErase| (|histFileName|)))
  (t nil)))
```

34.4.33 defun writeHistModesAndValues

[get p**??**]
[putHist p617]
[$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 lisplibs. These functions transform an object to a writable form and back.

34.5.1 defun spadrwrite0

[safeWritify p637]
[rwrite p635]

⟨*defun spadrwrite0*⟩≡
```
(defun spadrwrite0 (vec item stream)
 (let (val)
  (setq val (|safeWritify| item))
  (if (eq val '|writifyFailed|)
    val
    (progn
     (|rwrite| vec val stream)
     item))))
```

34.5.2 defun Random write to a stream

[rwrite p635]
[pname p**??**]
[identp p1111]

⟨*defun rwrite*⟩≡
```
(defun |rwrite| (key val stream)
  (when (identp key) (setq key (pname key)))
  (rwrite key val stream)))
```

34.5.3 defun spadrwrite

[spadrwrite0 p635]
[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)))
```

34.5.4 defun spadrread

[dewritify p647]
[rread p636]

⟨*defun spadrread*⟩≡
```
(defun spadrread (vec stream)
 (|dewritify| (|rread| vec stream nil)))
```

34.5.5 defun Random read a key from a stream

RREAD takes erroval to return if key is missing [rread p636]
[identp p1111]
[pname p**??**]

⟨*defun rread*⟩≡
```
(defun |rread| (key rstream errorval)
  (when (identp key) (setq key (pname key)))
  (rread key rstream errorval))
```

34.5.6 defun unwritable?

[pairp p??]
[vecp p??]
[hashtablep p??]
[placep p??]

⟨*defun unwritable?*⟩≡
```
(defun |unwritable?| (ob)
 (cond
  ((or (pairp ob) (vecp ob)) nil)
  ((or (compiled-function-p ob) (hashtablep ob)) t)
  ((or (placep ob) (readtablep ob)) t)
  ((floatp ob) t)
  (t nil)))
```

34.5.7 defun writifyComplain

Create a full isomorphic object which can 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 p357]
[$writifyComplained p??]

⟨*defun writifyComplain*⟩≡
```
(defun |writifyComplain| (s)
 (declare (special |$writifyComplained|))
 (unless |$writifyComplained|
  (setq |$writifyComplained| t)
  (|sayKeyedMsg| 's2ih0027 (list s)))) ; cannot save value
```

34.5.8 defun safeWritify

[writifyTag p??]
[writify p642]

⟨*defun safeWritify*⟩≡
```
(defun |safeWritify| (ob)
 (catch '|writifyTag| (|writify| ob)))
```

34.5.9 defun writify,writifyInner

[writifyTag p??]
[seq p??]
[exit p??]
[hget p1110]
[pairp p??]
[qcar p??]
[qcdr p??]
[spadClosure? p642]
[writify,writifyInner p638]
[hput p1109]
[qrplaca p??]
[qrplacd p??]
[vecp p??]
[isDomainOrPackage p930]
[mkEvalable p??]
[devaluate p??]
[qvmaxindex p??]
[qsetvelt p??]
[qvelt p??]
[constructor? p??]
[hashtablep p??]
[hkeys p1110]
[hashtable-class p??]
[placep p??]
[boot-equal p??]
[$seen p??]
[$NonNullStream p643]
[$NullStream p643]

⟨*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 (pairp 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 (pairp ob)
            (eq (qcar ob) 'lambda-closure)
            (progn
             (setq tmp1 (qcdr ob))
             (and (pairp tmp1)
                  (progn
                   (setq tmp2 (qcdr tmp1))
                   (and
                    (pairp tmp2)
                    (progn
                     (setq tmp3 (qcdr tmp2))
                     (and (pairp 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 (hashtablep 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)))))
```

34.5.10 defun writify

[ScanOrPairVec p648]
[function p??]
[writify,writifyInner p638]
[$seen p??]
[$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)))))
```

34.5.11 defun spadClosure?

[qcar p??]
[bpiname p??]
[qcdr p??]
[vecp p??]

⟨*defun spadClosure?*⟩≡
```
(defun |spadClosure?| (ob)
 (let (fun name vec)
  (setq fun (qcar ob))
  (if (null (setq name (bpiname fun)))
   nil
   (progn
     (setq vec (qcdr ob))
     (if (null (vecp vec))
      nil
      name)))))
```

34.5.12 defun dewritify,is?

⟨*defun dewritify,is?*⟩≡
```
(defun |dewritify,is?| (a)
 (eq a 'writified!!))
```

34.5.13 defvar $NonNullStream

⟨*initvars*⟩+≡
```
(defvar |$NonNullStream| "NonNullStream")
```

34.5.14 defvar $NullStream

⟨*initvars*⟩+≡
```
(defvar |$NullStream| "NullStream")
```

34.5.15 defun dewritify,dewritifyInner

[seq p??]
[exit p??]
[hget p1110]
[pairp p??]
[intp p??]
[gensymmer p??]
[error p??]
[poundsign p??]
[nequal p??]
[hasheq p??]
[hput p1109]
[dewritify,dewritifyInner p644]
[concat p1112]
[vmread p??]
[make-instream p1037]
[spaddifference p??]
[qcar p??]
[qcdr p??]
[qrplaca p??]
[qrplacd p??]
[vecp p??]
[qvmaxindex p??]
[qsetvelt p??]
[qvelt p??]
[$seen p??]
[$NullStream p643]
[$NonNullStream p643]

⟨*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 (pairp 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) (nequal (hasheq 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 (cadddr 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 (pairp 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| (qvelt ob i))))))
      (exit nob))))
   (exit ob)))))
```

34.5.16 defun dewritify

[ScanOrPairVec p648]
[function p**??**]
[dewritify,dewritifyInner p644]
[$seen p**??**]

⟨*defun dewritify*⟩≡

```
(defun |dewritify| (ob)
 (let (|$seen|)
 (declare (special |$seen|))
   (if (null (|ScanOrPairVec| (|function| |dewritify,is?|) ob))
    ob
    (progn
      (setq |$seen| (make-hash-table :test #'eq))
      (|dewritify,dewritifyInner| ob)))))
```

34.5.17 defun ScanOrPairVec,ScanOrInner

[ScanOrPairVecAnswer p??]
[hget p1110]
[pairp p??]
[hput p1109]
[ScanOrPairVec,ScanOrInner p648]
[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 (pairp 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)
```

34.5.18 defun ScanOrPairVec

[ScanOrPairVecAnswer p??]
[ScanOrPairVec,ScanOrInner p648]
[$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))))
```

34.5.19 defun gensymInt

[gensymp p**??**]
[error p**??**]
[pname p**??**]
[charDigitVal p649]

⟨*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))))
```

34.5.20 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)))
```

34.5.21 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

35.2.1 defun ncloopInclude1

[ncloopIncFileName p654]
[ncloopInclude p654]

⟨*defun ncloopInclude1*⟩≡
```
(defun |ncloopInclude1| (name n)
 (let (a)
  (if (setq a (|ncloopIncFileName| name))
    (|ncloopInclude| a n)
    n)))
```

35.2.2 Returns the first non-blank substring of the given string

[incFileName p655]
[concat p1112]

⟨*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))
```

35.2.3 Open the include file and read it in

The ncloopInclude0 function is part of the parser and lives in int-top.boot. [ncloopInclude0 p82]

⟨*defun ncloopInclude*⟩≡
```
(defun |ncloopInclude| (name n)
 "Open the include file and read it in"
 (with-open-file (st name) (|ncloopInclude0| st name n)))
```

35.2.4 Return the include filename

Given a string we return the first token from the string which is the first non-blank substring. [incBiteOff p655]

⟨*defun incFileName*⟩≡
```
(defun |incFileName| (x)
 "Return the include filename"
  (car (|incBiteOff| x)))
```

35.2.5 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]

[1] “cd” (?? p ??) “frame” (32.5.16 p 588) “set” (44.37.1 p 857)

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` 18.1.3 which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` 18.2.1

[1] "system" (?? p ??) "boot" (5.1.8 p 24) "fin" (31.1.1 p 568)

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.
```

38.1.1 defun The)load command (obsolete)

We keep this command around in case anyone has the original Axiom book. [sayKeyedMsg p357]

⟨*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]

39.1.1 defun The top level)ltrace function

[trace p895]

⟨*defun ltrace*⟩≡
```
(defun |ltrace| (arg) (|trace| arg))
```

39.2 Variables Used

39.3 Functions

[1] "boot" (5.1.8 p 24) "lisp" (**??** p **??**) "trace" (50.1.7 p 895)

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

40.2.1 The top level pquit command

[pquitSpad2Cmd p667]

⟨*defun pquit*⟩≡

```
(defun |pquit| ()
 "The top level pquit command"
 (|pquitSpad2Cmd|))
```

[1] "fin" (31.1.1 p 568) "history" (34.4.7 p 606) "close" (24.2.2 p 529) "quit" (41.2.1 p 670) "system" (?? p ??)

40.2.2 The top level pquit command handler

[quitSpad2Cmd p671]
[$quitCommandType p849]

⟨*defun pquitSpad2Cmd*⟩≡
```
(defun |pquitSpad2Cmd| ()
 "The top level pquit command handler"
 (let ((|$quitCommandType| '|protected|))
  (declare (special |$quitCommandType|))
  (|quitSpad2Cmd|)))
```

This command is in the list of `$noParseCommands` 18.1.3 which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` 18.2.1

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

41.2.1 The top level quit command

[quitSpad2Cmd p671]

⟨*defun quit*⟩≡

```
(defun |quit| ()
 "The top level quit command"
 (|quitSpad2Cmd|))
```

[1] "fin" (31.1.1 p 568) "history" (34.4.7 p 606) "close" (24.2.2 p 529) "pquit" (40.2.1 p 666) "system" (?? p ??)

41.2.2 The top level quit command handler

[upcase p??]
[queryUserKeyedMsg p??]
[string2id-n p??]
[leaveScratchpad p671]
[sayKeyedMsg p357]
[tersyscommand p463]
[$quitCommandType p849]

⟨*defun quitSpad2Cmd*⟩≡
```
(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|)))
```

41.2.3 Leave the Axiom interpreter

⟨*defun leaveScratchpad*⟩≡
```
(defun |leaveScratchpad| ()
 "Leave the Axiom interpreter"
 (bye))
```

This command is in the list of `$noParseCommands` 18.1.3 which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` 18.2.1

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]

42.1.1 defun The)read command

[readSpad2Cmd p675]

⟨*defun read*⟩≡
```
(defun |read| (arg) (|readSpad2Cmd| arg))
```

[1] "edit" (30.2.1 p 564) "history" (34.4.7 p 606)

42.1.2 defun Implement the)read command

[selectOptionLC p498]
[optionError p460]
[pathname p1108]
[pathnameTypeId p1107]
[makePathname p1108]
[pathnameName p1106]
[mergePathnames p1107]
[findfile p??]
[throwKeyedMsg p??]
[namestring p1106]
[upcase p??]
[member p1113]
[/read p676]
[$InteractiveMode p24]
[$findfile p??]
[$UserLevel p856]
[$options p??]
[/editfile p534]

⟨*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)))))
```

42.1.3 defun /read

[p??]
[/editfile p534]

⟨*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

)savesystem help page Command

43.1 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.
```

43.1.1 defun The)savesystem command

[nequal p**??**]
[helpSpad2Cmd p596]
[spad-save p1045]

⟨*defun savesystem*⟩≡

```
(defun |savesystem| (arg)
  (if (or (nequal (|#| arg) 1) (null (symbolp (car arg))))
    (|helpSpad2Cmd| '(|savesystem|))
    (spad-save (symbol-name (car arg)))))
```

Chapter 44

)set help page Command

44.1 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

44.2 Overview

This section contains tree of information used to initialize the **)set** command in the interpreter. The current list is:

```
Variable     Description                              Current Value
------------------------------------------------------------------
compile    Library compiler options                     ...
breakmode  execute break processing on error          break
expose     control interpreter constructor exposure   ...
functions  some interpreter function options           ...
fortran    view and set options for FORTRAN output    ...
kernel     library functions built into the kernel for
           efficiency                                 ...
hyperdoc   options in using HyperDoc                  ...
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 .
```

44.3 Variables Used

44.4 Functions

44.4.1 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

[1] "quit" (41.2.1 p 670)

structure section 44.5. [sayMSG p359]
[literals p**??**]
[translateYesNo2TrueFalse p689]
[tree p**??**]
[initializeSetVariables p681]

⟨*defun initializeSetVariables*⟩≡

```
(defun |initializeSetVariables| (settree)
 "Initialize the set variables"
 (dolist (setdata settree)
  (case (fourth setdata)
   (function
      (if (functionp (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))))))
```

44.4.2 Reset the workspace variables

[copy p??]
[initializeSetVariables p681]
[/countlist p??]
[/editfile p534]
[/sourcefiles p??]
[/pretty p??]
[/spacelist p??]
[/timerlist p??]
[$sourceFiles p??]
[$existingFiles p??]
[$functionTable p520]
[$boot p24]
[$compileMapFlag p??]
[$echoLineStack p??]
[$operationNameList p??]
[$slamFlag p??]
[$CommandSynonymAlist p496]
[$InitialCommandSynonymAlist p494]
[$UserAbbreviationsAlist p??]
[$msgAlist p354]
[$msgDatabase p??]
[$msgDatabaseName p354]
[$dependeeClosureAlist p??]
[$IOindex p??]
[$coerceIntByMapCounter p??]
[$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 |$IOindex| 1)
(setq |$coerceIntByMapCounter| 0)
(setq |$e| (cons (cons nil nil) nil))
(setq |$env| (cons (cons nil nil) nil))
(|initializeSetVariables| |$setOptions|))
```

44.4.3 Display the set option information

[displaySetVariableSettings p687]
[centerAndHighlight p??]
[concat p1112]
[object2String p??]
[specialChar p1036]
[sayBrightly p??]
[bright p??]
[sayMSG p359]
[boot-equal p??]
[sayMessage p??]
[eval p??]
[literals p??]
[translateTrueFalse2YesNo p689]
[$linelength p817]

⟨*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 (functionp (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.")))))))
```

44.4.4 Display the set variable settings

[concat p1112]
[object2String p??]
[centerAndHighlight p??]
[sayBrightly p??]
[say p??]
[fillerSpaces p19]
[specialChar p1036]
[pairp p??]
[concat p1112]
[satisfiesUserLevel p462]
[spaddifference p??]
[poundsign p??]
[eval p??]
[bright p??]
[literals p??]
[translateTrueFalse2YesNo p689]
[tree p??]
[$linelength p817]

⟨*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 (functionp (fifth setdata))
         (funcall (fifth setdata) '|%display%|)
         "unimplemented"))
       (cond
        ((pairp 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") ".")))))
```

44.4.5 Translate options values to t or nil

[member p1113]

⟨*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)))
```

44.4.6 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)))
```

44.5 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 looks like (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

44.6 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.
```

44.6.1 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
```

44.7 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|
      (
  ⟨debuglambdatype⟩
  ⟨debugdalymode⟩
     ))
```

44.8 debug lambda type

```
---------------------- The lambdatype Option ----------------------

 Description: Show type information for #1 syntax
```

44.8.1 defvar $lambdatype

⟨*initvars*⟩+≡
```
  (defvar $lambdatype nil "show type information for #1 syntax")
```

⟨*debuglambdatype*⟩≡
```
        (|lambdatype|
         "show type information for #1 syntax"
         |interpreter|
         LITERALS
         $lambdatype
         (|on| |off|)
         |off|)
```

44.9 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
```

44.9.1 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|)
```

44.10 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|
      (
  ⟨compileoutput⟩
  ⟨compileinput⟩
      ))
```

44.11 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|
         )
```

44.12 Variables Used

44.13 Functions

44.13.1 The set output command handler

[poundsign p??]
[describeOutputLibraryArgs p695]
[filep p??]
[openOutputLibrary p696]
[$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))))))
```

44.13.2 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.")))
```

44.13.3 Open the output library

The input-libraries and output-library are now truename based. [dropInputLibrary p699]
[output-library p??]
[input-libraries p??]

⟨*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))
```

44.14 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|)
```

44.15 Variables Used

44.16 Functions

44.16.1 The set input library command handler

The input-libraries is now maintained as a list of truenames. [describeInputLibraryArgs p698]
[pairp p??]
[qcar p??]
[qcdr p??]
[selectOptionLC p498]
[addInputLibrary p698]
[dropInputLibrary p699]
[setInputLibrary p697]
[input-libraries p??]

⟨*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 (pairp arg)
         (progn
          (setq act (qcar arg))
          (setq tmp1 (qcdr arg))
          (and (pairp 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)))))
```

44.16.2 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.")))
```

44.16.3 Add the input library to the list

The input-libraries variable is now maintained as a list of truenames. [dropInputLibrary p699]
[$input-libraries p**??**]

⟨*defun addInputLibrary*⟩≡
```
(defun |addInputLibrary| (lib)
 "Add the input library to the list"
 (declare (special input-libraries))
  (|dropInputLibrary| lib)
  (push (truename lib) input-libraries))
```

44.16.4 Drop an input library from the list

[$input-libraries p??]

⟨*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)))
```

44.17 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|)
```

44.18 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.

44.18.1 defvar $globalExposureGroupAlist

⟨*initvars*⟩+≡

```
(defvar |$globalExposureGroupAlist|
 '(
 ;;define the groups |basic| |naglink| |anna| |categories| |Hidden| |defaults|
  (|basic|
   (|AffineAlgebraicSetComputeWithGroebnerBasis| . AFALGGRO)
   (|AffineAlgebraicSetComputeWithResultant| . AFALGRES)
   (|AffinePlane| . AFFPL)
   (|AffinePlaneOverPseudoAlgebraicClosureOfFiniteField| . AFFPLPS)
   (|AffineSpace| . AFFSP)
   (|AlgebraicManipulations| . ALGMANIP)
   (|AlgebraicNumber| . AN)
   (|AlgFactor| . ALGFACT)
   (|AlgebraicMultFact| . ALGMFACT)
   (|AlgebraPackage| . ALGPKG)
   (|AlgebraGivenByStructuralConstants| . ALGSC)
   (|Any| . ANY)
   (|AnyFunctions1| . ANY1)
   (|ApplicationProgramInterface| . API)
   (|ArrayStack| . ASTACK)
   (|AssociatedJordanAlgebra| . JORDAN)
   (|AssociatedLieAlgebra| . LIE)
   (|AttachPredicates| . PMPRED)
   (|AxiomServer| . AXSERV)
   (|BalancedBinaryTree| . BBTREE)
   (|BasicOperator| . BOP)
   (|BasicOperatorFunctions1| . BOP1)
   (|Bezier| . BEZIER)
   (|BinaryExpansion| . BINARY)
   (|BinaryFile| . BINFILE)
   (|BinarySearchTree| . BSTREE)
   (|BinaryTournament| . BTOURN)
   (|BinaryTree| . BTREE)
   (|Bits| . BITS)
   (|BlasLevelOne| . BLAS1)
   (|BlowUpPackage| . BLUPPACK)
   (|BlowUpWithHamburgerNoether| . BLHN)
   (|BlowUpWithQuadTrans| . BLQT)
```

```
(|Boolean| . BOOLEAN)
(|CardinalNumber| . CARD)
(|CartesianTensor| . CARTEN)
(|CartesianTensorFunctions2| . CARTEN2)
(|Character| . CHAR)
(|CharacterClass| . CCLASS)
(|CharacteristicPolynomialPackage| . CHARPOL)
(|CliffordAlgebra| . CLIF)
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(|MonadWithUnit| . MONADWU)
(|Monoid| . MONOID)
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(|MonogenicLinearOperator| . MLO)
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(|NonAssociativeRng| . NARNG)
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(|OrderedAbelianMonoidSup| . OAMONS)
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(|OrderedSet| . ORDSET)
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(|PatternMatchable| . PATMAB)
(|PermutationCategory| . PERMCAT)
(|PlacesCategory| . PLACESC)
(|PlottablePlaneCurveCategory| . PPCURVE)
(|PlottableSpaceCurveCategory| . PSCURVE)
(|PointCategory| . PTCAT)
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(|PolynomialFactorizationExplicit| . PFECAT)
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(|PowerSeriesCategory| . PSCAT)
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(|PrincipalIdealDomain| . PID)
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(|ProjectiveSpaceCategory| . PRSPCAT)
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(|PseudoAlgebraicClosureOfFiniteField| . PACOFF)
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(|PseudoAlgebraicClosureOfPerfectFieldCategory| . PACPERC)
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(|Rng| . RNG)
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(|SetCategory| . SETCAT)
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    (|SquareMatrixCategory| . SMATCAT)
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    (|StreamAggregate| . STAGG)
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    (|TableAggregate| . TBAGG)
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    (|UnivariatePolynomialCategory| . UPOLYC)
    (|UnivariatePowerSeriesCategory| . UPSCAT)
    (|UnivariatePuiseuxSeriesCategory| . UPXSCAT)
    (|UnivariatePuiseuxSeriesConstructorCategory| . UPXSCCA)
    (|UnivariateSkewPolynomialCategory| . OREPCAT)
    (|UnivariateTaylorSeriesCategory| . UTSCAT)
    (|VectorCategory| . VECTCAT)
    (|VectorSpace| . VSPACE)
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    (|XFreeAlgebra| . XFALG)
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    (|AlgebraicIntegrate| . INTALG)
    (|AlgebraicIntegration| . INTAF)
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    (|ApplyUnivariateSkewPolynomial| . APPLYORE)
    (|ArrayStack| . ASTACK)
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(|BalancedPAdicRational| . BPADICRT)
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(|BrillhartTests| . BRILL)
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(|DefiniteIntegrationTools| . DFINTTLS)
(|DegreeReductionPackage| . DEGRED)
(|DeRhamComplex| . DERHAM)
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(|DirectProductMatrixModule| . DPMM)
(|DirectProductModule| . DPMO)
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(|DistributedMultivariatePolynomial| . DMP)
(|DoubleResultantPackage| . DBLRESP)
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(|DrawOptionFunctions1| . DROPT1)
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(|ElementaryFunctionsUnivariateLaurentSeries| . EFULS)
(|ElementaryFunctionsUnivariatePuiseuxSeries| . EFUPXS)
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(|ElementaryRischDE| . RDEEF)
(|ElementaryRischDESystem| . RDEEFS)
(|EllipticFunctionsUnivariateTaylorSeries| . ELFUTS)
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(|FactoringUtilities| . FACUTIL)
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(|FiniteFieldCyclicGroupExtensionByPolynomial| . FFCGP)
(|FiniteFieldExtension| . FFX)
(|FiniteFieldExtensionByPolynomial| . FFP)
(|FiniteFieldFunctions| . FFF)
(|FiniteFieldNormalBasisExtension| . FFNBX)
(|FiniteFieldNormalBasisExtensionByPolynomial| . FFNBP)
(|FiniteFieldPolynomialPackage| . FFPOLY)
(|FiniteFieldSolveLinearPolynomialEquation| . FFSLPE)
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(|FourierComponent| . FCOMP)
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(|FreeModule1| . FM1)
(|FreeMonoid| . FMONOID)
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(|FunctionSpaceToExponentialExpansion| . FS2EXPXP)
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(|GaloisGroupPolynomialUtilities| . GALPOLYU)
(|GaloisGroupUtilities| . GALUTIL)
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(|GenExEuclid| . GENEEZ)
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(|GrayCode| . GRAY)
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(|GroebnerSolve| . GROEBSOL)
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(|HeuGcd| . HEUGCD)
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(|IndexedDirectProductAbelianMonoid| . IDPAM)
(|IndexedDirectProductObject| . IDPO)
(|IndexedDirectProductOrderedAbelianMonoid| . IDPOAM)
(|IndexedDirectProductOrderedAbelianMonoidSup| . IDPOAMS)
(|IndexedExponents| . INDE)
(|IndexedFlexibleArray| . IFARRAY)
(|IndexedList| . ILIST)
(|IndexedMatrix| . IMATRIX)
(|IndexedOneDimensionalArray| . IARRAY1)
(|IndexedString| . ISTRING)
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(|InnerFiniteField| . IFF)
(|InnerFreeAbelianMonoid| . IFAMON)
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(|InnerMatrixQuotientFieldFunctions| . IMATQF)
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(|InnerMultFact| . INNMFACT)
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(|InnerTrigonometricManipulations| . ITRIGMNP)
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(|IntegerMod| . ZMOD)
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(|IntegralBasisTools| . IBATOOL)
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(|IntegrationTools| . INTTOOLS)
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(|InternalRationalUnivariateRepresentationPackage| . IRURPK)
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(|Kovacic| . KOVACIC)
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(|LinearOrdinaryDifferentialOperator2| . LODO2)
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(|Localize| . LO)
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(|MakeCachableSet| . MKCHSET)
(|MakeUnaryCompiledFunction| . MKUCFUNC)
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(|MappingPackageInternalHacks2| . MAPHACK2)
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(|ModuleMonomial| . MODMONOM)
(|MoebiusTransform| . MOEBIUS)
(|MonoidRing| . MRING)
(|MonomialExtensionTools| . MONOTOOL)
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(|MPolyCatFunctions3| . MPC3)
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(|OrderedFreeMonoid| . OFMONOID)
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(|OrderlyDifferentialVariable| . ODVAR)
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(|PAdicRational| . PADICRAT)
(|PAdicRationalConstructor| . PADICRC)
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(|PatternMatchPushDown| . PMDOWN)
(|PatternMatchQuotientFieldCategory| . PMQFCAT)
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(|PlotTools| . PLOTTOOL)
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(|PointsOfFiniteOrder| . PFO)
(|PointsOfFiniteOrderRational| . PFOQ)
(|PointsOfFiniteOrderTools| . PFOTOOLS)
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(|PolToPol| . POLTOPOL)
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(|PolynomialCategoryQuotientFunctions| . POLYCATQ)
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(|PolynomialFactorizationByRecursionUnivariate| . PFBRU)
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(|PolynomialInterpolationAlgorithms| . PINTERPA)
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(|PolynomialRing| . PR)
(|PolynomialRoots| . POLYROOT)
(|PolynomialSetUtilitiesPackage| . PSETPK)
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(|PolynomialSquareFree| . PSQFR)
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(|PrimitiveArray| . PRIMARR)
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(|RandomIntegerDistributions| . RIDIST)
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(|ReduceLODE| . ODERED)
(|ReductionOfOrder| . REDORDER)
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(|RepeatedDoubling| . REPDB)
(|RepeatedSquaring| . REPSQ)
(|ResidueRing| . RESRING)
(|RetractSolvePackage| . RETSOL)
(|RuleCalled| . RULECOLD)
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(|SExpressionOf| . SEXOF)
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(|SequentialDifferentialVariable| . SDVAR)
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(|SingletonAsOrderedSet| . SAOS)
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(|SparseUnivariatePolynomial| . SUP)
(|SparseUnivariateSkewPolynomial| . ORESUP)
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(|SparseUnivariateTaylorSeries| . SUTS)
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(|SplittingTree| . SPLTREE)
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(|Stack| . STACK)
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(|StreamInfiniteProduct| . STINPROD)
(|StreamTaylorSeriesOperations| . STTAYLOR)
(|StreamTranscendentalFunctions| . STTF)
(|StreamTranscendentalFunctionsNonCommutative| . STTFNC)
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(|SubResultantPackage| . SUBRESP)
(|SubSpace| . SUBSPACE)
(|SubSpaceComponentProperty| . COMPPROP)
(|SuchThat| . SUCH)
(|SupFractionFactorizer| . SUPFRACF)
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(|SymmetricPolynomial| . SYMPOLY)
(|SystemODESolver| . ODESYS)
(|Table| . TABLE)
(|TableauxBumpers| . TABLBUMP)
(|TabulatedComputationPackage| . TBCMPPK)
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(|ToolsForSign| . TOOLSIGN)
(|TranscendentalHermiteIntegration| . INTHERTR)
(|TranscendentalIntegration| . INTTR)
(|TranscendentalRischDE| . RDETR)
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(|TransSolvePackageService| . SOLVESER)
(|TriangularMatrixOperations| . TRIMAT)
(|TubePlot| . TUBE)
(|TubePlotTools| . TUBETOOL)
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(|TwoDimensionalViewport| . VIEW2D)
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(|UnivariateFactorize| . UNIFACT)
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(|UnivariateLaurentSeriesConstructor| . ULSCONS)
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(|UnivariatePolynomialDivisionPackage| . UPDIVP)
(|UnivariatePolynomialSquareFree| . UPSQFREE)
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    (|UnivariateSkewPolynomialCategoryOps| . OREPCTO)
    (|UnivariateTaylorSeries| . UTS)
    (|UnivariateTaylorSeriesODESolver| . UTSODE)
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    (|UTSodetools| . UTSODETL)
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    (|ViewportPackage| . VIEW)
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    (|XExponentialPackage| . XEXPPKG)
    (|XPBWPolynomial| . XPBWPOLY)
    (|XPolynomial| . XPOLY)
    (|XPolynomialRing| . XPR)
    (|XRecursivePolynomial| . XRPOLY))
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    (|AbelianMonoid&| . ABELMON-)
    (|AbelianMonoidRing&| . AMR-)
    (|AbelianSemiGroup&| . ABELSG-)
    (|Aggregate&| . AGG-)
    (|Algebra&| . ALGEBRA-)
    (|AlgebraicallyClosedField&| . ACF-)
    (|AlgebraicallyClosedFunctionSpace&| . ACFS-)
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    (|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-)
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(|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-)
(|FullyEvalableOver&| . FEVALAB-)
(|FullyLinearlyExplicitRingOver&| . FLINEXP-)
(|FullyRetractableTo&| . FRETRCT-)
(|FunctionFieldCategory&| . FFCAT-)
(|FunctionSpace&| . FS-)
(|GcdDomain&| . GCDDOM-)
(|GradedAlgebra&| . GRALG-)
(|GradedModule&| . GRMOD-)
(|Group&| . GROUP-)
(|HomogeneousAggregate&| . HOAGG-)
(|HyperbolicFunctionCategory&| . HYPCAT-)
(|IndexedAggregate&| . IXAGG-)
(|InnerEvalable&| . 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-)
(|UnivariatePuiseuxSeriesConstructorCategory&| . UPXSCCA-)
(|UnivariateSkewPolynomialCategory&| . OREPCAT-)
(|UnivariateTaylorSeriesCategory&| . UTSCAT-)
(|VectorCategory&| . VECTCAT-)
```

```
    (|VectorSpace&| . VSPACE-))))
```

44.18.2 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 )))
```

44.18.3 defvar $localExposureData

⟨*initvars*⟩+≡

```
(defvar |$localExposureData|  (copy-seq |$localExposureDataDefault|))
```

44.19 Functions

44.19.1 The top level set expose command handler

[displayExposedGroups p739]
[sayMSG p359]
[displayExposedConstructors p739]
[displayHiddenConstructors p740]
[sayKeyedMsg p357]
[namestring p1106]
[pathname p1108]
[pairp p??]
[qcar p??]
[qcdr p??]
[selectOptionLC p498]
[setExposeAdd p731]
[setExposeDrop p735]
[setExpose p730]

⟨*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 (pairp 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)))))
```

44.19.2 The top level set expose add command handler

[centerAndHighlight p??]
[specialChar p1036]
[displayExposedGroups p739]
[sayMSG p359]
[displayExposedConstructors p739]
[sayKeyedMsg p357]
[pairp p??]
[qcar p??]
[qcdr p??]
[selectOptionLC p498]
[setExposeAddGroup p732]
[setExposeAddConstr p734]
[setExposeAdd p731]
[$linelength p817]

⟨*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 (pairp 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)))))
```

44.19.3 Expose a group

Note that `$localExposureData` is a vector of lists. It consists of [exposed groups,exposed constructors,hidden constructors] [object2String p**??**]
[pairp p**??**]
[qcar p**??**]
[setelt p**??**]
[displayExposedGroups p739]
[sayMSG p359]
[displayExposedConstructors p739]
[displayHiddenConstructors p740]
[clearClams p**??**]
[getalist p**??**]
[sayKeyedMsg p357]
[member p1113]
[msort p**??**]
[centerAndHighlight p**??**]
[specialChar p1036]
[namestring p1106]
[pathname p1108]
[sayAsManyPerLineAsPossible p**??**]
[$globalExposureGroupAlist p701]
[$localExposureData p729]
[$interpreterFrameName p**??**]
[$linelength p817]

⟨*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 (pairp 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|))))))
```

44.19.4 The top level set expose add constructor handler

[unabbrev p**??**]
[pairp p**??**]
[qcar p**??**]
[getdatabase p1071]
[sayKeyedMsg p357]
[member p1113]
[setelt p**??**]
[delete p**??**]
[msort p**??**]
[clearClams p**??**]
[centerAndHighlight p**??**]
[specialChar p1036]
[displayExposedConstructors p739]
[$linelength p817]
[$localExposureData p729]
[$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| $linelength (|specialChar| '|hbar|))
    (|displayExposedConstructors|))
   (dolist (x arg)
     (setq x (|unabbrev| x))
     (when (pairp x) (setq x (qcar x)))
     (cond
      ((null (getdatabase x 'constructorkind))
       (|sayKeyedMsg| 's2iz0049j (list x)))
      ((|member| x (elt |$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| )))))))
```

44.19.5 The top level set expose drop handler

[centerAndHighlight p??]
[specialChar p1036]
[displayHiddenConstructors p740]
[sayMSG p359]
[sayKeyedMsg p357]
[pairp p??]
[qcar p??]
[qcdr p??]
[selectOptionLC p498]
[setExposeDropGroup p736]
[setExposeDropConstr p738]
[setExposeDrop p735]
[$linelength p817]

⟨*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 (pairp 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)))))
```

44.19.6 The top level set expose drop group handler

[pairp p??]
[qcar p??]
[setelt p??]
[displayExposedGroups p739]
[sayMSG p359]
[displayExposedConstructors p739]
[displayHiddenConstructors p740]
[clearClams p??]
[member p1113]
[delete p??]
[sayKeyedMsg p357]
[getalist p??]
[centerAndHighlight p??]
[specialChar p1036]
[$linelength p817]
[$localExposureData p729]
[$interpreterFrameName p??]
[$globalExposureGroupAlist p701]

⟨*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| $linelength (|specialChar| '|hbar|))
   (|sayKeyedMsg| 's2iz0049l nil)
   (|sayMSG| " ")
   (|displayExposedGroups|))
  (dolist (x arg)
    (when (pairp x) (setq x (qcar x)))
    (cond
     ((eq x '|all|)
      (setelt |$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 )))))))
```

44.19.7 The top level set expose drop constructor handler

[unabbrev p??]
[pairp p??]
[qcar p??]
[getdatabase p1071]
[sayKeyedMsg p357]
[member p1113]
[setelt p??]
[delete p??]
[msort p??]
[clearClams p??]
[centerAndHighlight p??]
[specialChar p1036]
[sayMSG p359]
[displayExposedConstructors p739]
[displayHiddenConstructors p740]
[$linelength p817]
[$localExposureData p729]
[$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| $linelength (|specialChar| '|hbar|))
   (|sayKeyedMsg| 's2iz0049n nil)
   (|sayMSG| " ")
   (|displayExposedConstructors|)
   (|sayMSG| " ")
   (|displayHiddenConstructors|))
  (dolist (x arg)
    (setq x (|unabbrev| x))
    (when (pairp x) (setq x (qcar x)))
    (cond
     ((null (getdatabase x 'constructorkind))
      (|sayKeyedMsg| 's2iz0049j (list x)))
     ((|member| x (elt |$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|)))))))
```

44.19.8 Display exposed groups

[sayKeyedMsg p357]
[centerAndHighlight p**??**]
[$interpreterFrameName p**??**]
[$localExposureData p729]

⟨*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))))
```

44.19.9 Display exposed constructors

[sayKeyedMsg p357]
[centerAndHighlight p**??**]
[$localExposureData p729]

⟨*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))))
```

44.19.10 Display hidden constructors

[sayKeyedMsg p357]
[centerAndHighlight p??]
[$localExposureData p729]

⟨*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))))
```

44.20 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|
     (
  ⟨functionscache⟩
  ⟨functionscompile⟩
  ⟨functionsrecurrence⟩
    ))
```

44.21 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|)
```

44.22 Variables Used

44.22.1 defvar $cacheAlist

⟨*initvars*⟩+≡

```
  (defvar |$cacheAlist| nil)
```

44.23 Functions

44.23.1 The top level set functions cache handler

```
\calls{setFunctionsCache}{object2String}
\calls{setFunctionsCache}{describeSetFunctionsCache}
\calls{setFunctionsCache}{sayAllCacheCounts}
\calls{setFunctionsCache}{nequal}
\calls{setFunctionsCache}{sayMessage}
\calls{setFunctionsCache}{bright}
\calls{setFunctionsCache}{terminateSystemCommand}
\calls{setFunctionsCache}{countCache}
\usesdollar{setFunctionsCache}{options}
\usesdollar{setFunctionsCache}{cacheCount}
\usesdollar{setFunctionsCache}{cacheAlist}
\nwenddocs{}\nwbegincode{2351}\moddef{defun setFunctionsCache}\endmoddef
(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 (nequal 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)))))))

\nwendcode{}\nwbegindocs{2352}\nwdocspar

\defunsec{countCache}{Display a particular cache count}
\calls{countCache}{pairp}
\calls{countCache}{qcdr}
```

```
\calls{countCache}{qcar}
\calls{countCache}{identp}
\calls{countCache}{sayKeyedMsg}
\calls{countCache}{insertAlist}
\calls{countCache}{internl}
\calls{countCache}{sayCacheCount}
\calls{countCache}{optionError}
\usesdollar{countCache}{options}
\usesdollar{countCache}{cacheAlist}
\usesdollar{countCache}{cacheCount}
\nwenddocs{}\nwbegincode{2353}\moddef{defun countCache}\endmoddef
(defun |countCache| (n)
 "Display a particular cache count"
 (let (tmp1 l cachecountname)
 (declare (special |$options| |$cacheAlist| |$cacheCount|))
 (cond
  (|$options|
   (cond
    ((and (pairp |$options|)
          (eq (qcdr |$options|) nil)
          (progn
           (setq tmp1 (qcar |$options|))
           (and (pairp tmp1)
                (eq (qcar tmp1) '|vars|)
                (progn (setq l (qcdr tmp1)) t))))
     (dolist (x l)
       (if (null (identp x))
         (|sayKeyedMsg| 's2if0007 (list x))
         (progn
          (setq |$cacheAlist| (|insertAlist| x n |$cacheAlist|))
          (setq cachecountname (internl x ";COUNT"))
          (set cachecountname n)
          (|sayCacheCount| x n)))))
    (t (|optionError| (caar |$options|) nil))))
  (t
   (|sayCacheCount| nil (setq |$cacheCount| n))))))

\nwendcode{}\nwbegindocs{2354}\nwdocspar

\defunsec{describeSetFunctionsCache}{Describe the set functions cache}
\calls{describeSetFunctionsCache}{sayBrightly}
\nwenddocs{}\nwbegincode{2355}\moddef{defun describeSetFunctionsCache}\endmoddef
(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")))

\nwendcode{}\nwbegindocs{2356}\nwdocspar

\defunsec{sayAllCacheCounts}{Display all cache counts}
\calls{sayAllCacheCounts}{sayCacheCount}
\calls{sayAllCacheCounts}{nequal}
\usesdollar{sayAllCacheCounts}{cacheCount}
\usesdollar{sayAllCacheCounts}{cacheAlist}
\nwenddocs{}\nwbegincode{2357}\moddef{defun sayAllCacheCounts}\endmoddef
(defun |sayAllCacheCounts| ()
 "Display all cache counts"
 (let (x n)
 (declare (special |$cacheCount| |$cacheAlist|))
   (|sayCacheCount| nil |$cacheCount|)
   (when |$cacheAlist|
     (do ((t0 |$cacheAlist| (cdr t0)) (t1 nil))
         ((or (atom t0)
              (progn (setq t1 (car t0)) nil)
              (progn
               (progn (setq x (car t1)) (setq n (cdr t1)) t1)
               nil))
             nil)
       (when (nequal n |$cacheCount|) (|sayCacheCount| x n))))))

\nwendcode{}\nwbegindocs{2358}\nwdocspar

\defunsec{sayCacheCount}{Describe the cache counts}
\calls{sayCacheCount}{bright}
\calls{sayCacheCount}{linearFormatName}
\calls{sayCacheCount}{sayBrightly}
\nwenddocs{}\nwbegincode{2359}\moddef{defun sayCacheCount}\endmoddef
(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))))))
```

```
\nwendcode{}\nwbegindocs{2360}\nwdocspar

\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.
```

44.23.2 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|)
```

44.24 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.
```

44.24.1 defvar $compileRecurrence

⟨*initvars*⟩+≡
```
  (defvar |$compileRecurrence| t "specially compile recurrence relations")
```

⟨*functionsrecurrence*⟩≡
```
       (|recurrence|
        "specially compile recurrence relations"
        |interpreter|
        LITERALS
        |$compileRecurrence|
        (|on| |off|)
        |on|)
```

44.25 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|
      (
```

⟨*fortranints2floats*⟩
⟨*fortranfortindent*⟩
⟨*fortranfortlength*⟩
⟨*fortrantypedecs*⟩
⟨*fortrandefaulttype*⟩
⟨*fortranprecision*⟩
⟨*fortranintrinsic*⟩
⟨*fortranexplength*⟩
⟨*fortransegment*⟩
⟨*fortranoptlevel*⟩
⟨*fortranstartindex*⟩
⟨*fortrancalling*⟩

```
    ))
```

44.25.1 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.
```

44.25.2 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|)
```

44.25.3 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
```

44.25.4 defvar $fortIndent

⟨*initvars*⟩+≡

```
  (defvar |$fortIndent| 6 "the number of characters indented")
```

⟨*fortranfortindent*⟩≡
```
       (|fortindent|
        "the number of characters indented"
        |interpreter|
        INTEGER
        |$fortIndent|
        (0 NIL)
        6)
```

44.25.5 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
```

44.25.6 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)
```

44.25.7 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.
```

44.25.8 defvar $printFortranDecs

⟨*initvars*⟩+≡

```
  (defvar |$printFortranDecs| t "print type and dimension lines")
```

⟨*fortrantypedecs*⟩≡

```
        (|typedecs|
         "print type and dimension lines"
         |interpreter|
         LITERALS
         |$printFortranDecs|
         (|on| |off|)
         |on|)
```

44.25.9 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.
```

44.25.10 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)
```

44.25.11 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.
```

44.25.12 defvar $fortranPrecision

⟨*initvars*⟩+≡
```
(defvar |$fortranPrecision| '|double| "precision of generated FORTRAN objects")
```

⟨*fortranprecision*⟩≡
```
(|precision|
"precision of generated FORTRAN objects"
 |interpreter|
 LITERALS
 |$fortranPrecision|
 (|single| |double|)
 |double|)
```

44.25.13 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.
```

44.25.14 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|)
```

44.25.15 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
```

44.25.16 defvar $maximumFortranExpressionLength

⟨*initvars*⟩+≡
```
  (defvar |$maximumFortranExpressionLength| 1320
    "character limit for FORTRAN expressions")
```

⟨*fortranexplength*⟩≡
```
        (|explength|
         "character limit for FORTRAN expressions"
         |interpreter|
         INTEGER
         |$maximumFortranExpressionLength|
         (0 NIL)
         1320)
```

44.25.17 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.
```

44.25.18 defvar $fortranSegment

⟨*initvars*⟩+≡
```
  (defvar |$fortranSegment| t "split long FORTRAN expressions")
```

⟨*fortransegment*⟩≡
```
        (|segment|
         "split long FORTRAN expressions"
         |interpreter|
         LITERALS
         |$fortranSegment|
         (|on| |off|)
         |on|)
```

44.25.19 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
```

44.25.20 defvar $fortranOptimizationLevel

⟨*initvars*⟩+≡
```
  (defvar |$fortranOptimizationLevel| 0 "FORTRAN optimisation level")
```

⟨*fortranoptlevel*⟩≡
```
        (|optlevel|
         "FORTRAN optimisation level"
         |interpreter|
         INTEGER
         |$fortranOptimizationLevel|
         (0 2)
         0)
```

44.25.21 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
```

44.25.22 defvar $fortranArrayStartingIndex

⟨*initvars*⟩+≡
```
(defvar |$fortranArrayStartingIndex| 1 "starting index for FORTRAN arrays")
```

⟨*fortranstartindex*⟩≡
```
        (|startindex|
         "starting index for FORTRAN arrays"
         |interpreter|
         INTEGER
         |$fortranArrayStartingIndex|
         (0 1)
         1)
```

44.25.23 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) -lxlf
```

⟨*fortrancalling*⟩≡
```
        (|calling|
        "options for external FORTRAN calls"
        |interpreter|
        TREE
        |novar|
        (
  ⟨callingtempfile⟩
  ⟨callingdirectory⟩
  ⟨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/
```

44.25.24 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)
```

44.25.25 The top level set fortran calling tempfile handler

[pname p??]
[describeSetFortTmpDir p758]
[validateOutputDirectory p757]
[sayBrightly p??]
[bright p??]
[$fortranTmpDir p756]

⟨*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)))))
```

44.25.26 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)))
```

44.25.27 Describe the set fortran calling tempfile

[sayBrightly p??]
[$fortranTmpDir p756]

⟨*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 ./
```

44.25.28 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)
```

44.25.29 defun setFortDir

[pname p**??**]
[describeSetFortDir p760]
[validateOutputDirectory p757]
[sayBrightly p**??**]
[bright p**??**]
[$fortranDirectory p758]

⟨*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)))))
```

44.25.30 defun describeSetFortDir

[sayBrightly p??]
[$fortranDirectory p758]

⟨*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 "-lxlf"

 The current setting is -lxlf
```

44.25.31 defvar $fortranLibraries

⟨*initvars*⟩+≡
```
(defvar |$fortranLibraries| "-lxlf"
  "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|
             "-lxlf"))
           NIL
           )
```

44.25.32 defun setLinkerArgs

[object2String p**??**]
[describeSetLinkerArgs p762]
[$fortranLibraries p760]

⟨*defun setLinkerArgs*⟩≡
```
  (defun |setLinkerArgs| (arg)
   (declare (special |$fortranLibraries|))
   (cond
    ((eq arg '|%initialize%|) (setq |$fortranLibraries| "-lxlf"))
    ((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|))))
```

44.25.33 defun describeSetLinkerArgs

[sayBrightly p**??**]
[$fortranLibraries p760]

⟨*defun describeSetLinkerArgs*⟩≡

```
(defun |describeSetLinkerArgs| ()
 (declare (special |$fortranLibraries|))
 (|sayBrightly| (list
  '|%b| ")set fortran calling linkerargs"
  '|%d| " is used to pass arguments to the linker"
  '|%l| " when using "
  '|%b| "mkFort"
  '|%d| " to create functions which call Fortran code."
  '|%l| " For example, it might give a list of libraries to be searched,"
  '|%l| " and their locations."
  '|%l| " The string is passed verbatim, so must be the correct syntax for"
  '|%l| " the particular linker being used."
  '|%l|
  '|%l| " Example: )set fortran calling linker \"-lxlf\""
  '|%l|
  '|%l| " The current setting is"
  '|%b| |$fortranLibraries|
  '|%d|)))
```

44.26 kernel

```
             Current Values of  kernel  Variables

Variable     Description                            Current Value
-----------------------------------------------------------------
warn         warn when re-definition is attempted       off
protect      prevent re-definition of kernel functions  off
```

⟨*kernel*⟩≡
```
    (|kernel|
     "library functions built into the kernel for efficiency"
     |interpreter|
     TREE
     |novar|
     (
  ⟨kernelwarn⟩
  ⟨kernelprotect⟩
     )
    )
```

44.26.1 kernelwarn

```
---------------------- The warn Option -----------------------

 Description: warn when re-definition is attempted

Some AXIOM library functions are compiled into the kernel for
efficiency reasons. To prevent them being re-defined when loaded
from a library they are specially protected. If a user wishes to
know when an attempt is made to re-define such a function, he or
she should issue the command:
        )set kernel warn on
To restore the default behaviour, he or she should issue the
command:
        )set kernel warn off
```

⟨*kernelwarn*⟩≡
```
        (|warn|
         "warn when re-definition is attempted"
         |interpreter|
         FUNCTION
         |protectedSymbolsWarning|
         NIL
         |htSetKernelWarn|)
```

44.26.2 defun protectedSymbolsWarning

[protected-symbol-warn p**??**]
[describeProtectedSymbolsWarning p764]
[translateYesNo2TrueFalse p689]

⟨*defun protectedSymbolsWarning*⟩≡
```
(defun |protectedSymbolsWarning| (arg)
 (let (v)
   (cond
    ((eq arg '|%initialize%|) (protected-symbol-warn nil))
    ((eq arg '|%display%|)
     (setq v (protected-symbol-warn t))
     (protected-symbol-warn v)
     (if v "on" "off"))
    ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
     (|describeProtectedSymbolsWarning|))
    (t (protected-symbol-warn (|translateYesNo2TrueFalse| (car arg)))))))
```

44.26.3 defun describeProtectedSymbolsWarning

[sayBrightly p**??**]

⟨*defun describeProtectedSymbolsWarning*⟩≡
```
(defun |describeProtectedSymbolsWarning| ()
 (|sayBrightly| (list
  "Some AXIOM library functions are compiled into the kernel for efficiency"
  '|%l| "reasons.  To prevent them being re-defined when loaded from a library"
  '|%l|
  "they are specially protected.  If a user wishes to know when an attempt"
  '|%l|
  "is made to re-define such a function, he or she should issue the command:"
  '|%l| "        )set kernel warn on"
  '|%l| "To restore the default behaviour, he or she should issue the command:"
  '|%l| "        )set kernel warn off")))
```

44.26.4 kernelprotect

```
-------------------- The protect Option ----------------------

 Description: prevent re-definition of kernel functions

Some AXIOM library functions are compiled into the kernel for
efficiency reasons. To prevent them being re-defined when loaded
from a library they are specially protected.  If a user wishes
to re-define these functions, he or she should issue the command:
        )set kernel protect off
To restore the default behaviour, he or she should issue the
command:
        )set kernel protect on
```

⟨*kernelprotect*⟩≡

```
        (|protect|
         "prevent re-definition of kernel functions"
         |interpreter|
         FUNCTION
         |protectSymbols|
         NIL
         |htSetKernelProtect|)
```

44.26.5 defun protectSymbols

[protect-symbols p**??**]
[describeProtectSymbols p766]
[translateYesNo2TrueFalse p689]

⟨*defun protectSymbols*⟩≡

```
  (defun |protectSymbols| (arg)
   (let (v)
     (cond
      ((eq arg '|%initialize%|) (protect-symbols  t))
      ((eq arg '|%display%|)
       (setq v (protect-symbols t))
       (protect-symbols v)
       (if v "on" "off"))
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
       (|describeProtectSymbols|))
      (t (protect-symbols (|translateYesNo2TrueFalse| (car arg)))))))
```

44.26.6 defun describeProtectSymbols

[sayBrightly p**??**]

⟨*defun describeProtectSymbols*⟩≡
```
(defun |describeProtectSymbols| ()
 (|sayBrightly| (list
  "Some AXIOM library functions are compiled into the kernel for efficiency"
  '|%l|
  "reasons.  To prevent them being re-defined when loaded from a library"
  '|%l| "they are specially protected.  If a user wishes to re-define these"
  '|%l| "functions, he or she should issue the command:"
  '|%l| "        )set kernel protect off"
  '|%l|
  "To restore the default behaviour, he or she should issue the command:"
  '|%l| "        )set kernel protect on")))
```

44.27 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|
     (
  ⟨hyperdocfullscreen⟩
  ⟨hyperdocmathwidth⟩
     ))
```

44.27.1 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.
```

44.27.2 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|)
```

44.27.3 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
```

44.27.4 defvar $historyDisplayWidth

⟨*initvars*⟩+≡
```
  (defvar |$historyDisplayWidth| 120 "screen width for history output")
```

⟨*hyperdocmathwidth*⟩≡
```
       (|mathwidth|
        "screen width for history output"
        |interpreter|
        INTEGER
        |$historyDisplayWidth|
        (0 NIL)
        120)
```

44.28 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|
     (
  ⟨helpfullscreen⟩
     ))
```

44.28.1 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.
```

44.28.2 defvar $useFullScreenHelp

⟨*initvars*⟩+≡

```
  (defvar |$useFullScreenHelp| t "use fullscreen facility, if possible")
```

⟨*helpfullscreen*⟩≡

```
      (|fullscreen|
       "use fullscreen facility, if possible"
       |interpreter|
       LITERALS
       |$useFullScreenHelp|
       (|on| |off|)
       |on|)
```

44.29 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.
```

44.29.1 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|)
```

44.30 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
interponly   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|
     (
```

⟨*messagesany*⟩
⟨*messagesautoload*⟩
⟨*messagesbottomup*⟩
⟨*messagescoercion*⟩
⟨*messagesdropmap*⟩
⟨*messagesexpose*⟩
⟨*messagesfile*⟩
⟨*messagesframe*⟩
⟨*messageshighlighting*⟩
⟨*messagesinstant*⟩
⟨*messagesinsteach*⟩

⟨*messagesinterponly*⟩
⟨*messagesnaglink*⟩
⟨*messagesnumber*⟩
⟨*messagesprompt*⟩
⟨*messagesselection*⟩
⟨*messagesset*⟩
⟨*messagesstartup*⟩
⟨*messagessummary*⟩
⟨*messagestesting*⟩
⟨*messagestime*⟩
⟨*messagestype*⟩
⟨*messagesvoid*⟩
))

44.30.1 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.
```

44.30.2 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|)
```

44.30.3 autoload

```
--------------------- The autoload Option ---------------------

 Description: print file auto-load messages
```

44.30.4 defvar $printLoadMsgs

⟨*initvars*⟩+≡

```
  (defvar |$printLoadMsgs| nil "print file auto-load messages")
```

⟨*messagesautoload*⟩≡

```
       (|autoload|
        "print file auto-load messages"
        |interpreter|
        LITERALS
        |$printLoadMsgs|
        (|on| |off|)
        |on|)
```

44.30.5 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.
```

44.30.6 defvar $reportBottomUpFlag

⟨*initvars*⟩+≡

```
  (defvar |$reportBottomUpFlag| nil "display bottom up modemap selection")
```

⟨*messagesbottomup*⟩≡
```
       (|bottomup|
        "display bottom up modemap selection"
        |development|
        LITERALS
        |$reportBottomUpFlag|
        (|on| |off|)
        |off|)
```

44.30.7 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.
```

44.30.8 defvar $reportCoerceIfTrue

⟨*initvars*⟩+≡
```
  (defvar |$reportCoerceIfTrue| nil "display datatype coercion messages")
```

⟨*messagescoercion*⟩≡
```
       (|coercion|
        "display datatype coercion messages"
        |development|
        LITERALS
        |$reportCoerceIfTrue|
        (|on| |off|)
        |off|)
```

44.30.9 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.
```

44.30.10 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|)
```

44.30.11 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.
```

44.30.12 defvar $giveExposureWarning

⟨*initvars*⟩+≡

```
  (defvar |$giveExposureWarning| nil "warning for unexposed functions")
```

⟨*messagesexpose*⟩≡

```
       (|expose|
        "warning for unexposed functions"
        |interpreter|
        LITERALS
        |$giveExposureWarning|
        (|on| |off|)
        |off|)
```

44.30.13 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.
```

44.30.14 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|)
```

44.30.15 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.
```

44.30.16 defvar $frameMessages

⟨*initvars*⟩+≡
```
  (defvar |$frameMessages| nil "display messages about frames")
```

⟨*messagesframe*⟩≡
```
        (|frame|
         "display messages about frames"
         |interpreter|
         LITERALS
         |$frameMessages|
         (|on| |off|)
         |off|)
```

44.30.17 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.
```

44.30.18 defvar $highlightAllowed

⟨*initvars*⟩+≡

```
  (defvar |$highlightAllowed| nil "use highlighting in system messages")
```

⟨*messageshighlighting*⟩≡

```
        (|highlighting|
         "use highlighting in system messages"
         |interpreter|
         LITERALS
         |$highlightAllowed|
         (|on| |off|)
         |off|)
```

44.30.19 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.
```

44.30.20 defvar $reportInstantiations

⟨*initvars*⟩+≡

```
  (defvar |$reportInstantiations| nil "present instantiation summary")
```

⟨*messagesinstant*⟩≡

```
        (|instant|
         "present instantiation summary"
         |development|
         LITERALS
         |$reportInstantiations|
         (|on| |off|)
         |off|)
```

44.30.21 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.
```

44.30.22 defvar $reportEachInstantiation—

⟨*initvars*⟩+≡
```
  (defvar |$reportEachInstantiation| nil "present instantiation info")
```

⟨*messagesinsteach*⟩≡
```
        (|insteach|
         "present instantiation info"
         |development|
         LITERALS
         |$reportEachInstantiation|
         (|on| |off|)
         |off|)
```

44.30.23 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.
```

44.30.24 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|)
```

44.30.25 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.
```

44.30.26 defvar $nagMessages

⟨*initvars*⟩+≡

```
  (defvar |$nagMessages| t "show NAGLink messages")
```

⟨*messagesnaglink*⟩≡

```
        (|naglink|
         "show NAGLink messages"
         |interpreter|
         LITERALS
         |$nagMessages|
         (|on| |off|)
         |on|)
```

44.30.27 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.
```

44.30.28 defvar $displayMsgNumber

⟨*initvars*⟩+≡

```
  (defvar |$displayMsgNumber| nil "display message number with message")
```

⟨*messagesnumber*⟩≡

```
        (|number|
         "display message number with message"
         |interpreter|
         LITERALS
         |$displayMsgNumber|
         (|on| |off|)
         |off|)
```

44.30.29 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.
```

44.30.30 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|)
```

44.30.31 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|)
```

44.30.32 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.
```

44.30.33 defvar $displaySetValue

⟨*initvars*⟩+≡

```
  (defvar |$displaySetValue| nil "show )set setting after assignment")
```

⟨*messagesset*⟩≡

```
        (|set|
         "show )set setting after assignment"
         |interpreter|
         LITERALS
         |$displaySetValue|
         (|on| |off|)
         |off|)
```

44.30.34 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.
```

44.30.35 defvar $displayStartMsgs

⟨*initvars*⟩+≡
```
  (defvar |$displayStartMsgs| t "display messages on start-up")
```

⟨*messagesstartup*⟩≡
```
        (|startup|
         "display messages on start-up"
         |interpreter|
         LITERALS
         |$displayStartMsgs|
         (|on| |off|)
         |on|)
```

44.30.36 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.
```

44.30.37 defvar $printStatisticsSummaryIfTrue

⟨*initvars*⟩+≡

```
  (defvar |$printStatisticsSummaryIfTrue| nil
       "print statistics after computation")
```

⟨*messagessummary*⟩≡

```
       (|summary|
        "print statistics after computation"
        |interpreter|
        LITERALS
        |$printStatisticsSummaryIfTrue|
        (|on| |off|)
        |off|)
```

44.30.38 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.
```

44.30.39 defvar $testingSystem

⟨*initvars*⟩+≡
```
(defvar |$testingSystem| nil "print system testing header")
```

⟨*messagestesting*⟩≡
```
       (|testing|
        "print system testing header"
        |development|
        LITERALS
        |$testingSystem|
        (|on| |off|)
        |off|)
```

44.30.40 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.
```

44.30.41 defvar $printTimeIfTrue

⟨*initvars*⟩+≡
```
(defvar |$printTimeIfTrue| nil "print timings after computation")
```

⟨*messagestime*⟩≡
```
       (|time|
        "print timings after computation"
        |interpreter|
        LITERALS
        |$printTimeIfTrue|
        (|on| |off| |long|)
        |off|)
```

44.30.42 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.
```

44.30.43 defvar $printTypeIfTrue

⟨*initvars*⟩+≡

```
  (defvar |$printTypeIfTrue| t "print type after computation")
```

⟨*messagestype*⟩≡

```
        (|type|
         "print type after computation"
         |interpreter|
         LITERALS
         |$printTypeIfTrue|
         (|on| |off|)
         |on|)
```

44.30.44 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.
```

44.30.45 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|)
```

44.31 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|
     (
  ⟨naglinkhost⟩
  ⟨naglinkpersistence⟩
  ⟨naglinkmessages⟩
  ⟨naglinkdouble⟩
     ))
```

44.31.1 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
```

44.31.2 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)
```

44.31.3 defun setNagHost

[object2String p**??**]
[describeSetNagHost p794]
[$nagHost p792]

⟨*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)))))
```

44.31.4 defun describeSetNagHost

[sayBrightly p??]
[$nagHost p792]

⟨*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|)))
```

44.31.5 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
```

44.31.6 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)
```

44.31.7 defun setFortPers

[describeFortPersistence p796]
[sayMessage p??]
[bright p??]
[terminateSystemCommand p463]
[$fortPersistence p794]

⟨*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))))))))
```

44.31.8 defun describeFortPersistence

[sayBrightly p**??**]
[$fortPersistence p794]

⟨*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|)))
```

44.31.9 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|)
```

44.31.10 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.
```

44.31.11 defvar $nagEnforceDouble

⟨*initvars*⟩+≡

```
(defvar |$nagEnforceDouble| t "enforce DOUBLE PRECISION ASPs")
```

⟨*naglinkdouble*⟩≡

```
(|double|
 "enforce DOUBLE PRECISION ASPs"
 |interpreter|
 LITERALS
 |$nagEnforceDouble|
 (|on| |off|)
 |on|)
```

44.32 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 )show 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|
      (
```

⟨*outputabbreviate*⟩
⟨*outputalgebra*⟩
⟨*outputcharacters*⟩
⟨*outputfortran*⟩
⟨*outputfraction*⟩
⟨*outputhtml*⟩
⟨*outputlength*⟩
⟨*outputmathml*⟩
⟨*outputopenmath*⟩
⟨*outputscript*⟩
⟨*outputscripts*⟩
⟨*outputshoweditor*⟩
⟨*outputtex*⟩

```
     ))
```

44.32.1 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.
```

44.32.2 defvar $abbreviateTypes

⟨*initvars*⟩+≡
```
  (defvar |$abbreviateTypes| nil "abbreviate type names")
```

⟨*outputabbreviate*⟩≡
```
        (|abbreviate|
         "abbreviate type names"
         |interpreter|
         LITERALS
         |$abbreviateTypes|
         (|on| |off|)
         |off|)
```

44.32.3 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
```

44.32.4 defvar $algebraFormat

⟨*initvars*⟩+≡
```
(defvar |$algebraFormat| t "display output in algebraic form")
```

44.32.5 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)
```

44.32.6 defvar $algebraOutputStream

⟨*initvars*⟩+≡
```
(defvar |$algebraOutputStream| *standard-output*)
```

44.32.7 defun setOutputAlgebra

[defiostream p1038]
[concat p1112]
[describeSetOutputAlgebra p806]
[pairp p??]
[qcdr p??]
[qcar p??]
[member p1113]
[upcase p??]
[sayKeyedMsg p357]
[shut p1039]
[pathnameType p1106]
[pathnameDirectory p1107]
[pathnameName p1106]
[$filep p??]
[make-outstream p1037]
[object2String p??]
[$algebraOutputStream p802]
[$algebraOutputFile p801]
[$filep p??]
[$algebraFormat p801]

⟨*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 (pairp 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 (pairp 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 |$algebraOutputFile| "CONSOLE"))))
 ((or
   (and (pairp arg)
        (progn
         (setq fn (qcar arg))
         (setq tmp1 (qcdr arg))
         (and (pairp tmp1)
              (eq (qcdr tmp1) nil)
              (progn (setq ft (qcar tmp1)) t))))
   (and (pairp arg)
        (progn (setq fn (qcar arg))
               (setq tmp1 (qcdr arg))
               (and (pairp tmp1)
                    (progn (setq ft (qcar tmp1))
                           (setq tmp2 (qcdr tmp1))
                           (and (pairp tmp2)
                                (eq (qcdr tmp2) nil)
                                (progn
                                 (setq fm (qcar tmp2))
                                 t)))))))
  (when (setq ptype (|pathnameType| fn))
   (setq fn (concat (|pathnameDirectory| fn) (|pathnameName| fn)))
   (setq ft ptype))
  (unless fm (setq fm 'a))
  (setq filename ($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|)))))))
```

44.32.8 defun describeSetOutputAlgebra

[sayBrightly p??]
[setOutputAlgebra p803]

⟨*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|)))
```

44.32.9 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|)
```

44.32.10 defun setOutputCharacters

[sayMessage p??]
[bright p??]
[sayBrightly p??]
[concat p1112]
[pname p??]
[specialChar p1036]
[sayAsManyPerLineAsPossible p??]
[pairp p??]
[qcdr p??]
[qcar p??]
[downcase p??]
[setOutputCharacters p808]
[$specialCharacters p1035]
[$plainRTspecialCharacters p1034]
[$RTspecialCharacters p1035]
[$specialCharacterAlist p1036]

⟨*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 |$specialCharacterAlist| (CDR t1)) (t2 nil))
    ((or (atom t1)
         (progn (setq t2 (car t1)) nil)
         (progn (progn (setq char (car t2)) t2) nil)) nil)
  (setq s
   (concat "   " (pname char) " is shown as "
    (pname (|specialChar| char))))
   (setq l (cons s l)))
 (|sayAsManyPerLineAsPossible| (reverse l)))
((and (pairp arg)
      (eq (qcdr arg) NIL)
      (progn (setq fn (qcar arg)) t)
      (setq fn (downcase fn)))
 (cond
  ((eq fn '|default|)
   (setq |$specialCharacters| |$RTspecialCharacters|))
  ((eq fn '|plain|)
   (setq |$specialCharacters| |$plainRTspecialCharacters|))
  (t (|setOutputCharacters| nil))))
(t (|setOutputCharacters| nil)))))))
```

44.32.11 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
```

44.32.12 defvar $fortranFormat

⟨*initvars*⟩+≡

```
(defvar |$fortranFormat| nil "create output in FORTRAN format")
```

44.32.13 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)
```

44.32.14 defun setOutputFortran

[defiostream p1038]
[concat p1112]
[describeSetOutputFortran p815]
[upcase p??]
[pairp p??]
[qcdr p??]
[qcar p??]
[member p1113]
[sayKeyedMsg p357]
[shut p1039]
[pathnameType p1106]
[pathnameDirectory p1107]
[pathnameName p1106]
[$filep p??]
[makeStream p1039]
[object2String p??]
[$fortranOutputStream p??]
[$fortranOutputFile p810]
[$filep p??]
[$fortranFormat p810]

⟨*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 (pairp 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 (pairp 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 (pairp arg)
         (progn
          (setq fn (qcar arg))
          (setq tmp1 (qcdr arg))
          (and (pairp tmp1)
               (eq (qcdr tmp1) nil)
               (progn (setq ft (qcar tmp1)) t))))
    (and (pairp arg)
         (progn
          (setq fn (qcar arg))
          (setq tmp1 (qcdr arg))
          (and (pairp tmp1)
               (progn
                (setq ft (qcar tmp1))
                (setq tmp2 (qcdr tmp1))
                (and (pairp 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|)))))))
```

44.32.15 defun describeSetOutputFortran

[sayBrightly p??]
[setOutputFortran p812]

⟨*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|)))
```

44.32.16 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.
```

44.32.17 defvar $fractionDisplayType

⟨*initvars*⟩+≡

```
  (defvar |$fractionDisplayType| '|vertical| "how fractions are formatted")
```

⟨*outputfraction*⟩≡

```
        (|fraction|
         "how fractions are formatted"
         |interpreter|
         LITERALS
         |$fractionDisplayType|
         (|vertical| |horizontal|)
         |vertical|)
```

44.32.18 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
```

44.32.19 defvar $margin

⟨*initvars*⟩+≡

```
  (defvar $margin 3)
```

44.32.20 defvar $linelength

⟨*initvars*⟩+≡
```
(defvar $linelength 77 "line length of output displays")
```

⟨*outputlength*⟩≡
```
       (|length|
        "line length of output displays"
        |interpreter|
        INTEGER
        $LINELENGTH
        (10 245)
        77)
```

44.32.21 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
```

44.32.22 defvar $mathmlFormat

⟨*initvars*⟩+≡

```
(defvar |$mathmlFormat| nil "create output in MathML format")
```

44.32.23 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)
```

44.32.24 defun setOutputMathml

[defiostream p1038]
[concat p1112]
[describeSetOutputMathml p823]
[pairp p??]
[qcdr p??]
[qcar p??]
[member p1113]
[upcase p??]
[sayKeyedMsg p357]
[shut p1039]
[pathnameType p1106]
[pathnameDirectory p1107]
[pathnameName p1106]
[$filep p??]
[make-outstream p1037]
[object2String p??]
[$mathmlOutputStream p??]
[$mathmlOutputFile p818]
[$mathmlFormat p818]
[$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 (pairp 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 (pairp 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 |$mathmlOutputFile| "CONSOLE"))))
  ((or
    (and (pairp arg)
         (progn
          (setq fn (qcar arg))
          (setq tmp1 (qcdr arg))
          (and (pairp tmp1)
               (eq (qcdr tmp1) nil)
               (progn (setq ft (qcar tmp1)) t))))
    (and (pairp arg)
         (progn (setq fn (qcar arg))
                (setq tmp1 (qcdr arg))
                (and (pairp tmp1)
                     (progn
                      (setq ft (qcar tmp1))
                      (setq tmp2 (qcdr tmp1))
                      (and (pairp tmp2)
                           (eq (qcdr tmp2) nil)
                           (progn
                            (setq fm (qcar tmp2))
                            t)))))))
     (when (setq ptype (|pathnameType| fn))
      (setq fn
       (concat (|pathnameDirectory| fn) (|pathnameName| fn)))
      (setq ft ptype))
     (unless fm (setq fm 'a))
     (setq filename ($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|)))))))
```

44.32.25 defun describeSetOutputMathml

[sayBrightly p??]
[setOutputMathml p820]

⟨*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|)))
```

44.32.26 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
```

44.32.27 defvar $htmlFormat

⟨*initvars*⟩+≡

```
(defvar |$htmlFormat| nil "create output in HTML format")
```

44.32.28 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)
```

44.32.29 defun setOutputHtml

[defiostream p1038]
[concat p1112]
[describeSetOutputHtml p829]
[pairp p??]
[qcdr p??]
[qcar p??]
[member p1113]
[upcase p??]
[sayKeyedMsg p357]
[shut p1039]
[pathnameType p1106]
[pathnameDirectory p1107]
[pathnameName p1106]
[$filep p??]
[make-outstream p1037]
[object2String p??]
[$htmlOutputStream p??]
[$htmlOutputFile p824]
[$htmlFormat p824]
[$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 (pairp 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 (pairp 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 |$htmlOutputFile| "CONSOLE"))))
  ((or
    (and (pairp arg)
         (progn
          (setq fn (qcar arg))
          (setq tmp1 (qcdr arg))
          (and (pairp tmp1)
               (eq (qcdr tmp1) nil)
               (progn (setq ft (qcar tmp1)) t))))
    (and (pairp arg)
         (progn (setq fn (qcar arg))
                (setq tmp1 (qcdr arg))
                (and (pairp tmp1)
                     (progn
                      (setq ft (qcar tmp1))
                      (setq tmp2 (qcdr tmp1))
                      (and (pairp tmp2)
                           (eq (qcdr tmp2) nil)
                           (progn
                            (setq fm (qcar tmp2))
                            t)))))))
     (when (setq ptype (|pathnameType| fn))
      (setq fn
       (concat (|pathnameDirectory| fn) (|pathnameName| fn)))
      (setq ft ptype))
     (unless fm (setq fm 'a))
     (setq filename ($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|)))))))
```

44.32.30 defun describeSetOutputHtml

[sayBrightly p??]
[setOutputHtml p826]

⟨*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|)))
```

44.32.31 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
```

44.32.32 defvar $openMathFormat

⟨*initvars*⟩+≡

```
(defvar |$openMathFormat| nil "create output in OpenMath format")
```

44.32.33 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)
```

44.32.34 defun setOutputOpenMath

[defiostream p1038]
[concat p1112]
[describeSetOutputOpenMath p835]
[pairp p??]
[qcdr p??]
[qcar p??]
[member p1113]
[upcase p??]
[sayKeyedMsg p357]
[shut p1039]
[pathnameType p1106]
[pathnameDirectory p1107]
[pathnameName p1106]
[$filep p??]
[make-outstream p1037]
[object2String p??]
[$openMathOutputStream p??]
[$openMathFormat p830]
[$filep p??]
[$openMathOutputFile p830]

⟨*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 (pairp 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 (pairp 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 |$openMathOutputFile| "CONSOLE"))))
  ((or
    (and (pairp arg)
         (progn (setq fn (qcar arg))
                (setq tmp1 (qcdr arg))
                (and (pairp tmp1)
                     (eq (qcdr tmp1) nil)
                     (progn (setq ft (qcar tmp1)) t))))
    (and (pairp arg)
         (progn
          (setq fn (qcar arg))
          (setq tmp1 (qcdr arg))
          (and (pairp tmp1)
               (progn (setq ft (qcar tmp1))
                      (setq tmp2 (qcdr tmp1))
                      (and (pairp tmp2)
                           (eq (qcdr tmp2) nil)
                           (progn (setq fm (qcar tmp2)) t)))))))
    (when (setq ptype (|pathnameType| fn))
     (setq fn (concat (|pathnameDirectory| fn) (|pathnameName| fn)))
     (setq ft ptype))
    (unless fm (setq fm 'a))
    (setq filename ($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|)))))))
```

44.32.35 defun describeSetOutputOpenMath

[sayBrightly p??]
[setOutputOpenMath p832]

⟨*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|)))
```

44.32.36 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
```

44.32.37 defvar $formulaFormat

⟨*initvars*⟩+≡

```
(defvar |$formulaFormat| nil "display output in SCRIPT format")
```

44.32.38 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)
```

44.32.39 defun setOutputFormula

[defiostream p1038]
[concat p1112]
[describeSetOutputFormula p841]
[pairp p??]
[qcdr p??]
[qcar p??]
[member p1113]
[upcase p??]
[sayKeyedMsg p357]
[shut p1039]
[pathnameType p1106]
[pathnameDirectory p1107]
[pathnameName p1106]
[$filep p??]
[make-outstream p1037]
[object2String p??]
[$formulaOutputStream p??]
[$formulaOutputFile p836]
[$filep p??]
[$formulaFormat p836]

⟨*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 (pairp 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 (pairp 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 |$formulaOutputFile| "CONSOLE"))))
   ((or
     (and (pairp arg)
          (progn (setq fn (qcar arg))
                 (setq tmp1 (qcdr arg))
                 (and (pairp tmp1)
                      (eq (qcdr tmp1) nil)
                      (progn (setq ft (qcar tmp1)) t))))
     (and (pairp arg)
          (progn (setq fn (qcar arg))
                 (setq tmp1 (qcdr arg))
                 (and (pairp tmp1)
                      (progn (setq ft (qcar tmp1))
                             (setq tmp2 (qcdr tmp1))
                             (and (pairp tmp2)
                                  (eq (qcdr tmp2) nil)
                                  (progn
                                   (setq fm (qcar tmp2)) t)))))))
     (if (setq ptype (|pathnameType| fn))
       (setq fn (concat (|pathnameDirectory| fn) (|pathnameName| fn)))
       (setq ft ptype))
     (unless fm (setq fm 'a))
     (setq filename ($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|)))))))
```

44.32.40 defun describeSetOutputFormula

[sayBrightly p??]
[setOutputFormula p838]

⟨*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|)))
```

44.32.41 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.
```

44.32.42 defvar $linearFormatScripts

⟨*initvars*⟩+≡
```
  (defvar |$linearFormatScripts| nil "show subscripts,... linearly")
```

⟨*outputscripts*⟩≡
```
       (|scripts|
        "show subscripts,... linearly"
        |interpreter|
        LITERALS
        |$linearFormatScripts|
        (|on| |off|)
        |off|)
```

44.32.43 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.
```

44.32.44 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|)
```

44.32.45 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
```

44.32.46 defvar $texFormat

⟨*initvars*⟩+≡

```
(defvar |$texFormat| nil "create output in TeX format")
```

44.32.47 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)
```

44.32.48 defun setOutputTex

[defiostream p1038]
[concat p1112]
[describeSetOutputTex p848]
[pairp p??]
[qcdr p??]
[qcar p??]
[member p1113]
[upcase p??]
[sayKeyedMsg p357]
[shut p1039]
[pathnameType p1106]
[pathnameDirectory p1107]
[pathnameName p1106]
[$filep p??]
[make-outstream p1037]
[object2String p??]
[$texOutputStream p??]
[$texOutputFile p844]
[$texFormat p844]
[$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 (pairp 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 (pairp 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 |$texOutputFile| "CONSOLE"))))
 ((or
   (and (pairp arg)
        (progn (setq fn (qcar arg))
               (setq tmp1 (qcdr arg))
               (and (pairp tmp1)
                    (eq (qcdr tmp1) nil)
                    (progn (setq ft (qcar tmp1)) t))))
  (and (pairp arg)
       (progn (setq fn (qcar arg))
              (setq tmp1 (qcdr arg))
              (and (pairp tmp1)
              (progn (setq ft (qcar tmp1))
                     (setq tmp2 (qcdr tmp1))
                     (and (pairp tmp2)
                          (eq (qcdr tmp2) nil)
                          (progn (setq fm (qcar tmp2)) t)))))))
  (when (setq ptype (|pathnameType| fn))
   (setq fn (concat (|pathnameDirectory| fn) (|pathnameName| fn)))
   (setq ft ptype))
  (unless fm (setq fm 'A))
  (setq filename ($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|)))))))
```

44.32.49 defun describeSetOutputTex

[sayBrightly p**??**]
[setOutputTex p846]

⟨*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|)))
```

44.33 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.
```

44.33.1 defvar $quitCommandType

⟨*initvars*⟩+≡

```
  (defvar |$quitCommandType| '|protected| "protected or unprotected quit")
```

⟨*quit*⟩≡

```
    (|quit|
     "protected or unprotected quit"
     |interpreter|
     LITERALS
     |$quitCommandType|
     (|protected| |unprotected|)
     |protected|)
```

44.34 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|
     (
```
⟨*streamscalculate*⟩
⟨*streamsshowall*⟩
```
    ))
```

44.34.1 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 .
```

44.34.2 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)
```

44.34.3 defun setStreamsCalculate

[object2String p**??**]
[describeSetStreamsCalculate p852]
[nequal p**??**]
[sayMessage p**??**]
[bright p**??**]
[terminateSystemCommand p463]
[$streamCount p850]

⟨*defun setStreamsCalculate*⟩≡
```
  (defun |setStreamsCalculate| (arg)
   (let (n)
    (declare (special |$streamCount|))
    (cond
     ((eq arg '|%initialize%|) (setq |$streamCount| 10))
     ((eq arg '|%display%|) (|object2String| |$streamCount|))
     ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
       (|describeSetStreamsCalculate|))
     (t
       (setq n (car arg))
       (cond
        ((and (nequal n '|all|) (or (null (integerp n)) (minusp n)))
          (|sayMessage|
           `("Your value of" ,@(|bright| n) "is invalid because ..."))
          (|describeSetStreamsCalculate|)
          (|terminateSystemCommand|))
        (t (setq |$streamCount| n)))))))
```

44.34.4 defun describeSetStreamsCalculate

[sayKeyedMsg p357]
[$streamCount p850]

⟨*defun describeSetStreamsCalculate*⟩≡
```
(defun |describeSetStreamsCalculate| ()
 (declare (special |$streamCount|))
 (|sayKeyedMsg| 's2iv0001 (list |$streamCount|)))
```

44.34.5 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.
```

44.34.6 defvar $streamsShowAll

⟨*initvars*⟩+≡
```
(defvar |$streamsShowAll| nil "display all stream elements computed")
```

⟨*streamsshowall*⟩≡
```
      (|showall|
       "display all stream elements computed"
       |interpreter|
       LITERALS
       |$streamsShowAll|
       (|on| |off|)
       |off|)
```

44.35 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|
     (
```
⟨*systemfunctioncode*⟩
⟨*systemoptimization*⟩
⟨*systemprettyprint*⟩
```
     ))
```

44.35.1 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.
```

44.35.2 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|)
```

44.35.3 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.
```

44.35.4 defvar $reportOptimization

⟨*initvars*⟩+≡
```
  (defvar |$reportOptimization| nil "show optimized LISP code")
```

⟨*systemoptimization*⟩≡
```
       (|optimization|
        "show optimized LISP code"
        |development|
        LITERALS
        |$reportOptimization|
        (|on| |off|)
        |off|)
```

44.35.5 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.
```

44.35.6 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|)
```

44.36 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.
```

44.36.1 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| '(
```
⟨*breakmode*⟩
⟨*compile*⟩
⟨*debug*⟩
⟨*expose*⟩
⟨*functions*⟩
⟨*fortran*⟩
⟨*kernel*⟩
⟨*hyperdoc*⟩
⟨*help*⟩
⟨*history*⟩
⟨*messages*⟩
⟨*naglink*⟩
⟨*output*⟩
⟨*quit*⟩
⟨*streams*⟩
⟨*system*⟩
⟨*userlevel*⟩
```
 ))
```

44.36.2 defvar $setOptionNames

⟨*initvars*⟩+≡
```
(defvar |$setOptionNames| (mapcar #'car |$setOptions|))
```

⟨*postvars*⟩+≡
```
(eval-when (eval load)
 (|initializeSetVariables| |$setOptions|))
```

44.37 Set code

44.37.1 defun set

[set1 p858]
[$setOptions p??]

⟨*defun set*⟩≡
```
(defun |set| (l)
 (declare (special |$setOptions|))
 (|set1| l |$setOptions|))
```

44.37.2 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 is a FUNCTION (printLoadMessages), which gets called with `%describe%` [displaySetVariableSettings p687]
[seq p**??**]
[exit p**??**]
[selectOption p498]
[downcase p**??**]
[lassoc p**??**]
[satisfiesUserLevel p462]
[sayKeyedMsg p357]
[poundsign p**??**]
[displaySetOptionInformation p685]
[kdr p**??**]
[sayMSG p359]
[sayMessage p**??**]
[bright p**??**]
[object2String p**??**]
[translateYesNo2TrueFalse p689]
[use-fast-links p**??**]
[literals p**??**]
[tree p**??**]
[set1 p858]
[$setOptionNames p856]
[$UserLevel p856]

[$displaySetValue p786]

⟨*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 |$UserLevel| "set option" nil)))
     ((eql 1 (|#| l)) (|displaySetOptionInformation| arg setdata))
     (t
      (setq st (fourth setdata))
      (case (fourth setdata)
       (function
        (setq setfunarg
         (if (eq (elt l 1) 'default)
          '|%initialize%|
          (kdr l)))
        (if (functionp (fifth setdata))
          (funcall (fifth setdata) setfunarg)
          (|sayMSG| (concatenate 'string "   Function not implemented. "
           (string (fifth setdata)))))
        (when |$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 |$displaySetValue| (null arg2))
   (|displaySetOptionInformation| arg setdata)))
 (cond
  ((null arg2)
   (|sayMessage|
    `(" Your value" ,@(|bright| (|object2String| (elt l 1)))
      "is not among the valid choices.")))
  (t nil)))
(literals
 (cond
  ((setq arg2
   (|selectOption| (elt l 1)
    (cons '|default| (sixth setdata)) nil))
   (cond
    ((eq arg2 'default)
     (set (fifth setdata)
       (|translateYesNo2TrueFalse| (seventh setdata))))
    (t
     (cond ((eq arg2 '|nobreak|) (use-fast-links t)))
     (cond
      ((eq arg2 '|fastlinks|)
       (use-fast-links nil)
       (setq arg2 '|break|)))
     (set (fifth setdata) (|translateYesNo2TrueFalse| arg2))))))
 (when (or |$displaySetValue| (null arg2))
   (|displaySetOptionInformation| arg setdata))
```

```
 (cond
  ((null arg2)
   (|sayMessage|
    (cons " Your value"
     (append (|bright| (|object2String| (elt l 1)))
      (cons "is not among the valid choices." nil)))))
  (t nil)))
(tree (|set1| (kdr l) (sixth setdata)) nil)
(t
 (|sayMessage|
  `("Cannot handle set tree node type" ,@(|bright| st) |yet|))
 nil))))))))
```

Chapter 45

)show help page Command

45.1 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]

45.1.1 defun The)show command

[showSpad2Cmd p865]

⟨*defun show*⟩≡
```
(defun |show| (arg) (|showSpad2Cmd| arg))
```

[1] "display" (29.2.1 p 553) "set" (44.37.1 p 857) "what" (52.1.2 p 997)

45.1.2 defun The internal)show command

[member p1113]
[helpSpad2Cmd p596]
[sayKeyedMsg p357]
[qcar p??]
[reportOperations p866]
[$showOptions p??]
[$e 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 (pairp 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 (pairp constr) (eq (qcar constr) '|Mapping|))
              (|sayKeyedMsg| 'S2IZ0044M nil))
       (t (|reportOperations| constr constr))))
      (t (|reportOperations| arg arg)))))))
```

45.1.3 defun reportOperations

[sayBrightly p??]
[bright p??]
[sayKeyedMsg p357]
[qcar p??]
[isNameOfType p??]
[isDomainValuedVariable p??]
[reportOpsFromUnitDirectly0 p872]
[opOf p??]
[unabbrev p??]
[reportOpsFromLisplib0 p867]
[evaluateType p??]
[mkAtree p??]
[removeZeroOneDestructively p??]
[isType p??]
[$env p??]
[$eval p??]
[$genValue p57]
[$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 (pairp u) (eq (qcar u) '|Record|)))
          (null (and (pairp u) (eq (qcar u) '|Union|)))
          (null (|isNameOfType| u))
          (null (and (pairp u)
                     (eq (qcar u) '|typeOf|)
```

```
                  (progn
                   (setq tmp1 (qcdr u))
                   (and (pairp 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)))))))))
```

45.1.4 defun reportOpsFromLisplib0

[reportOpsFromLisplib1 p868]
[reportOpsFromLisplib p869]
[$useEditorForShowOutput p843]

⟨*defun reportOpsFromLisplib0*⟩≡

```
(defun |reportOpsFromLisplib0| (unitForm u)
 (declare (special |$useEditorForShowOutput|))
  (if |$useEditorForShowOutput|
   (|reportOpsFromLisplib1| unitForm u)
   (|reportOpsFromLisplib| unitForm u)))
```

45.1.5 defun reportOpsFromLisplib1

[pathname p1108]
[erase p**??**]
[defiostream p1038]
[sayShowWarning p876]
[reportOpsFromLisplib p869]
[shut p1039]
[editFile p566]
[$sayBrightlyStream p**??**]
[$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)))
```

45.1.6 defun reportOpsFromLisplib

[constructor? p??]
[sayKeyedMsg p357]
[getConstructorSignature p??]
[kdr p??]
[getdatabase p1071]
[eqsubstlist p??]
[nreverse0 p??]
[sayBrightly p??]
[concat p1112]
[bright p??]
[form2StringWithWhere p??]
[isExposedConstructor p??]
[strconc p??]
[namestring p1106]
[selectOptionLC p498]
[dc1 p??]
[centerAndHighlight p??]
[specialChar p1036]
[remdup p??]
[msort p??]
[form2String p??]
[say2PerLine p??]
[formatAttribute p??]
[displayOperationsFromLisplib p871]
[$linelength p817]
[$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))))))))
```

45.1.7 defun displayOperationsFromLisplib

[getdatabase p1071]
[centerAndHighlight p??]
[specialChar p1036]
[reportOpsFromUnitDirectly p873]
[remdup p??]
[msort p??]
[eqsubstlist p??]
[formatOperationAlistEntry p??]
[say2PerLine p??]
[$FormalMapVariableList p??]
[$linelength p817]

⟨*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)))))
```

45.1.8 defun reportOpsFromUnitDirectly0

[reportOpsFromUnitDirectly1 p876]
[reportOpsFromUnitDirectly p873]
[$useEditorForShowOutput p843]

⟨*defun reportOpsFromUnitDirectly0*⟩≡

```
(defun |reportOpsFromUnitDirectly0| (D)
 (declare (special |$useEditorForShowOutput|))
  (if |$useEditorForShowOutput|
   (|reportOpsFromUnitDirectly1| D)
   (|reportOpsFromUnitDirectly| D)))
```

45.1.9 defun reportOpsFromUnitDirectly

[member p1113]
[qcar p??]
[evalDomain p??]
[getdatabase p1071]
[sayBrightly p??]
[concat p1112]
[formatOpType p??]
[isExposedConstructor p??]
[bright p??]
[sayBrightly p??]
[strconc p??]
[namestring p1106]
[selectOptionLC p498]
[centerAndHighlight p??]
[specialChar p1036]
[remdup p??]
[msort p??]
[formatAttribute p??]
[centerAndHighlight p??]
[getl p??]
[systemErrorHere p??]
[nreverse0 p??]
[getOplistForConstructorForm p??]
[say2PerLine p??]
[formatOperation p??]
[$commentedOps p??]
[$CategoryFrame p??]
[$linelength p817]
[$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 (pairp 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 (getl 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))
```

45.1.10 defun reportOpsFromUnitDirectly1

[pathname p1108]
[erase p**??**]
[defiostream p1038]
[sayShowWarning p876]
[reportOpsFromUnitDirectly p873]
[shut p1039]
[editFile p566]
[$sayBrightlyStream p**??**]
[$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)))
```

45.1.11 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 46

)spool help page Command

46.1 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 47

)summary help page Command

47.1 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
   )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
```

47.1.1 defun summary

[obey p**??**]
[concat p1112]
[getenviron p31]

⟨*defun summary*⟩≡

```
(defun |summary| (l)
 (declare (ignore l))
 (obey (concat "cat " (getenviron "AXIOM") "/doc/spadhelp/summary.help")))
```

Chapter 48

)synonym help page Command

48.1 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]

48.1.1 defun The)synonym command

[synonymSpad2Cmd p883]

⟨*defun synonym*⟩≡

```
(defun |synonym| (&rest ignore)
 (declare (ignore ignore))
 (|synonymSpad2Cmd|))
```

[1] “set” (44.37.1 p 857) “what” (52.1.2 p 997)

48.1.2 defun The)synonym command implementation

[getSystemCommandLine p884]
[printSynonyms p491]
[processSynonymLine p885]
[putalist p**??**]
[terminateSystemCommand p463]
[$CommandSynonymAlist p496]

⟨*defun synonymSpad2Cmd*⟩≡

```
(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|)))
```

48.1.3 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 p498]
[commandsForUserLevel p460]
[$systemCommands p453]
[$UserLevel p856]

⟨*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))
```

48.1.4 defun Get the system command from the input line

[strpos p1111]
[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)))
```

48.1.5 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)))))))))))))))))
```

48.1.6 defun processSynonymLine

[processSynonymLine,removeKeyFromLine p885]

⟨*defun processSynonymLine*⟩≡
```
(defun |processSynonymLine| (line)
 (cons
  (string2id-n line 1)
  (|processSynonymLine,removeKeyFromLine| line)))
```

This command is in the list of `$noParseCommands` 18.1.3 which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` 18.2.1

Chapter 49

)system help page Command

49.1 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` 18.1.3 which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` 18.2.1

[1] "boot" (5.1.8 p 24) "fin" (31.1.1 p 568) "lisp" (**??** p **??**) "pquit" (40.2.1 p 666) "quit" (41.2.1 p 670)

Chapter 50

)trace help page Command

50.1 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]

50.1.1 The trace global variables

This decides when to give trace and untrace messages.

50.1.2 defvar $traceNoisely

⟨*initvars*⟩+≡
```
(defvar |$traceNoisely| nil)
```

50.1.3 defvar $reportSpadTrace

This reports the traced functions
⟨*initvars*⟩+≡
```
(defvar |$reportSpadTrace| nil)
```

50.1.4 defvar $optionAlist

⟨*initvars*⟩+≡
```
(defvar |$optionAlist| nil)
```

50.1.5 defvar $tracedMapSignatures

⟨*initvars*⟩+≡
```
(defvar |$tracedMapSignatures| nil)
```

[1] "boot" (5.1.8 p 24) "lisp" (**??** p **??**) "ltrace" (39.1.1 p 664)

50.1.6 defvar $traceOptionList

⟨*initvars*⟩+≡
```
(defvar |$traceOptionList|
 '(|after| |before| |break| |cond| |count| |depth| |local| |mathprint|
   |nonquietly| |nt| |of| |only| |ops| |restore| |timer| |varbreak|
   |vars| |within|))
```

50.1.7 defun trace

[traceSpad2Cmd p896]

⟨*defun trace*⟩≡
```
(defun |trace| (l)
 (|traceSpad2Cmd| l))
```

50.1.8 defun traceSpad2Cmd

[pairp p??]
[qcar p??]
[qcdr p??]
[getMapSubNames p924]
[trace1 p897]
[augmentTraceNames p927]
[traceReply p960]
[$mapSubNameAlist p??]

⟨*defun traceSpad2Cmd*⟩≡

```
(defun |traceSpad2Cmd| (l)
 (let (tmp1 l1)
 (declare (special |$mapSubNameAlist|))
  (cond
   ((and (pairp l)
         (eq (qcar l) '|Tuple|)
         (progn
          (setq tmp1 (qcdr l))
          (and (pairp tmp1)
               (eq (qcdr tmp1) nil)
               (progn
                (setq l1 (qcar tmp1))
                t))))
     (setq l l1)))
   (setq |$mapSubNameAlist| (|getMapSubNames| l))
   (|trace1| (|augmentTraceNames| l))
   (|traceReply|)))
```

50.1.9 defun trace1

[hasOption p463]
[throwKeyedMsg p??]
[unabbrev p??]
[isFunctor p??]
[getTraceOption p905]
[untraceDomainLocalOps p936]
[qslessp p??]
[poundsign p??]
[untrace p914]
[centerAndHighlight p??]
[ptimers p910]
[say p??]
[pcounters p911]
[selectOptionLC p498]
[resetSpacers p909]
[resetTimers p909]
[resetCounters p909]
[pairp p??]
[qcar p??]
[qcdr p??]
[vecp p??]
[sayKeyedMsg p357]
[devaluate p??]
[lassoc p??]
[trace1 p897]
[delete p??]
[?t p964]
[seq p??]
[exit p??]
[transTraceItem p915]
[addassoc p??]
[getTraceOptions p902]
[/trace,0 p??]
[saveMapSig p903]
[$traceNoisely p894]
[$options p??]
[$lastUntraced p??]
[$optionAlist p894]

⟨*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 (|isFunctor| 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 (pairp x)
               (progn
                (setq domain (qcar x))
                (setq oplist (qcdr x))
                t)
               (vecp domain))
       (|sayKeyedMsg| 's2it0003 (cons (|devaluate| domain) nil))
       (progn
         (setq |$options| (append newoptions (lassoc x |$optionAlist|)))
         (|trace1| (list x))))))))
((null arg) nil)
((and (pairp 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))))))))))))))
```

50.1.10 defun getTraceOptions

[throwKeyedMsg p**??**]
[throwListOfKeyedMsgs p**??**]
[poundsign p**??**]
[seq p**??**]
[exit p**??**]
[getTraceOption p905]
[$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)))))))
```

50.1.11 defun saveMapSig

[rassoc p??]
[addassoc p??]
[getMapSig p903]
[$tracedMapSignatures p894]
[$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|))))))
```

50.1.12 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)))
```

50.1.13 defun getTraceOption,hn

[seq p**??**]
[exit p**??**]
[isDomainOrPackage p930]
[stackTraceOptionError p912]
[domainToGenvar p913]

⟨*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))))))))
```

50.1.14 defun getTraceOption

[seq p??]
[exit p??]
[selectOptionLC p498]
[identp p1111]
[stackTraceOptionError p912]
[concat p1112]
[object2String p??]
[transOnlyOption p911]
[pairp p??]
[qcdr p??]
[qcar p??]
[getTraceOption,hn p904]
[isListOfIdentifiersOrStrings p923]
[isListOfIdentifiers p922]
[throwKeyedMsg p??]
[$traceOptionList p895]

⟨*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| l)))
((eq key '|within|)
  (cond
   ((and (pairp l)
         (eq (qcdr l) nil)
         (progn (setq a (qcar l)) 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 (pairp l)
         (eq (qcdr l) nil)
         (progn (setq a (qcar l)) t))
      (cons key l))
   (t
```

```
     (|stackTraceOptionError|
      (cons 's2it0011
       (cons
        (cons (concat ")"
         (|object2String| key)) nil) nil))))))
((eq key '|depth|)
  (cond
   ((and (pairp l)
         (eq (qcdr l) nil)
         (progn (setq |n| (qcar l)) t)
         (integerp |n|))
     arg)
   (t
    (|stackTraceOptionError|
     (cons 's2it0012 (cons (cons ")depth" nil) nil))))))
((eq key '|count|)
  (cond
   ((or (null l)
        (and (pairp l)
             (eq (qcdr l) nil)
             (progn (setq |n| (qcar l)) 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 l (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 l)
        (and (pairp l) (eq (qcdr l) nil) (eq (qcar l) '|all|)))
     (cons key '|all|))
   ((|isListOfIdentifiersOrStrings| l) arg)
   (t
     (|stackTraceOptionError|
      (cons 's2it0015
       (cons
```

```
          (cons (concat ")" (|object2String| key)) nil) nil))))))
    ((eq key '|varbreak|)
      (cond
       ((or (null l)
            (and (pairp l) (eq (qcdr l) nil) (eq (qcar l) '|all|)))
        (cons '|varbreak| '|all|))
       ((|isListOfIdentifiers| l) arg)
       (t
         (|stackTraceOptionError|
          (cons 's2it0016
           (cons
            (cons (concat ")" (|object2String| key)) nil) nil))))))
    ((eq key '|mathprint|)
      (cond
       ((null l) arg)
       (t
         (|stackTraceOptionError|
          (cons 's2it0009
           (cons
            (cons (concat ")" (|object2String| key)) nil) nil))))))
    (key (|throwKeyedMsg| 's2it0005 (cons key nil)))))))))
```

50.1.15 defun traceOptionError

[stackTraceOptionError p912]
[commandAmbiguityError p464]

⟨*defun traceOptionError*⟩≡

```
(defun |traceOptionError| (opt keys)
 (if (null keys)
  (|stackTraceOptionError| (cons 's2it0007 (cons (cons opt nil) nil)))
  (|commandAmbiguityError| '|trace option| opt keys)))
```

50.1.16 defun resetTimers

[concat p1112]
[/timerlist p??]

⟨*defun resetTimers*⟩≡
```
(defun |resetTimers| ()
 (declare (special /timerlist))
 (dolist (timer /timerlist)
  (set (intern (concat timer ",TIMER")) 0)))
```

50.1.17 defun resetSpacers

[concat p1112]
[/spacelist p??]

⟨*defun resetSpacers*⟩≡
```
(defun |resetSpacers| ()
 (declare (special /spacelist))
 (dolist (spacer /spacelist)
   (set (intern (concat spacer ",SPACE")) 0)))
```

50.1.18 defun resetCounters

[concat p1112]
[/countlist p??]

⟨*defun resetCounters*⟩≡
```
(defun |resetCounters| ()
 (declare (special /countlist))
 (dolist (k /countlist)
  (set (intern (concat k ",COUNT")) 0)))
```

50.1.19 defun ptimers

[sayBrightly p??]
[bright p??]
[quotient p??]
[concat p1112]
[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.")))))
```

50.1.20 defun pspacers

[sayBrightly p??]
[bright p??]
[concat p1112]
[/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")))))
```

50.1.21 defun pcounters

[sayBrightly p??]
[bright p??]
[concat p1112]
[/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")))))
```

50.1.22 defun transOnlyOption

[transOnlyOption p911]
[upcase p??]
[stackTraceOptionError p912]
[pairp p??]
[qcar p??]
[qcdr p??]

⟨*defun transOnlyOption*⟩≡
```
(defun |transOnlyOption| (arg)
 (let (y n)
  (when (and (pairp 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))))))
```

50.1.23 defun stackTraceOptionError

[$traceErrorStack p**??**]

⟨*defun stackTraceOptionError*⟩≡
```
(defun |stackTraceOptionError| (x)
 (declare (special |$traceErrorStack|))
 (push x |$traceErrorStack|)
 nil)
```

50.1.24 defun removeOption

[nequal p**??**]

⟨*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 (nequal opt op) (setq t0 (cons optentry t0))))))
```

50.1.25 defun domainToGenvar

[unabbrevAndLoad p**??**]
[getdatabase p1071]
[opOf p**??**]
[genDomainTraceName p913]
[evalDomain p**??**]
[$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)))
```

50.1.26 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))))
```

50.1.27 defun untrace

[copy p??]
[transTraceItem p915]
[/untrace,0 p??]
[lassocSub p926]
[removeTracedMapSigs p916]
[$lastUntraced p??]
[$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)))
```

50.1.28 defun transTraceItem

[get p??]
[member p1113]
[objMode p??]
[objVal p??]
[domainToGenvar p913]
[unabbrev p??]
[constructor? p??]
[pairp p??]
[vecp p??]
[transTraceItem p915]
[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 (pairp y) (|constructor?| (car y))) (car y))
           ((setq y (|domainToGenvar| x)) y)
           (t x)))
        (t x)))
      ((vecp (car x)) (|transTraceItem| (|devaluate| (car x))))
      ((setq y (|domainToGenvar| x)) y)
      (t (|throwKeyedMsg| 's2it0018 (cons x nil))))))))
```

50.1.29 defun removeTracedMapSigs

[$tracedMapSignatures p894]

⟨*defun removeTracedMapSigs*⟩≡

```
(defun |removeTracedMapSigs| (untraceList)
 (declare (special |$tracedMapSignatures|))
 (dolist (name untraceList)
   (remprop name |$tracedMapSignatures|)))
```

50.1.30 defun coerceTraceArgs2E

[spadsysnamep p??]
[pname p??]
[coerceSpadArgs2E p919]
[objValUnwrap p??]
[coerceInteractive p??]
[objNewWrap p??]
[$OutputForm p??]
[$mathTraceList p??]
[$tracedMapSignatures p894]

⟨*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))))
```

50.1.31 defun coerceSpadArgs2E

[seq p??]
[exit p??]
[objValUnwrap p??]
[coerceInteractive p??]
[objNewWrap p??]
[$streamCount p850]
[$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)))))))
```

50.1.32 defun subTypes

[lassoc p**??**]
[seq p**??**]
[exit p**??**]
[subTypes p920]

⟨*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))))))))))))
```

50.1.33 defun coerceTraceFunValue2E

[spadsysnamep p??]
[pname p??]
[coerceSpadFunValue2E p922]
[lassoc p??]
[objValUnwrap p??]
[coerceInteractive p??]
[objNewWrap p??]
[$tracedMapSignatures p894]
[$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|)))
```

50.1.34 defun coerceSpadFunValue2E

[objValUnwrap p??]
[coerceInteractive p??]
[objNewWrap p??]
[$streamCount p850]
[$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|))))
```

50.1.35 defun isListOfIdentifiers

[seq p??]
[exit p??]
[identp p1111]

⟨*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))))))))))))
```

50.1.36 defun isListOfIdentifiersOrStrings

[seq p??]
[exit p??]
[identp p1111]

⟨*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))))))))))))
```

50.1.37 defun getMapSubNames

[get p??]
[union p??]
[getPreviousMapSubNames p925]
[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| |$InteractiveFrame|))
     (setq subs
      (append
        (do ((t2 lmm (cdr t2)) (t1 nil) (|mm| nil))
            ((or (atom t2)
                 (progn (setq |mm| (CAR t2)) nil)) (nreverse0 t1))
           (setq t1 (cons (cons mapname (cadr |mm|)) t1)))
       subs))))
  (|union| subs
    (|getPreviousMapSubNames| (unionq /tracenames |$lastUntraced|)))))
```

50.1.38 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)) (|mm| nil))
                   ((or (atom t1) (progn (setq |mm| (car t1)) nil)) nil)
                (seq
                 (exit
                  (setq subs
                   (cons (cons mapname (cadr |mm|)) subs)))))))))))))
      (exit subs)))))))
```

50.1.39 defun lassocSub

[lassq p**??**]

⟨*defun lassocSub*⟩≡
```
(defun |lassocSub| (x subs)
 (let (y)
  (if (setq y (lassq x subs))
    y
    x)))
```

50.1.40 defun rassocSub

[rassoc p**??**]

⟨*defun rassocSub*⟩≡
```
(defun |rassocSub| (x subs)
 (let (y)
   (if (setq y (|rassoc| x subs))
    y
    x)))
```

50.1.41 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|))))))
```

50.1.42 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|))))
```

50.1.43 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))
```

50.1.44 defun isSubForRedundantMapName

[rassocSub p926]
[member p1113]
[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)))))))
```

50.1.45 defun untraceMapSubNames

[assocright p**??**]
[/untrace,2 p**??**]
[setdifference p**??**]
[getPreviousMapSubNames p925]
[$mapSubNameAlist p**??**]
[$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)))))))
```

50.1.46 defun funfind,LAM

[pairp p??]
[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 (pairp u)
                 (progn
                  (setq tmp1 (qcar u))
                  (and (pairp tmp1) (equal (qcar tmp1) opname))))
             (setq t0 (cons u t0)))))))))))))
```

50.1.47 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))))
```

50.1.48 defun isDomainOrPackage

[refvecp p??]
[poundsign p??]
[isFunctor p??]
[opOf p??]

⟨*defun isDomainOrPackage*⟩≡
```
(defun |isDomainOrPackage| (dom)
 (and
  (refvecp dom)
  (> (|#| dom) 0)
  (|isFunctor| (|opOf| (elt dom 0)))))
```

50.1.49 defun isTraceGensym

[gensymp p??]

⟨*defun isTraceGensym*⟩≡
```
(defun |isTraceGensym| (x)
 (gensymp x))
```

50.1.50 defun spadTrace,g

⟨*defun spadTrace,g*⟩≡
```
(defun |spadTrace,g| (x)
  (if (stringp x) (intern x) x))
```

50.1.51 defun spadTrace,isTraceable

[seq p??]
[exit p??]
[gensymp p??]
[reportSpadTrace p952]
[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)))))))
```

50.1.52 defun spadTrace

[pairp p??]
[refvecp p??]
[aldorTrace p??]
[isDomainOrPackage p930]
[userError p??]
[seq p??]
[exit p??]
[spadTrace,g p930]
[getOption p951]
[removeOption p912]
[opOf p??]
[assoc p??]
[kdr p??]
[flattenOperationAlist p941]
[getOperationAlistFromLisplib p??]
[spadTrace,isTraceable p931]
[as-insert p??]
[bpiname p??]
[spadTraceAlias p951]
[subTypes p920]
[constructSubst p??]
[bpitrace p??]
[rplac p??]
[printDashedLine p??]
[reportSpadTrace p952]
[setletprintflag p??]
[spadReply p955]
[$tracedModemap p??]
[$fromSpadTrace p??]
[$letAssoc p??]
[$reportSpadTrace p952]
[$traceNoisely p894]
[/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 (pairp 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)
 (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 (|$traceNoisely| (|printDashedLine|)))
  (do ((t12 (|orderBySlotNumber| sigslotnumberalist) (cdr t12))
       (x nil))
      ((or (atom t12)
           (progn (setq x (car t12)) nil))
          nil)
       (seq (exit (|reportSpadTrace| 'tracing x))))))
(cond (|$letAssoc| (setletprintflag t)))
(cond
 (currententry
  (rplac (cdr currententry)
    (append sigslotnumberalist currentalist)))
 (t
  (setq /tracenames
   (cons (cons domain sigslotnumberalist) /tracenames))
   (|spadReply|)))))))
```

50.1.53 defun traceDomainLocalOps

[sayMSG p359]

⟨*defun traceDomainLocalOps*⟩≡
```
(defun |traceDomainLocalOps| ()
  (|sayMSG| '("  The )local option has been withdrawn"))
  (|sayMSG| '("  Use )ltr to trace local functions.")))
```

50.1.54 defun untraceDomainLocalOps

[sayMSG p359]

⟨*defun untraceDomainLocalOps*⟩≡
```
(defun |untraceDomainLocalOps| ()
  (|sayMSG| '("  The )local option has been withdrawn"))
  (|sayMSG| '("  Use )ltr to trace local functions.")))
```

50.1.55 defun traceDomainConstructor

[getOption p951]
[seq p??]
[exit p??]
[spadTrace p932]
[concat p1112]
[embed p??]
[mkq p??]
[loadFunctor p??]
[traceDomainLocalOps p936]
[$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))))))))))
```

50.1.56 defun untraceDomainConstructor,keepTraced?

[seq p??]
[pairp p??]
[qcar p??]
[isDomainOrPackage p930]
[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 (pairp 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)))))
```

50.1.57 defun untraceDomainConstructor

[untraceDomainConstructor,keepTraced? p939]
[unembed p**??**]
[seq p**??**]
[exit p**??**]
[concat p1112]
[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)))))))
```

50.1.58 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|)))))
```

50.1.59 defun mapLetPrint

[getAliasIfTracedMapParameter p949]
[getBpiNameIfTracedMap p950]
[letPrint p943]

⟨*defun mapLetPrint*⟩≡

```
(defun |mapLetPrint| (x val currentFunction)
  (setq x (|getAliasIfTracedMapParameter| x currentFunction))
  (setq currentFunction (|getBpiNameIfTracedMap| currentFunction))
  (|letPrint| x val currentFunction))
```

50.1.60 defun letPrint

[lassoc p??]
[isgenvar p945]
[isSharpVarWithNum p944]
[gensymp p??]
[sayBrightlyNT p??]
[bright p??]
[shortenForPrinting p951]
[hasPair p950]
[pname p??]
[break p969]
[$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|))))
```

50.1.61 defun Identifier beginning with a sharpsign-number?

This tests if x is an identifier beginning with # followed by a number. [isSharpVar p944]
[pname p??]
[qcsize p??]
[digitp p1110]
[dig2fix p??]

⟨*defun isSharpVarWithNum*⟩≡

```
(defun |isSharpVarWithNum| (x)
 (let (p n d ok c)
  (cond
   ((null (|isSharpVar| x)) nil)
   ((> 2 (setq n (qcsize (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)))))
```

50.1.62 defun Identifier beginning with a sharpsign?

This tests if x is an identifier beginning with # [identp p1111]

⟨*defun isSharpVar*⟩≡

```
(defun |isSharpVar| (x)
 (and (identp x) (char= (schar (symbol-name x) 0) #\#)))
```

50.1.63 defun isgenvar

[size p1110]
[digitp p1110]
[identp p1111]

⟨*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))))))
```

50.1.64 defun letPrint2

[letPrint2 p946]
[lassoc p??]
[isgenvar p945]
[isSharpVarWithNum p944]
[gensymp p??]
[mathprint p??]
[print p??]
[hasPair p950]
[pname p??]
[break p969]
[bright p??]
[$BreakMode p691]
[$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))))
```

50.1.65 defun letPrint3

This is the version for use when we have our hands on a function to convert the data into type "Expression" [letPrint2 p946]
[lassoc p**??**]
[isgenvar p945]
[isSharpVarWithNum p944]
[gensymp p**??**]
[mathprint p**??**]
[spadcall p**??**]
[print p**??**]
[hasPair p950]
[pname p**??**]
[break p969]
[bright p**??**]
[$BreakMode p691]
[$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))))
```

50.1.66 defun getAliasIfTracedMapParameter

[isSharpVarWithNum p944]
[get p??]
[exit p??]
[spaddifference p??]
[string2pint-n p??]
[substring p??]
[pname p??]
[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))))))
```

50.1.67 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))))))
```

50.1.68 defun hasPair

[pairp p??]
[qcar p??]
[qcdr p??]
[hasPair p950]

⟨*defun hasPair*⟩≡
```
(defun |hasPair| (key arg)
 (prog (tmp1 a)
  (return
   (cond
    ((atom arg) nil)
    ((and (pairp arg)
          (progn
           (setq tmp1 (qcar arg))
           (and (pairp tmp1)
                (equal (qcar tmp1) key)
                (progn (setq a (qcdr tmp1)) t))))
       a)
    (t (|hasPair| key (cdr arg)))))))
```

50.1.69 defun shortenForPrinting

[isDomainOrPackage p930]
[devaluate p??]

⟨*defun shortenForPrinting*⟩≡
```
(defun |shortenForPrinting| (|val|)
 (if (|isDomainOrPackage| |val|)
  (|devaluate| |val|)
  |val|))
```

50.1.70 defun spadTraceAlias

[internl p??]

⟨*defun spadTraceAlias*⟩≡
```
(defun |spadTraceAlias| (domainid op n)
 (internl domainid (intern "." "boot") op '|,| (princ-to-string n)))
```

50.1.71 defun getOption

[assoc p??]

⟨*defun getOption*⟩≡
```
(defun |getOption| (opt l)
 (let (y)
  (when (setq y (|assoc| opt l))  (cdr y))))
```

50.1.72 defun reportSpadTrace

[pairp p??]
[qcar p??]
[sayBrightly p??]
[$traceNoisely p894]

⟨*defun reportSpadTrace*⟩≡

```
(defun |reportSpadTrace| (|header| t0)
 (prog (op sig n |t| |msg| |namePart| y |tracePart|)
 (declare (special |$traceNoisely|))
  (return
   (progn
    (setq op (car t0))
    (setq sig (cadr t0))
    (setq n (caddr t0))
    (setq |t| (cdddr t0))
    (cond
     ((null |$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 (pairp |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|)))))))))
```

50.1.73 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)))))))))))))
```

50.1.74 defun /tracereply

[pairp p??]
[qcar p??]
[isDomainOrPackage p930]
[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 (pairp 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)))))))))
```

50.1.75 defun spadReply,printName

[seq p??]
[pairp p??]
[qcar p??]
[isDomainOrPackage p930]
[exit p??]
[devaluate p??]

⟨*defun spadReply,printName*⟩≡
```
(defun |spadReply,printName| (x)
 (prog (|d|)
  (return
   (seq
    (if (and (and (pairp x) (progn (setq |d| (qcar x)) t))
             (|isDomainOrPackage| |d|))
      (exit (|devaluate| |d|)))
     (exit x)))))
```

50.1.76 defun spadReply

[seq p??]
[exit p??]
[spadReply,printName p955]
[/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))))))))))
```

50.1.77 defun spadUntrace

[isDomainOrPackage p930]
[userError p??]
[getOption p951]
[devaluate p??]
[assoc p??]
[sayMSG p359]
[bright p??]
[prefix2String p??]
[bpiname p??]
[remover p??]
[setletprintflag p??]
[bpiuntrace p??]
[rplac p??]
[seq p??]
[exit p??]
[delasc p??]
[spadReply p955]
[$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| (cadddr |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 (cdddr |pair|) nil)
        (cond
         ((setq |assocPair|
             (|assoc| (bpiname |bpiPointer|) |$letAssoc|))
           (setq |$letAssoc| (remover |$letAssoc| |assocPair|))
           (cond
            ((null |$letAssoc|) (setletprintflag 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 ((cdddr x) (setq t1 (cons x t1))))))))))
(cond
 (|newSigSlotNumberAlist|
  (rplac (cdr |pair|) |newSigSlotNumberAlist|))
 (t
  (setq /tracenames (delasc domain /tracenames))
```

```
            (|spadReply|))))))))))))
```

50.1.78 defun prTraceNames,fn

[seq p??]
[pairp p??]
[qcar p??]
[qcdr p??]
[isDomainOrPackage p930]
[exit p??]
[devaluate p??]

⟨*defun prTraceNames,fn*⟩≡

```
(defun |prTraceNames,fn| (x)
 (prog (|d| |t|)
  (return
   (seq
    (if (and (and (pairp x)
                  (progn (setq |d| (qcar x)) (setq |t| (qcdr x)) t))
             (|isDomainOrPackage| |d|))
      (exit (cons (|devaluate| |d|) |t|)))
    (exit x)))))
```

50.1.79 defun prTraceNames

[seq p??]
[exit p??]
[prTraceNames,fn p958]
[/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)))
```

50.1.80 defvar $constructors

⟨*initvars*⟩+≡

```
(defvar |$constructors| nil)
```

50.1.81 defun traceReply

[sayMessage p??]
[sayBrightly p??]
[pairp p??]
[qcar p??]
[isDomainOrPackage p930]
[addTraceItem p963]
[isFunctor p??]
[isgenvar p945]
[userError p??]
[seq p??]
[exit p??]
[isSubForRedundantMapName p928]
[rassocSub p926]
[poundsign p??]
[sayMSG p359]
[sayBrightlyLength p??]
[flowSegmentedMsg p??]
[concat p1112]
[prefix2String p??]
[abbreviate p??]
[$domains p??]
[$packages p??]
[$constructors p959]
[$linelength p817]
[/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 (pairp 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
   ((eql 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))))))))
```

50.1.82 defun addTraceItem

[constructor? p??]
[isDomain p??]
[devaluate p??]
[isDomainOrPackage p930]
[$constructors p959]
[$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|)))))
```

50.1.83 defun ?t

[isgenvar p945]
[get p??]
[sayMSG p359]
[bright p??]
[rassocSub p926]
[pairp p??]
[qcar p??]
[qcdr p??]
[isDomainOrPackage p930]
[isDomain p??]
[reportSpadTrace p952]
[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 (pairp 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)))))))))
```

50.1.84 defun tracelet

[gensymp p??]
[stupidIsSpadFunction p969]
[bpiname p??]
[lassoc p??]
[union p??]
[setletprintflag p??]
[isgenvar p945]
[compileBoot p970]
[delete p??]
[$traceletflag p??]
[$QuickLet p??]
[$letAssoc p??]
[$traceletFunctions p??]

⟨*defun tracelet*⟩≡

```
(defun |tracelet| (fn |vars|)
 (prog ($traceletflag |$QuickLet| l)
  (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 (bpiname fn)))
        (t nil))))
    (cond
     ((eq fn '|Undef|) nil)
     (t
       (setq |vars|
         (cond
          ((eq |vars| '|all|) '|all|)
          ((setq l (lassoc fn |$letAssoc|)) (|union| |vars| l))
          (t |vars|)))
       (setq |$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|))))))))))
```

50.1.85 defun breaklet

[gensymp p??]
[stupidIsSpadFunction p969]
[bpiname p??]
[lassoc p??]
[assoc p??]
[union p??]
[setletprintflag p??]
[compileBoot p970]
[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 (bpiname 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|))))))))))
```

50.1.86 defun stupidIsSpadFunction

[strpos p1111]
[pname p**??**]

⟨*defun stupidIsSpadFunction*⟩≡

```
(defun |stupidIsSpadFunction| (fn)
 (strpos ";" (pname fn) 0 nil))
```

50.1.87 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))
    (enable-backtrace nil)
    (when (eval condition)
      (|sayBrightly| msg)
      (interrupt))))))
```

50.1.88 defun compileBoot

[/D,1 p**??**]

⟨*defun compileBoot*⟩≡
```
(defun |compileBoot| (fn)
 (|/D,1| (list fn) '(/comp) nil nil))
```

Chapter 51

)undo help page Command

51.1 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 nummber n. If n is a negative number, it refers to the nth 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 <= 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

51.2 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.

Note: recordFrame('system) is called before a command is executed, and record-Frame('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`.

51.3 Functions

51.3.1 Initial Undo Variables

```
$undoFlag := true     --Default setting for undo is "on"
$frameRecord  := nil  --Initial setting for frame record
$previousBindings := nil
```

51.3.2 defvar $undoFlag

⟨*initvars*⟩+≡

```
(defvar |$undoFlag| t "t means we record undo information")
```

51.3.3 defvar $frameRecord

⟨*initvars*⟩+≡

```
(defvar |$frameRecord| nil "a list of value changes")
```

[1] "history" (34.4.7 p 606)

51.3.4 defvar $previousBindings

⟨*initvars*⟩+≡
```
(defvar |$previousBindings| nil "a copy of Interactive Frame info for undo")
```

51.3.5 defvar $reportUndo

⟨*initvars*⟩+≡
```
(defvar |$reportUndo| nil "t means we report the steps undo takes")
```

51.3.6 defun undo

[stringPrefix? p??]
[pname p??]
[read p674]
[userError p??]
[pairp p??]
[qcdr p??]
[qcar p??]
[spaddifference p??]
[identp p1111]
[undoSteps p986]
[undoCount p985]
[$options p??]
[$InteractiveFrame p??]

⟨*defun undo*⟩≡

```
(defun |undo| (l)
 (let (tmp1 key s undoWhen n)
 (declare (special |$options| |$InteractiveFrame|))
  (setq undoWhen '|after|)
  (when
    (and (pairp |$options|)
         (eq (qcdr |$options|) nil)
         (progn
          (setq tmp1 (qcar |$options|))
          (and (pairp tmp1)
               (eq (qcdr tmp1) nil)
               (progn (setq key (qcar tmp1)) t)))
     (cond
      ((|stringPrefix?| (setq s (pname key)) "redo")
        (setq |$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))
```

51.3.7 defun recordFrame

[kar p??]
[diffAlist p979]
[seq p??]
[exit p??]
[$undoFlag p973]
[$frameRecord p973]
[$InteractiveFrame p??]
[$previousBindings p974]

⟨*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|))))))))
```

51.3.8 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 p1115]
[tmp1 p??]
[seq p??]
[exit p??]
[assoc p??]
[lassq p??]
[reportUndo p983]

⟨*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)
           (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
           (progn
            (setq name (car oldPair))
            (setq r (cdr oldPair))
            oldPair)
           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)))))))
```

51.3.9 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
  value is:  ((|BinaryExpansion|) WRAPPED . #(1 (1 1) NIL (0 0 1)))
```

[seq p??]
[exit p??]
[sayBrightly p??]
[concat p1112]
[pname p??]
[lassoc p??]
[sayBrightlyNT p??]
[pp p??]
[$InteractiveFrame p??]

⟨*defun reportUndo*⟩≡

```
(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)
     (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)
  (seq
   (exit
    (progn
     (|sayBrightlyNT|
      (cons "  " (cons prop (cons " was: " nil))))
     (|pp| value)
     (|sayBrightlyNT|
      (cons "  " (cons prop (cons " is:  " nil))))
     (|pp| (lassoc prop curproplist)))))))))))))))
```

51.3.10 defun clearFrame

[clearCmdAll p522]
[$frameRecord p973]
[$previousBindings p974]

⟨*defun clearFrame*⟩≡

```
(defun |clearFrame| ()
 (declare (special |$frameRecord| |$previousBindings|))
  (|clearCmdAll|)
  (setq |$frameRecord| nil)
  (setq |$previousBindings| nil))
```

51.3.11 Undo previous n commands

[spaddifference p??]
[userError p??]
[concat p1112]
[$IOindex p??]

⟨*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))))))
```

51.3.12 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 p613]
[spaddifference p??]
[recordFrame p977]
[copy p??]
[undoSingleStep p988]
[pairp p??]
[qcdr p??]
[qcar p??]
[$IOindex p??]
[$InteractiveFrame p??]
[$frameRecord p973]

⟨*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 (pairp framelist)
             (progn
              (setq tmp1 (qcdr framelist))
              (and (pairp tmp1)
                   (progn
                    (setq tmp2 (qcar tmp1))
                    (and (pairp 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)))))
```

51.3.13 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 p1115]
[seq p**??**]
[exit p**??**]
[lassoc p**??**]
[undoLocalModemapHack p990]

⟨*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)))))
```

51.3.14 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
                (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)))))))))))))
```

51.3.15 Remove undo lines from history write

Removing undo lines from `)hist )write linelist` [stringPrefix? p**??**]
[seq p**??**]
[exit p**??**]
[trimString p**??**]
[substring p**??**]
[nequal p**??**]
[charPosition p**??**]
[maxindex p**??**]
[undoCount p985]
[spaddifference p**??**]
[concat p1112]
[$currentLine p**??**]
[$IOindex p**??**]

⟨*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
              ((nequal 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)
              ((nequal s2 "")
                (|undoCount| (parse-integer s2)))
              (t (spaddifference 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 (nequal code #\b))
             (setq acc (cons c acc)))))
        (t (setq acc (cons x acc)))))))
(setq |$IOindex| savedIOindex)
acc)))))))
```

Chapter 52

)what help page Command

52.1 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]

52.1.1 defvar $whatOptions

⟨*initvars*⟩+≡
```
(defvar |$whatOptions| '(|operations| |categories| |domains| |packages|
                         |commands| |synonyms| |things|))
```

52.1.2 defun what

[whatSpad2Cmd p998]

⟨*defun what*⟩≡
```
(defun |what| (l)
 (|whatSpad2Cmd| l))
```

52.1.3 defun whatSpad2Cmd,fixpat

[pairp p**??**]
[qcar p**??**]
[downcase p**??**]

⟨*defun whatSpad2Cmd,fixpat*⟩≡
```
(defun |whatSpad2Cmd,fixpat| (x)
 (let (xp)
  (if (and (pairp x) (progn (setq xp (qcar x)) t))
   (downcase xp)
   (downcase x))))
```

[1] "display" (29.2.1 p 553) "set" (44.37.1 p 857) "show" (45.1.1 p 864)

52.1.4 defun whatSpad2Cmd

[reportWhatOptions p999]
[selectOptionLC p498]
[sayKeyedMsg p357]
[seq p**??**]
[exit p**??**]
[whatSpad2Cmd,fixpat p997]
[whatSpad2Cmd p998]
[filterAndFormatConstructors p1002]
[whatCommands p1000]
[apropos p1004]
[printSynonyms p491]
[$e p**??**]
[$whatOptions p997]

⟨*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
```

```
(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))))))))))))))
```

52.1.5 defun Show keywords for)what command

[sayBrightly p**??**]
[$whatOptions p997]

⟨*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."))))
```

52.1.6 defun The)what commands implementation

[stringimage p??]
[centerAndHighlight p??]
[strconc p??]
[specialChar p1036]
[filterListOfStrings p1001]
[commandsForUserLevel p460]
[sayMessage p??]
[blankList p??]
[sayAsManyPerLineAsPossible p??]
[say p??]
[sayKeyedMsg p357]
[$systemCommands p453]
[$linelength p817]
[$UserLevel p856]

⟨*defun whatCommands*⟩≡

```
(defun |whatCommands| (patterns)
 (let (label ell)
 (declare (special |$systemCommands| $linelength |$UserLevel|))
  (setq label
   (strconc '|System Commands for User Level: | (stringimage |$UserLevel|)))
  (|centerAndHighlight| label $linelength (|specialChar| '|hbar|))
  (setq ell
   (|filterListOfStrings| patterns
    (mapcar #'stringimage (|commandsForUserLevel| |$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))))
```

52.1.7 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 p1001]

⟨*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))))))
```

52.1.8 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 p1001]

⟨*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))))))
```

52.1.9 defun satisfiesRegularExpressions

[strpos p1111]

⟨*defun satisfiesRegularExpressions*⟩≡
```
(defun |satisfiesRegularExpressions| (name patterns)
 (let ((dname (downcase (copy name))))
  (dolist (pattern patterns)
   (when (strpos pattern dname 0 "@")
    (return-from nil t)))))
```

52.1.10 defun filterAndFormatConstructors

[sayMessage p??]
[blankList p??]
[pp2Cols p??]
[centerAndHighlight p??]
[specialChar p1036]
[filterListOfStringsWithFn p1001]
[whatConstructors p1003]
[function p??]
[$linelength p817]

⟨*defun filterAndFormatConstructors*⟩≡

```
(defun |filterAndFormatConstructors| (|constrType| label patterns)
 (prog (l)
 (declare (special $linelength))
  (return
   (progn (|centerAndHighlight| label $linelength (|specialChar| '|hbar|))
    (setq l
     (|filterListOfStringsWithFn| patterns
       (|whatConstructors| |constrType|)
       (|function| cdr)))
    (cond (patterns
     (cond
      ((null l)
       (|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 (l (|pp2Cols| l)))))))
```

52.1.11 defun whatConstructors

[boot-equal p??]
[getdatabase p1071]
[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
           ((boot-equal (getdatabase |con| 'constructorkind)
                        |constrType|)
             (setq t0
              (cons
               (cons
                (getdatabase |con| 'abbreviation)
                (string |con|))
               t0)))))))))))))
```

52.1.12 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 p1101]
[filterListOfStrings p1001]
[seq p**??**]
[exit p**??**]
[downcase p**??**]
[sayMessage p**??**]
[sayAsManyPerLineAsPossible p**??**]
[msort p**??**]
[sayKeyedMsg p357]

⟨*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 53

)with help page Command

53.1 with help page man page

⟨*with.help*⟩≡

```
This command is obsolete.
This has been renamed )library.

See also:
o )library
```

[1]

53.1.1 defun with

[library p1075]

⟨*defun with*⟩≡

```
(defun |with| (args)
 (|library| args))
```

[1] "library" (63.1.34 p 1075)

Chapter 54

)workfiles help page Command

54.1 workfiles help page man page

54.1.1 defun workfiles

[workfilesSpad2Cmd p1008]

⟨*defun workfiles*⟩≡
```
(defun |workfiles| (l)
 (|workfilesSpad2Cmd| l))
```

54.1.2 defun workfilesSpad2Cmd

[throwKeyedMsg p??]
[selectOptionLC p498]
[pathname p1108]
[delete p??]
[makeInputFilename p1040]
[sayKeyedMsg p357]
[namestring p1106]
[updateSourceFiles p566]
[say p??]
[centerAndHighlight p??]
[specialChar p1036]
[sortby p??]
[sayBrightly p??]
[$options p??]
[$sourceFiles p??]
[$linelength p817]

⟨*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)) (fl nil))
       ((or (atom t5) (progn (setq fl (car t5)) nil)) nil)
      (|sayBrightly| (list "   " (|namestring| fl))))))))))
```

Chapter 55

)zsystemdevelopment help page Command

55.1 zsystemdevelopment help page man page

55.1.1 defun zsystemdevelopment

[zsystemDevelopmentSpad2Cmd p1011]

⟨*defun zsystemdevelopment*⟩≡
```
(defun |zsystemdevelopment| (arg)
 (|zsystemDevelopmentSpad2Cmd| arg))
```

55.1.2 defun zsystemDevelopmentSpad2Cmd

[zsystemdevelopment1 p1012]
[$InteractiveMode p24]

⟨*defun zsystemDevelopmentSpad2Cmd*⟩≡
```
(defun |zsystemDevelopmentSpad2Cmd| (arg)
 (declare (special |$InteractiveMode|))
 (|zsystemdevelopment1| arg |$InteractiveMode|))
```

55.1.3 defun zsystemdevelopment1

[filenam p??]
[selectOptionLC p498]
[/D,1 p??]
[/comp p??]
[version p??]
[defiostream p1038]
[next p39]
[shut p1039]
[kar p??]
[kadr p??]
[kaddr p??]
[sayMessage p??]
[sayBrightly p??]
[bright p??]
[$InteractiveMode p24]
[$options p??]
[/wsname p??]
[/version p??]

⟨*defun zsystemdevelopment1*⟩≡

```
(defun |zsystemdevelopment1| (arg im)
 (let (|$InteractiveMode| fromopt opt optargs newopt opt1 constream upf fun)
 (declare (special |$InteractiveMode| /wsname /version |$options|))
 (setq |$InteractiveMode| im)
 (setq fromopt nil)
 (do ((t0 |$options| (cdr t0)) (t1 nil))
     ((or (atom t0)
          (progn (setq t1 (car t0)) nil)
          (progn
           (progn
            (setq opt (CAR t1))
            (setq optargs (CDR t1))
            t1)
           nil))
       nil)
   (setq opt1 (|selectOptionLC| opt '(|from|) nil))
   (when (eq opt1 '|from|) (setq fromopt (cons (cons 'from optargs) nil))))
 (do ((t2 |$options| (cdr t2)) (t3 nil))
     ((or (atom t2)
          (progn (setq t3 (car t2)) nil)
          (progn
           (progn
            (setq opt (car t3))
```

```
           (setq optargs (cdr t3))
           t3)
          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 '|e|)       (|/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 56

Handling input files

56.0.4 defun Handle .axiom.input file

[/editfile p534]

⟨*defun readSpadProfileIfThere*⟩≡
```
(defun |readSpadProfileIfThere| ()
 (let ((file (list '|.axiom| '|input|)))
 (declare (special /editfile))
  (when (makeInputFilename file) (setq /editfile file) (/rq))))
```

56.0.5 defun /rq

[/rf-1(9) p**??**]
[echo-meta p1016]

⟨*defun /rq*⟩≡
```
(defun /RQ (&rest foo &aux (echo-meta nil))
  (declare (special Echo-Meta) (ignore foo))
  (/rf-1 nil))
```

56.0.6 defun /rf

Compile with noisy output [/rf-1 p**??**]
[echo-meta p1016]

⟨*defun /rf*⟩≡
```
(defun /rf (&rest foo &aux (echo-meta t))
 (declare (special echo-meta) (ignore foo))
  (/rf-1 nil))
```

56.0.7 defvar $boot-line-stack

⟨*initvars*⟩+≡
```
(defvar boot-line-stack nil "List of lines returned from preparse")
```

56.0.8 defvar $in-stream

⟨*initvars*⟩+≡
```
(defvar in-stream t "Current input stream.")
```

56.0.9 defvar $out-stream

⟨*initvars*⟩+≡
```
(defvar out-stream t "Current output stream.")
```

56.0.10 defvar $file-closed

⟨*initvars*⟩+≡
```
(defvar file-closed nil  "Way to stop EOF tests for console input.")
```

56.0.11 defvar $echo-meta

⟨*initvars*⟩+≡
```
(defvar echo-meta nil "T if you want a listing of what has been read.")
```

56.0.12 defvar $noSubsumption

⟨*initvars*⟩+≡
```
(defvar |$noSubsumption| t)
```

56.0.13 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)
```

56.0.14 defun Dynamically add bindings to the environment

[getProplist p1019]
[addBindingInteractive p1023]
[hput p1109]
[$InteractiveMode p24]
[$envHashTable p1017]

⟨*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 (pairp curContour)
                 (progn
                  (setq tmp1 (qcar curContour))
                  (and (pairp tmp1) (equal (qcar tmp1) var))))
        (setq curContour (cdr curContour)))
      (setq lx (cons var proplist))
      (cons (cons (cons lx curContour) tailContour) tailEnv)))))))
```

56.0.15 defun Fetch a property list for a symbol from CategoryFrame

[getProplist p1019]
[search p1019]
[$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))))
```

56.0.16 defun Search for a binding in the environment list

[searchCurrentEnv p1020]
[searchTailEnv p1021]

⟨*defun search*⟩≡
```
(defun |search| (x e)
 (let ((curEnv (car e)) (tailEnv (cdr e)))
  (or (|searchCurrentEnv| x curEnv) (|searchTailEnv| x tailEnv))))
```

56.0.17 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 p1115]
[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))))))
```

56.0.18 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 p1115]
[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 57

File Parsing

57.0.19 defun Bind a variable in the interactive environment

[assq p1115]

⟨*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))))
```

57.0.20 defvar $line-handler

⟨*initvars*⟩+≡
```
(defparameter line-handler 'next-META-line "Who grabs lines for us.")
```

57.0.21 defvar $spad-errors

⟨*initvars*⟩+≡
```
(defvar $spad_errors (vector 0 0 0))
```

57.0.22 defvar $xtokenreader

⟨*initvars*⟩+≡
```
(defvar xtokenreader 'spadtok)
```

57.0.23 defun Initialize the spad reader

[next-lines-clear p1024]
[ioclear p**??**]
[$spad-errors p1023]
[spaderrorstream p**??**]
[*standard-output* p**??**]
[xtokenreader p1024]
[line-handler p1023]
[meta-error-handler p**??**]
[file-closed p1016]
[boot-line-stack p1016]

⟨*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))
```

57.0.24 defun Set boot-line-stack to nil

[boot-line-stack p1016]

⟨*defun next-lines-clear*⟩≡
```
(defun next-lines-clear ()
 (setq boot-line-stack nil))
```

⟨*initvars*⟩+≡
```
(defvar $index 0 "File line number of most recently read line")
```

⟨*initvars*⟩+≡
```
(defvar $linelist nil "Stack of preparsed lines")
```

⟨*initvars*⟩+≡
```
(defvar echolinestack nil "Stack of lines to list")
```

⟨*initvars*⟩+≡
```
(defvar $preparse-last-line nil "Most recently read line")
```

57.0.25 defun initialize-preparse

[get-a-line p**??**]
[$index p**??**]
[$linelist p**??**]
[$echolinestack p**??**]
[$preparse-last-line p**??**]

⟨*defun initialize-preparse*⟩≡
```
(defun initialize-preparse (strm)
  (setq $index 0)
  (setq $linelist nil)
  (setq $echolinestack nil)
  (setq $preparse-last-line (get-a-line strm)))
```

57.0.26 defun preparse

[preparse p1026]
[preparse1 p1027]
[parseprint p??]
[ifcar p??]
[$comblocklist p??]
[$skipme p??]
[$preparse-last-line p??]
[$index p??]
[$docList p??]
[$preparseReportIfTrue p??]
[$headerDocumentation p??]
[$maxSignatureLineNumber p??]
[$constructorLineNumber p??]

⟨*defun preparse*⟩≡

```
(defun preparse (strm &aux (stack ()))
 (declare (special $comblocklist $skipme $preparse-last-line $index |$docList|
           $preparseReportIfTrue |$headerDocumentation|
           |$maxSignatureLineNumber| |$constructorLineNumber|))
  (setq $comblocklist nil)
  (setq $skipme nil)
  (when $preparse-last-line
   (if (pairp $preparse-last-line)
    (setq stack $preparse-last-line)
    (push $preparse-last-line stack))
   (setq $index (- $index (length stack))))
  (let ((u (preparse1 stack)))
   (if $skipme
    (preparse strm)
    (progn
      (when $preparseReportIfTrue (parseprint u))
      (setq |$headerDocumentation| nil)
      (setq |$docList| nil)
      (setq |$maxSignatureLineNumber| 0)
      (setq |$constructorLineNumber| (ifcar (ifcar u)))
      u))))
```

57.0.27 defun Build the lines from the input for piles

[preparseReadLine p??]
[atEndOfUnit p??]
[preparse-echo p??]
[fincomblock p??]
[parsepiles p??]
[doSystemCommand p456]
[escaped p??]
[instring p??]
[indent-pos p??]
[getfullstr p??]
[droptrailingblanks p??]
[maxindex p??]
[strposl p1111]
[is-console p??]
[spad-reader p??]
[$linelist p??]
[$echolinestack p??]
[$byConstructors p??]
[$skipme p??]
[$constructorsSeen p??]
[$preparse-last-line p??]

⟨*defun preparse1*⟩≡

```
(defun preparse1 (linelist)
 (prog (($linelist linelist) $echolinestack num a i l psloc
        instring pcount comsym strsym oparsym cparsym n ncomsym
        (sloc -1) (continue nil)  (parenlev 0) (ncomblock ())
        (lines ()) (locs ()) (nums ()) functor)
 (declare (special $linelist $echolinestack |$byConstructors| $skipme
           |$constructorsSeen| $preparse-last-line))
READLOOP
  (dcq (num . a) (preparseReadLine linelist))
  (when (atEndOfUnit a)
    (preparse-echo linelist)
    (cond
     ((null lines) (return nil))
     (ncomblock    (fincomblock nil nums locs ncomblock nil)))
    (return
     (pair (nreverse nums) (parsepiles (nreverse locs) (nreverse lines)))))
  ; this is a command line, don't parse it
  (when (and (null lines) (> (length a) 0) (eq (char a 0) #\) ))
    (preparse-echo linelist)
    (setq $preparse-last-line nil) ;don't reread this line
```

```
      (setq line a)
      (catch 'spad_reader (|doSystemCommand| (subseq line 1)))
      (go READLOOP))
    (setq l (length a))
    ; if we get a null line, read the next line
    (when (eq l 0) (go READLOOP))
    ; otherwise we have to parse this line
    (setq psloc sloc)
    (setq i 0)
    (setq instring nil)
    (setq pcount 0)
  STRLOOP ;; handle things that need ignoring, quoting, or grouping
    ; are we in a comment, quoting, or grouping situation?
    (setq strsym (or (position #\" a :start i ) l))
    (setq comsym (or (search "--" a :start2 i ) l))
    (setq ncomsym (or (search "++" a :start2 i ) l))
    (setq oparsym (or (position #\( a :start i ) l))
    (setq cparsym (or (position #\) a :start i ) l))
    (setq n (min strsym comsym ncomsym oparsym cparsym))
    (cond
     ; nope, we found no comment, quoting, or grouping
     ((= n l) (go NOCOMS))
     ((escaped a n))
     ; scan until we hit the end of the string
     ((= n strsym) (setq instring (not instring)))
     (instring)
     ;; handle -- comments by ignoring them
     ((= n comsym)
      (setq a (subseq a 0 n))
      (go NOCOMS)) ; discard trailing comment
     ;; handle ++ comments by chunking them together
     ((= n ncomsym)
      (setq sloc (indent-pos a))
      (cond
       ((= sloc n)
        (when (and ncomblock (not (= n (car ncomblock))))
         (fincomblock num nums locs ncomblock linelist)
         (setq ncomblock nil))
        (setq ncomblock (cons n (cons a (ifcdr ncomblock))))
        (setq a ""))
       (t
        (push (strconc (getfullstr n " ") (substring a n ())) $linelist)
        (setq $index (1- $index))
        (setq a (subseq a 0 n))))
      (go NOCOMS))
     ; know how deep we are into parens
```

```
   ((= n oparsym) (setq pcount (1+ pcount)))
   ((= n cparsym) (setq pcount (1- pcount))))
  (setq i (1+ n))
  (go STRLOOP)
NOCOMS
  ; remember the indentation level
  (setq sloc (indent-pos a))
  (setq a (droptrailingblanks a))
  (when (null sloc)
   (setq sloc psloc)
   (go READLOOP))
  ; handle line that ends in a continuation character
  (cond
   ((eq (elt a (maxindex a)) xcape)
    (setq continue t)
    (setq a (subseq a (maxindex a))))
   ((setq continue nil)))
  ; test for skipping constructors
  (when (and (null lines) (= sloc 0))
    (if (and |$byConstructors|
             (null (search "==>" a))
             (not
              (member
               (setq functor
                (intern (substring a 0 (strposl ": (=" a 0 nil))))
                |$byConstructors|)))
        (setq $skipme 't)
        (progn
         (push functor |$constructorsSeen|)
         (setq $skipme nil))))
  ; is this thing followed by ++ comments?
  (when (and lines (eql sloc 0))
   (when (and ncomblock (not (zerop (car ncomblock))))
    (fincomblock num nums locs ncomblock linelist))
   (when (not (is-console in-stream))
    (setq $preparse-last-line (nreverse $echolinestack)))
   (return
    (pair (nreverse nums) (parsepiles (nreverse locs) (nreverse lines)))))
  (when (> parenlev 0)
   (push nil locs)
   (setq sloc psloc)
   (go REREAD))
  (when ncomblock
   (fincomblock num nums locs ncomblock linelist)
   (setq ncomblock ()))
  (push sloc locs)
```

```
REREAD
  (preparse-echo linelist)
  (push a lines)
  (push num nums)
  (setq parenlev (+ parenlev pcount))
  (when (and (is-console in-stream) (not continue))
   (setq $preparse-last-line nil)
   (return
    (pair (nreverse nums) (parsepiles (nreverse locs) (nreverse lines)))))
  (go READLOOP)))
```

Chapter 58

Handling output

58.1 Special Character Tables

58.1.1 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
```

58.1.2 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
```

58.1.3 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
```

58.1.4 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
```

58.1.5 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
```

58.1.6 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
```

58.1.7 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
```

58.1.8 defvar $specialCharacters

⟨*initvars*⟩+≡

```
(defvar |$specialCharacters| |$RTspecialCharacters|)
```

58.1.9 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)
   (|rbrc| . 10)
   (|ttee| . 11)
   (|btee| . 12)
   (|rtee| . 13)
   (|ltee| . 14)
   (|ctee| . 15)
   (|bslash| . 16)))
```

58.1.10 defun Look up a special character code for a symbol

This function looks up a symbol in `$specialCharacterAlist`, gets the index into the EBCDIC table, and returns the appropriate character. **TPDHERE: Make this more international, not EBCDIC** [ifcdr p**??**]
[assq p1115]
[$specialCharacters p1035]
[$specialCharacterAlist p1036]

⟨*defun specialChar*⟩≡
```
(defun |specialChar| (symbol)
 (let (code)
 (declare (special |$specialCharacters| |$specialCharacterAlist|))
  (if (setq code (ifcdr (assq symbol |$specialCharacterAlist|)))
   (elt |$specialCharacters| code)
   "?")))
```

Chapter 59

Stream and File Handling

59.0.11 defun make-instream

[makeInputFilename p1040]

⟨*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))))
```

59.0.12 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))))
```

59.0.13 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))))
```

59.0.14 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))))
```

59.0.15 defun shut

[is-console p**??**]

⟨*defun shut*⟩≡
```
(defun shut (st)
  (if (is-console st)
   st
   (if (streamp st) (close st) -1)))
```

59.0.16 defun eofp

⟨*defun eofp*⟩≡
```
(defun eofp (stream) (null (peek-char nil stream nil nil)))
```

59.0.17 defun makeStream

[make-appendstream p1038]
[make-outstream p1037]

⟨*defun makeStream*⟩≡
```
(defun |makeStream| (append filename i j)
 (if append
  (make-appendstream filename i j)
  (make-outstream filename i j)))
```

59.0.18 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))))
```

59.0.19 defun getDirectoryList

[$current-directory p7]
[$UserLevel p856]
[$library-directory-list p9]
[$directory-list p8]

⟨*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=)))
```

59.0.20 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)))
```

59.0.21 defun makeFullNamestring

⟨*defun makeFullNamestring*⟩≡
```
(defun makeFullNamestring (filearg &optional (filetype nil))
  (namestring (merge-pathnames (make-filename filearg filetype))))
```

59.0.22 defun Replace a file by erase and rename

[makeFullNamestring p1041]

⟨*defun replaceFile*⟩≡
```
(defun replaceFile (filespec1 filespec2)
 ($erase (setq filespec1 (makeFullNamestring filespec1)))
 (rename-file (makeFullNamestring filespec2) filespec1))
```

Chapter 60

The Spad Server Mechanism

60.0.23 defun openserver

This is a cover function for the C code used for communication interface.

⟨*defun openserver*⟩≡

```
(defun openserver (name)
  (open_server name))
```

Chapter 61

Axiom Build-time Functions

61.0.24 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 cfuns.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**??**]
[$SpadServer p11]
[$openServerIfTrue p10]

⟨*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 62

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" 32.3.1 on page 573.

Chapter 63

Databases

63.1 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, compress.daase, and browse.daase. The compress.daase is special and does not follow the normal database format.

63.1.1 kaf File Format

This documentation refers to kaf files which are random access files. nrlib files are kaf files (look for nrlib/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. The squeeze routine is used to compress the keys, the unsqueeze routine uncompresses them. Making these two routines disappear should remove all of the compression.

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.

63.1.2 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 for 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 Constructor-Modemap. 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.

63.1.3 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
```

63.1.4 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|)))
```

63.1.5 defvar $*operation-hash*

⟨*initvars*⟩+≡

```
(defvar *operation-hash* nil "given an operation name, what are its modemaps?")
```

63.1.6 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")
```

63.1.7 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

63.1.8 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

63.1.9 defvar $*compressvector*

⟨*initvars*⟩+≡
```
(defvar *compressvector* nil "a vector of things to compress in the databases")
```

63.1.10 defvar $*compressVectorLength*

⟨*initvars*⟩+≡
```
(defvar *compressVectorLength* 0 "length of the compress vector")
```

63.1.11 defvar $*compress-stream*

⟨*initvars*⟩+≡
```
(defvar *compress-stream* nil "an stream containing the compress vector")
```

63.1.12 defvar $*compress-stream-stamp*

⟨*initvars*⟩+≡
```
(defvar *compress-stream-stamp* 0 "*compress-stream* (position . time)")
```

63.1.13 defvar $*interp-stream*

⟨*initvars*⟩+≡
```
(defvar *interp-stream* nil "an open stream to the interpreter database")
```

63.1.14 defvar $*interp-stream-stamp*

⟨*initvars*⟩+≡
```
(defvar *interp-stream-stamp* 0 "*interp-stream* (position . time)")
```

63.1.15 defvar $*operation-stream*

This is indexed by operation, not constructor

⟨*initvars*⟩+≡
```
(defvar *operation-stream* nil "the stream to operation.daase")
```

63.1.16 defvar $*operation-stream-stamp*

⟨*initvars*⟩+≡
```
(defvar *operation-stream-stamp* 0 "*operation-stream* (position . time)")
```

63.1.17 defvar $*browse-stream*

⟨*initvars*⟩+≡
```
(defvar *browse-stream* nil "an open stream to the browser database")
```

63.1.18 defvar $*browse-stream-stamp*

⟨*initvars*⟩+≡
```
(defvar *browse-stream-stamp* 0 "*browse-stream* (position . time)")
```

63.1.19 defvar $*category-stream*

This is indexed by (domain . category)

⟨*initvars*⟩+≡
```
(defvar *category-stream* nil "an open stream to the category table")
```

63.1.20 defvar $*category-stream-stamp*

⟨*initvars*⟩+≡
```
(defvar *category-stream-stamp* 0 "*category-stream* (position . time)")
```

63.1.21 defvar $*allconstructors*

⟨*initvars*⟩+≡
```
(defvar *allconstructors* nil "a list of all the constructors in the system")
```

63.1.22 defvar $*allOperations*

⟨*initvars*⟩+≡
```
(defvar *allOperations* nil "a list of all the operations in the system")
```

63.1.23 defun Reset all hash tables before saving system

[compressopen p??]
[interpopen p??]
[operationopen p??]
[browseopen p??]
[categoryopen p??]
[initial-getdatabase p1059]
[*sourcefiles* p??]
[*interp-stream* p1055]
[*operation-stream* p1055]
[*category-stream* p1056]
[*browse-stream* p1055]
[*category-stream-stamp* p1056]
[*operation-stream-stamp* p1055]
[*interp-stream-stamp* p1055]
[*compress-stream-stamp* p1055]
[*compressvector* p1054]
[*allconstructors* p1056]
[*operation-hash* p1053]
[*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*
                   *compress-stream-stamp* *compressvector*
                   *allconstructors* *operation-hash* *hascategory-hash*))
 (setq *hascategory-hash* (make-hash-table :test #'equal))
 (setq *operation-hash* (make-hash-table))
 (setq *allconstructors* nil)
 (setq *compressvector* nil)
 (setq *sourcefiles* nil)
 (setq *compress-stream-stamp* '(0 . 0))
 (compressopen)
 (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))
```

63.1.24 defun Preload algebra into saved system

[getdatabase p1071]
[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 "~%")))
```

63.1.25 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
)
```

[unsqueeze p1090]
[make-database p**??**]
[DaaseName p1085]
[$spadroot p11]
[*allconstructors* p1056]
[*interp-stream* p1055]
[*interp-stream-stamp* p1055]

⟨*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 item (unsqueeze item))
    (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.

63.1.26 defun Open the browse database

Format of an entry in browse.daase:

```
( constructorname
    sourcefile
    constructorform
    documentation
    attributes
    predicates
)
```

[unsqueeze p1090]
[$spadroot p11]
[*allconstructors* p1056]
[*browse-stream* p1055]
[*browse-stream-stamp* p1056]

⟨*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)
  (setq item (unsqueeze item))
  (unless (setq dbstruct (get (car item) 'database))
   (format t "browseOpen:~%")
   (format t "the browse database contains a contructor ~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 "~&")))
```

63.1.27 defun Open the category database

[unsqueeze p1090]
[$spadroot p11]
[*hasCategory-hash* p1053]
[*category-stream* p1056]
[*category-stream-stamp* p1056]

⟨*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)
    (setq item (unsqueeze item))
    (setf (gethash (first item) *hasCategory-hash*) (second item))))
  (format t "~&")))
```

63.1.28 defun Open the operations database

[unsqueeze p1090]
[$spadroot p11]
[*operation-hash* p1053]
[*operation-stream* p1055]
[*operation-stream-stamp* p1055]

⟨*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)
    (setq item (unsqueeze item))
    (setf (gethash (car item) *operation-hash*) (cdr item))))
  (format t "~&")))
```

63.1.29 defun Add operations from newly compiled code

[getdatabase p1071]
[*operation-hash* p1053]

⟨*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)))))
```

63.1.30 defun Show all database attributes of a constructor

[getdatabase p1071]

⟨*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)))
```

63.1.31 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))))))
```

63.1.32 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)))))
```

63.1.33 defun Get constructor information for a database key

[warn p??]
[unsqueeze p1090]
[$spadroot p11]
[*miss* p1054]
[*hascategory-hash* p??]
[*operation-hash* p1053]
[*browse-stream* p1055]
[*defaultdomain-list* p1053]
[*interp-stream* p1055]
[*category-stream* p1056]
[*hasCategory-hash* p1053]
[*operation-stream* p1055]

⟨*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) (pairp 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-constructorcategory 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 (unsqueeze (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))
```

63.1.34 defun The)library top level command

[localdatabase p1076]
[extendLocalLibdb p??]
[tersyscommand p463]
[$newConlist p??]
[$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)))
```

63.1.35 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 p357]
[localnrlib p1078]
[localasy p??]
[asharp p??]
[astran p??]
[localasy p??]
[hclear p??]
[$forceDatabaseUpdate p??]
[$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*
                     |$ConstructorCache|))
   (setq thisdir (namestring (truename ".")))
   (setq noexpose nil)
   (multiple-value-setq (only dir noexpose) (processOptions options))
      ;don't force exposure during database build
   (if make-database? (setq noexpose t))
   (when dir (setq nrlibs (processDir dir thisdir)))
   (dolist (file filelist)
    (let ((filename (pathname-name file))
          (namedir (directory-namestring file)))
     (unless namedir (setq thisdir (concatenate 'string thisdir "/")))
     (cond
      ((setq file (probe-file
        (concatenate 'string namedir filename ".nrlib/"
                     vmlisp::*index-filename*)))
       (push (namestring file) nrlibs))
      ('else (format t "   )library cannot find the file ~a.~%" filename)))))
   (dolist (file (nreverse nrlibs))
    (setq key (pathname-name (first (last (pathname-directory file)))))
    (setq object (concatenate 'string (directory-namestring file) "code"))
    (localnrlib key file object make-database? noexpose))
   (hclear |$ConstructorCache|))))
```

63.1.36 defun Update the database from an nrlib index.kaf file

[getdatabase p1071]
[make-database p??]
[addoperations p1068]
[sublislis p??]
[updateDatabase p??]
[installConstructor p??]
[updateCategoryTable p??]
[categoryForm? p??]
[setExposeAddConstr p734]
[startTimingProcess p??]
[loadLibNoUpdate p??]
[sayKeyedMsg p357]
[$FormalMapVariableList p??]
[*allOperations* p1056]
[*allconstructors* p1056]

⟨*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-constructorcategory 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 |$FormalMapVariableList|
    (cdr constructorform) (fetchdata alist in "ancestors"))))
 (|updateDatabase| key key systemdir?) ;makes many hashtables???
 (|installConstructor| key kind) ;used to be key cname ...
 (|updateCategoryTable| key kind)
 (if |$InteractiveMode| (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))))))
```

63.1.37 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-¿value is:

- abbreviation -¿ pamphlet file name
- abbreviation-line -¿ pamphlet file position
- constructor -¿ pamphlet file name
- constructor-line -¿ 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. [localdatabase p1076]
[getEnv p**??**]
[oldCompilerAutoloadOnceTrigger p**??**]
[browserAutoloadOnceTrigger p**??**]
[mkTopicHashTable p**??**]
[buildLibdb p**??**]
[dbSplitLibdb p**??**]
[mkUsersHashTable p**??**]
[saveUsersHashTable p**??**]
[mkDependentsHashTable p**??**]

[saveDependentsHashTable p**??**]
[write-compress p1088]
[write-browsedb p1097]
[write-operationdb p1100]
[write-categorydb p1099]
[allConstructors p1101]
[categoryForm? p**??**]
[domainsOf p**??**]
[getConstructorForm p**??**]
[write-interpdb p1095]
[write-warmdata p1100]
[$constructorList p**??**]
[*sourcefiles* p**??**]
[*compressvector* p1054]
[*allconstructors* p1056]
[*operation-hash* p1053]

⟨*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* *compressvector*
                    *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)
  (setq *compressvector* 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
  (|oldCompilerAutoloadOnceTrigger|)
  (|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-compress)
  (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 "compress"))
        (delete-file (final-name "compress")))
  (rename-file "compress.build" (final-name "compress"))
  (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")))))
```

63.1.38 defun Construct the proper database full pathname

[getEnv p**??**]
[$spadroot p11]

⟨*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))
```

63.1.39 compress.daase

The compress database is special. It contains a list of symbols. The character string name of a symbol in the other databases is represented by a negative number. To get the real symbol back you take the absolute value of the number and use it as a byte index into the compress database. In this way long symbol names become short negative numbers.

63.1.40 defun Set up compression vectors for the databases

[DaaseName p1085]
[$spadroot p11]
[*compressvector* p1054]
[*compressVectorLength* p1054]
[*compress-stream* p1054]
[*compress-stream-stamp* p1055]

⟨*defun compressOpen*⟩≡

```
(defun compressOpen ()
 (let (lst stamp pos)
  (declare (special $spadroot *compressvector* *compressVectorLength*
                    *compress-stream* *compress-stream-stamp*))
  (setq *compress-stream*
    (open (DaaseName "compress.daase"  nil) :direction :input))
  (setq stamp (read *compress-stream*))
  (unless (equal stamp *compress-stream-stamp*)
   (format t "   Re-reading compress.daase")
   (setq *compress-stream-stamp* stamp)
   (setq pos (car stamp))
   (file-position *compress-stream* pos)
   (setq lst (read *compress-stream*))
   (setq *compressVectorLength* (car lst))
   (setq *compressvector*
     (make-array (car lst) :initial-contents (cdr lst))))))
```

63.1.41 defvar $*attributes*

⟨*initvars*⟩+≡

```
(defvar *attributes*
      '(|nil| |infinite| |arbitraryExponent| |approximate| |complex|
        |shallowMutable| |canonical| |noetherian| |central|
        |partiallyOrderedSet| |arbitraryPrecision| |canonicalsClosed|
        |noZeroDivisors| |rightUnitary| |leftUnitary|
        |additiveValuation| |unitsKnown| |canonicalUnitNormal|
        |multiplicativeValuation| |finiteAggregate| |shallowlyMutable|
        |commutative|) "The list of known algebra attributes")
```

63.1.42 defun Write out the compress database

[allConstructors p1101]
[allOperations p1101]
[*compress-stream* p1054]
[*attributes* p1087]
[*compressVectorLength* p1054]

⟨*defun write-compress*⟩≡

```
(defun write-compress ()
 (let (compresslist masterpos out)
  (declare (special *compress-stream* *attributes* *compressVectorLength*))
  (close *compress-stream*)
  (setq out (open "compress.build" :direction :output))
  (princ "                                " out)
  (finish-output out)
  (setq masterpos (file-position out))
  (setq compresslist
        (append (|allConstructors|) (|allOperations|) *attributes*))
  (push "algebra" compresslist)
  (push "failed" compresslist)
  (push 'signature compresslist)
  (push '|ofType| compresslist)
  (push '|Join| compresslist)
  (push 'and compresslist)
  (push '|nobranch| compresslist)
  (push 'category compresslist)
  (push '|category| compresslist)
  (push '|domain| compresslist)
  (push '|package| compresslist)
  (push 'attribute compresslist)
  (push '|isDomain| compresslist)
  (push '|ofCategory| compresslist)
  (push '|Union| compresslist)
  (push '|Record| compresslist)
  (push '|Mapping| compresslist)
  (push '|Enumeration| compresslist)
  (setq *compressVectorLength* (length compresslist))
  (setq *compressvector*
    (make-array *compressVectorLength* :initial-contents compresslist))
  (print (cons (length compresslist) compresslist) out)
  (finish-output out)
  (file-position out 0)
  (print (cons masterpos (get-universal-time)) out)
  (finish-output out)
```

```
(close out)))
```

63.1.43 defun Compress an expression using the compress vector

This function is used to minimize the size of the databases by replacing symbols with indexes into the compression vector. [*compressvector* p1054]

⟨*defun squeeze*⟩≡

```
(defun squeeze (expr)
 (declare (special *compressvector*))
 (let (leaves pos (bound (length *compressvector*)))
  (labels (
   (flat (expr)
    (when (and (numberp expr) (< expr 0) (>= expr bound))
     (print expr)
     (break "squeeze found a negative number"))
    (if (atom expr)
     (unless (or (null expr)
                 (and (symbolp expr) (char= (schar (symbol-name expr) 0) #\*)))
      (setq leaves (adjoin expr leaves)))
     (progn
      (flat (car expr))
      (flat (cdr expr))))))
  (setq leaves nil)
  (flat expr)
  (dolist (leaf leaves)
   (when (setq pos (position leaf *compressvector*))
     (nsubst (- pos) leaf expr)))
  expr)))
```

63.1.44 defun Uncompress an expression using the compress vector

This function is used to recover symbols from the databases by using integers as indexes into the compression vector. [*compressvector* p1054]

⟨*defun unsqueeze*⟩≡

```
(defun unsqueeze (expr)
 (declare (special *compressvector*))
  (cond ((atom expr)
         (cond ((and (numberp expr) (<= expr 0))
                (svref *compressVector* (- expr)))
               (t expr)))
        (t (rplaca expr (unsqueeze (car expr)))
           (rplacd expr (unsqueeze (cdr expr)))
           expr)))
```

63.1.45 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", compress it, and write it out

    (print (squeeze (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", compress it, and write it out

    (print (squeeze (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", compress it, and write it out

    (print (squeeze (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 and compress it

    (setq concategory (squeeze (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
;     constructorcatagory 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,
;     compress it, and write it out. If it does not we place
;     and immediate value of nil in the key-value table

    (setq ancestors (squeeze (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 compress and print the key-value table

  (print (mapcar #'squeeze 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)))
```

63.1.46 defun Write the interp database

[squeeze p1089]
[$spadroot p11]
[*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 (squeeze (database-operationalist struct)) out)
      (finish-output out)
      (setq cmodemappos (file-position out))
      (print (squeeze (database-constructormodemap struct)) out)
      (finish-output out)
      (setq modemapspos (file-position out))
      (print (squeeze (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 (squeeze (database-constructorcategory 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
     (squeeze (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 (mapcar #'squeeze master) out)
  (finish-output out)
  (file-position out 0)
  (print (cons masterpos (get-universal-time)) out)
  (finish-output out)
  (close out)))
```

63.1.47 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.

63.1.48 defun Write the browse database

[allConstructors p1101]
[squeeze p1089]
[$spadroot p11]
[*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 (squeeze (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 (squeeze (database-attributes struct)) out)
    (finish-output out)
    (setq predpos (file-position out))
    (print (squeeze (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 (mapcar #'squeeze master) out)
  (finish-output out)
  (file-position out 0)
  (print (cons masterpos (get-universal-time)) out)
  (finish-output out)
  (close out)))
```

63.1.49 Building the category.daase from hash tables

This is a single table of category hash table information, dumped in the database format.

63.1.50 defun Write the category database

[genCategoryTable p??]
[squeeze p1089]
[*print-pretty* p??]
[*hasCategory-hash* p1053]

⟨*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 (squeeze value) out)
      (finish-output out)))
     (push (list key pos) master))
     *hasCategory-hash*)
  (setq pos (file-position out))
  (print (mapcar #'squeeze master) out)
  (finish-output out)
  (file-position out 0)
  (print (cons pos (get-universal-time)) out)
  (finish-output out)
  (close out)))
```

63.1.51 Building the operation.daase from hash tables

This is a single table of operations hash table information, dumped in the database format.

63.1.52 defun Write the operations database

[squeeze p1089]
[*operation-hash* p1053]

⟨*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 (squeeze value) out)
   (finish-output out)
   (push (cons key pos) master))
   *operation-hash*)
  (finish-output out)
  (setq pos (file-position out))
  (print (mapcar #'squeeze master) out)
  (file-position out 0)
  (print (cons pos (get-universal-time)) out)
  (finish-output out)
  (close out)))
```

63.1.53 Database support operations

63.1.54 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|)))
```

63.1.55 defun Return all constructors

[*allconstructors* p1056]

⟨*defun allConstructors*⟩≡
```
(defun |allConstructors| ()
 (declare (special *allconstructors*))
 *allconstructors*)
```

63.1.56 defun Return all operations

[*allOperations* p1056]
[*operation-hash* p1053]

⟨*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 64

System Statistics

[gbc-time p**??**]

⟨*defun statisticsInitialization*⟩≡

```
(defun |statisticsInitialization| ()
 "initialize the garbage collection timer"
 #+:akcl (system:gbc-time 0)
 nil)
```

Chapter 65

Special Lisp Functions

65.1 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.

65.1.1 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))
```

65.1.2 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))
```

65.2 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.

65.2.1 defun namestring

[pathname p1108]

⟨*defun namestring*⟩≡
```
(defun |namestring| (arg)
 (namestring (|pathname| arg)))
```

65.2.2 defun pathnameName

[pathname p1108]

⟨*defun pathnameName*⟩≡
```
(defun |pathnameName| (arg)
 (pathname-name (|pathname| arg)))
```

65.2.3 defun pathnameType

[pathname p1108]

⟨*defun pathnameType*⟩≡
```
(defun |pathnameType| (arg)
 (pathname-type (|pathname| arg)))
```

65.2.4 defun pathnameTypeId

[upcase p**??**]
[object2Identifier p**??**]
[pathnameType p1106]

⟨*defun pathnameTypeId*⟩≡
```
(defun |pathnameTypeId| (arg)
 (upcase (|object2Identifier| (|pathnameType| arg))))
```

65.2.5 defun mergePathnames

[pathnameName p1106]
[nequal p**??**]
[pathnameType p1106]
[pathnameDirectory p1107]

⟨*defun mergePathnames*⟩≡
```
(defun |mergePathnames| (a b)
 (let (fn ft fm)
  (cond
   ((string= (setq fn (|pathnameName| a)) "*") b)
   ((nequal fn (|pathnameName| b)) a)
   ((string= (setq ft (|pathnameType| a)) "*") b)
   ((nequal ft (|pathnameType| b)) a)
   ((equal (setq fm (|pathnameDirectory| a)) (list "*" )) b)
   (t a))))
```

65.2.6 defun pathnameDirectory

[pathname p1108]

⟨*defun pathnameDirectory*⟩≡
```
(defun |pathnameDirectory| (arg)
 (namestring (make-pathname :directory (pathname-directory (|pathname| arg)))))
```

65.2.7 defun Axiom pathnames

[pairp p??]
[pathname p1108]
[make-filename p??]

⟨*defun pathname*⟩≡
```
(defun |pathname| (p)
 (cond
  ((null p) p)
  ((pathnamep p) p)
  ((null (pairp p)) (pathname p))
  (t
   (when (> (|#| p) 2) (setq p (cons (elt p 0) (cons (elt p 1) nil))))
   (pathname (apply #'make-filename p)))))
```

65.2.8 defun makePathname

[pathname p1108]
[object2String p??]

⟨*defun makePathname*⟩≡
```
(defun |makePathname| (name type dir)
 (declare (ignore dir))
 (|pathname| (list (|object2String| name) (|object2String| type))))
```

65.2.9 defun Delete a file

[erase p??]
[pathname p1108]
[$erase p??]

⟨*defun deleteFile*⟩≡
```
(defun |deleteFile| (arg)
 (declare (special $erase))
 ($erase (|pathname| arg)))
```

65.2.10 defun wrap

[pairp p??]
[lotsof p1109]
[wrap p1109]

⟨*defun wrap*⟩≡
```
(defun wrap (list-of-items wrapper)
 (prog nil
  (cond
   ((or (not (pairp 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))))))
```

65.2.11 defun lotsof

⟨*defun lotsof*⟩≡
```
(defun lotsof (&rest items)
  (setq items (copy-list items))
  (nconc items items))
```

65.2.12 defmacro startsId?

⟨*defmacro startsId?*⟩≡
```
(defmacro |startsId?| (x)
 `(or (alpha-char-p ,x) (member ,x '(#\? #\% #\!) :test #'char=)))
```

65.2.13 defun hput

⟨*defun hput*⟩≡
```
(defun hput (table key value)
 (setf (gethash key table) value))
```

65.2.14 defmacro hget

⟨*defmacro hget*⟩≡
```
(defmacro HGET (table key &rest default)
   `(gethash ,key ,table ,@default))
```

65.2.15 defun hkeys

⟨*defun hkeys*⟩≡
```
(defun hkeys (table)
 (let (keys)
  (maphash
   #'(lambda (key val) (declare (ignore val)) (push key keys)) table)
   keys))
```

65.2.16 defun digitp

[digitp p1110]

⟨*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)))))
```

65.2.17 defun size

⟨*defun size*⟩≡
```
(defun size (l)
 (cond
  ((vectorp l) (length l))
  ((consp l)   (list-length l))
  (t 0)))
```

65.2.18 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))))
```

65.2.19 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)))
```

65.2.20 defun qenum

⟨*defun qenum 0*⟩≡
```
(defun qenum (cvec ind)
 (char-code (char cvec ind)))
```

65.2.21 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))))))
```

65.2.22 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))))
```

65.2.23 defun functionp

[identp p1111]

⟨*defun functionp*⟩≡
```
(defun |functionp| (fn)
 (if (identp fn)
  (and (fboundp fn) (not (macro-function fn)))
  (functionp fn)))
```

;; ————————¿ NEW DEFINITION (override in msgdb.boot.pamphlet)

65.2.24 defun brightprint

[messageprint p1113]

⟨*defun brightprint*⟩≡
```
(defun brightprint (x)
 (messageprint x))
```

;; ————————¿ NEW DEFINITION (override in msgdb.boot.pamphlet)

65.2.25 defun brightprint-0

[messageprint-1 p1114]

⟨*defun brightprint-0*⟩≡
```
(defun brightprint-0 (x)
 (messageprint-1 x))
```

65.2.26 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))))
```

65.2.27 defun messageprint

⟨*defun messageprint*⟩≡
```
(defun messageprint (x)
 (mapc #'messageprint-1 x))
```

65.2.28 defun messageprint-1

[identp p1111]
[messageprint-1 p1114]
[messageprint-2 p1114]

⟨*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 ")"))))
```

65.2.29 defun messageprint-2

[messageprint-1 p1114]
[messageprint-2 p1114]

⟨*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)))))
```

65.2.30 defun sayBrightly1

[brightprint-0 p1113]
[brightprint p1112]

⟨*defun sayBrightly1*⟩≡
```
(defun sayBrightly1 (x *standard-output*)
  (if (atom x)
   (progn (brightprint-0 x) (terpri) (force-output))
   (progn (brightprint   x) (terpri) (force-output))))
```

65.2.31 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))
```

Chapter 66

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 Comon 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.

66.1 IndexedBits

66.1.1 defmacro truth-to-bit

IndexedBits new function support

⟨*defmacro truth-to-bit*⟩≡

```
(defmacro truth-to-bit (x) `(cond (,x 1) ('else 0)))
```

66.1.2 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))
```

66.1.3 defmacro bit-to-truth

IndexedBits elt function support

⟨*defmacro bit-to-truth 0*⟩≡
```
(defmacro bit-to-truth (b) `(eq ,b 1))
```

66.1.4 defmacro bvec-elt

IndexedBits elt function support

⟨*defmacro bvec-elt 0*⟩≡
```
(defmacro bvec-elt (bv i) `(sbit ,bv ,i))
```

66.1.5 defmacro bvec-setelt

IndexedBits setelt function support

⟨*defmacro bvec-setelt*⟩≡
```
(defmacro bvec-setelt (bv i x) `(setf (sbit ,bv ,i) ,x))
```

66.1.6 defmacro bvec-size

IndexedBits length function support

⟨*defmacro bvec-size*⟩≡
```
(defmacro bvec-size (bv) `(size ,bv))
```

66.1.7 defun IndexedBits concat function support

⟨*defun bvec-concat 0*⟩≡
```
(defun bvec-concat (bv1 bv2) (concatenate '(vector bit) bv1 bv2))
```

66.1.8 defun IndexedBits copy function support

⟨*defun bvec-copy 0*⟩≡
```
(defun bvec-copy (bv) (copy-seq bv))
```

66.1.9 defun IndexedBits = function support

⟨*defun bvec-equal 0*⟩≡
```
(defun bvec-equal (bv1 bv2) (equal bv1 bv2))
```

66.1.10 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))))
```

66.1.11 defun IndexedBits And function support

⟨*defun bvec-and 0*⟩≡
```
(defun bvec-and (bv1 bv2) (bit-and  bv1 bv2))
```

66.1.12 defun IndexedBits Or function support

⟨*defun bvec-or 0*⟩≡
```
(defun bvec-or (bv1 bv2) (bit-ior  bv1 bv2))
```

66.1.13 defun IndexedBits xor function support

⟨*defun bvec-xor 0*⟩≡
```
(defun bvec-xor (bv1 bv2) (bit-xor  bv1 bv2))
```

66.1.14 defun IndexedBits nand function support

⟨*defun bvec-nand 0*⟩≡
```
(defun bvec-nand (bv1 bv2) (bit-nand bv1 bv2))
```

66.1.15 defun IndexedBits nor function support

⟨*defun bvec-nor 0*⟩≡
```
(defun bvec-nor (bv1 bv2) (bit-nor  bv1 bv2))
```

66.1.16 defun IndexedBits not function support

⟨*defun bvec-not 0*⟩≡
```
(defun bvec-not (bv) (bit-not  bv))
```

66.2 KeyedAccessFile

66.2.1 defun KeyedAccessFile defstream function support

This is a simpler interpface 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))))
```

66.2.2 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))))
```

66.3 Table

66.3.1 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 p??]
[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))))
```

66.4 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.

66.4.1 defmacro dlen

DoubleFloatVector Qsize function support
⟨*defmacro dlen*⟩≡
```
(defmacro dlen (v)
 `(length (the (simple-array double-float (*)) ,v)))
```

66.4.2 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))
```

66.4.3 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))
```

66.4.4 defmacro delt

DoubleFloatVector Qelt1 function support

⟨*defmacro delt*⟩≡
```
(defmacro delt (v i)
 `(aref (the (simple-array double-float (*)) ,v) ,i))
```

66.4.5 defmacro dsetelt

DoubleFloatVector Qsetelt1 function support

⟨*defmacro dsetelt*⟩≡
```
(defmacro dsetelt (v i s)
 `(setf (aref (the (simple-array double-float (*)) ,v) ,i) ,s))
```

66.5 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.

66.5.1 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))
```

66.5.2 defmacro cdelt

ComplexDoubleFloatVector Qelt1 function support

⟨*defmacro cdelt*⟩≡

```
(defmacro CDELT(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))))))
```

66.5.3 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)))
```

66.5.4 defmacro cdlen

ComplexDoubleFloatVector Qsize function support

⟨*defmacro cdlen*⟩≡
```
(defmacro cdlen(v)
    `(truncate (length (the (simple-array double-float (*)) ,v)) 2))
```

66.6 DoubleFloatMatrix

66.6.1 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))
```

66.6.2 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))
```

66.6.3 defmacro daref2

DoubleFloatMatrix qelt function support

⟨*defmacro daref2*⟩≡
```
(defmacro daref2 (v i j)
   `(aref (the (simple-array double-float (* *)) ,v) ,i ,j))
```

66.6.4 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))
```

66.6.5 defmacro danrows

DoubleFloatMatrix nrows function support

⟨*defmacro danrows*⟩≡
```
(defmacro danrows (v)
    `(array-dimension (the (simple-array double-float (* *)) ,v) 0))
```

66.6.6 defmacro dancols

DoubleFloatMatrix ncols function support

⟨*defmacro dancols*⟩≡
```
(defmacro dancols (v)
    `(array-dimension (the (simple-array double-float (* *)) ,v) 1))
```

66.7 ComplexDoubleFloatMatrix

66.7.1 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))
```

66.7.2 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))))))
```

66.7.3 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)))
```

66.7.4 defmacro cdanrows

ComplexDoubleFloatMatrix function support

⟨*defmacro cdanrows*⟩≡
```
(defmacro cdanrows (v)
    `(array-dimension (the (simple-array double-float (* *)) ,v) 0))
```

66.7.5 defmacro cdancols

ComplexDoubleFloatMatrix function support

⟨*defmacro cdancols*⟩≡
```
(defmacro cdancols (v)
    `(truncate
         (array-dimension (the (simple-array double-float (* *)) ,v) 1) 2))
```

66.8 Integer

66.8.1 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)))
```

66.8.2 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)
```

66.8.3 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)))
```

66.9 IndexCard

66.9.1 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))))
```

66.9.2 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)))
```

66.9.3 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))))
```

66.10 OperationsQuery

66.10.1 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 p1113]
[grepConstruct p**??**]
[$includeUnexposed? p**??**]

⟨*defun getBrowseDatabase*⟩≡
```
(defun |getBrowseDatabase| (kind)
 (let (|$includeUnexposed?|)
 (declare (special |$includeUnexposed?|))
  (setq |$includeUnexposed?| t)
  (when (|member| kind '("o" "k" "c" "d" "p"))
   (|grepConstruct| "*" (intern kind)))))
```

66.11 Database

66.11.1 defun Database elt function support

[basicMatch? p**??**]

⟨*defun stringMatches?*⟩≡
```
(defun |stringMatches?| (pattern subject)
 (when (integerp (|basicMatch?| pattern subject)) t))
```

66.12 FileName

66.12.1 defun FileName filename function implementation

[StringToDir p1131]

⟨*defun fnameMake*⟩≡
```
(defun |fnameMake| (d n e)
  (if (string= e "") (setq e nil))
  (make-pathname :directory (|StringToDir| d) :name  n :type e))
```

66.12.2 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")) ))) ))
```

66.12.3 defun FileName directory function implementation

[DirToString p1132]

⟨*defun fnameDirectory*⟩≡
```
(defun |fnameDirectory| (f)
  (|DirToString| (pathname-directory f)))
```

66.12.4 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)))) ))
```

66.12.5 defun FileName name function implementation

⟨*defun fnameName 0*⟩≡
```
(defun |fnameName| (f)
  (let ((s (pathname-name f)))
    (if s s "") ))
```

66.12.6 defun FileName extension function implementation

⟨*defun fnameType 0*⟩≡
```
(defun |fnameType| (f)
  (let ((s (pathname-type f)))
    (if s s "") ))
```

66.12.7 defun FileName exists? function implementation

⟨*defun fnameExists? 0*⟩≡
```
(defun |fnameExists?| (f)
  (if (probe-file (namestring f)) 't nil))
```

66.12.8 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)) ))
```

66.12.9 defun FileName writeable? function implementation

[myWriteable? p**??**]

⟨*defun fnameWritable?*⟩≡
```
(defun |fnameWritable?| (f)
  (|myWritable?| (namestring f)) )
```

66.12.10 defun FileName writeable? function support

[error p**??**]
[fnameExists? p1132]
[fnameDirectory p1131]
[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) )
```

66.12.11 defun FileName new function implementation

[fnameMake p1131]

⟨*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)) )))
```

66.13 DoubleFloat

These macros wrap their arguments with strong type information in order to optimize doublefloat computatations. They are used directly in the DoubleFloat domain (see Volume 10.3).

66.13.1 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)))
```

66.13.2 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))))
```

66.13.3 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)))
```

66.13.4 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)))
```

66.13.5 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))))
```

66.13.6 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))))
```

66.13.7 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))))
```

66.13.8 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))))
```

66.13.9 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))))
```

66.13.10 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))))
```

66.13.11 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)
 `(eql (the double-float ,x) (the double-float ,y)))
```

66.13.12 defmacro DFDivide

Divide a doublefloat by a 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))))
```

66.13.13 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))))
```

66.13.14 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)))
```

66.13.15 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)))
```

66.13.16 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)))
```

66.13.17 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))))
```

66.13.18 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)))
```

66.13.19 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))))
```

66.13.20 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))))
```

66.13.21 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))))
```

66.13.22 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))))
```

66.13.23 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)))
```

66.13.24 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)))
```

66.13.25 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))))
```

66.13.26 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	$0 <$ result $< \pi/2$
$y > 0$	$x = 0$	Positive y-axis	$\pi/2$
$y > 0$	$x < 0$	Quadrant II	$\pi/2 <$ result $< \pi$
$y = 0$	$x < 0$	Negative x-axis	π
$y < 0$	$x < 0$	Quadrant III	$-\pi <$ result $< -\pi/2$
$y < 0$	$x = 0$	Negative y-axis	$-\pi/2$
$y < 0$	$x > 0$	Quadrant IV	$-\pi/2 <$ 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))))
```

66.13.27 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))))
```

66.13.28 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))))
```

66.13.29 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))))
```

66.13.30 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))))
```

66.13.31 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)))
```

66.13.32 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)))
```

66.13.33 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))
```

66.13.34 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))))
```

66.13.35 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))
```

66.13.36 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))
```

66.13.37 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)))
```

66.13.38 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))))
```

66.13.39 defun The inverse cotangent function

The inverse cotangent (arc-cotangent) function is defined as

$$acot(z) = cot^{-1}(z) = tan^{-1}(\frac{1}{z})$$

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))))))
```

66.13.40 defun The secant function

$$sec(x) = \frac{1}{cos(x)}$$

⟨*defun sec 0*⟩≡
```
(defun sec (x) (/ 1 (cos x)))
```

66.13.41 defun The inverse secant function

$$asec(x) = acos\left(\frac{1}{x}\right)$$

⟨*defun asec 0*⟩≡
```
(defun asec (x) (acos (/ 1 x)))
```

66.13.42 defun The cosecant function

$$csc(x) = \frac{1}{sin(x)}$$

⟨*defun csc 0*⟩≡
```
(defun csc (x) (/ 1 (sin x)))
```

66.13.43 defun The inverse cosecant function

$$acsc(x) = \frac{1}{asin(x)}$$

⟨*defun acsc 0*⟩≡
```
(defun acsc (x) (asin (/ 1 x)))
```

66.13.44 defun The hyperbolic cosecant function

$$csch(x) = \frac{1}{sinh(x)}$$

⟨*defun csch 0*⟩≡
```
(defun csch (x) (/ 1 (sinh x)))
```

66.13.45 defun The hyperbolic cotangent function

$$coth(x) = cosh(x)csch(x)$$

⟨*defun coth 0*⟩≡

```
(defun coth (x) (* (cosh x) (csch x)))
```

66.13.46 defun The hyperbolic secant function

$$sech(x) = \frac{1}{cosh(x)}$$

⟨*defun sech 0*⟩≡

```
(defun sech (x) (/ 1 (cosh x)))
```

66.13.47 defun The inverse hyperbolic cosecant function

$$acsch(x) = asinh\left(\frac{1}{x}\right)$$

⟨*defun acsch 0*⟩≡

```
(defun acsch (x) (asinh (/ 1 x)))
```

66.13.48 defun The inverse hyperbolic cotangent function

$$acoth(x) = atanh\left(\frac{1}{x}\right)$$

⟨*defun acoth 0*⟩≡

```
(defun acoth (x) (atanh (/ 1 x)))
```

66.13.49 defun The inverse hyperbolic secant function

$$asech(x) = acosh\left(\frac{1}{x}\right)$$

⟨*defun asech 0*⟩≡

```
(defun asech (x) (acosh (/ 1 x)))
```

Chapter 67

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-nrlib (nrlib)                           FUNCTION
  takes an nrlib 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

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 INITS *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)

 FOO1
 FOO1
```

```
; 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"))

; TEMPORARILY STOP ALL MONITORING

>(monitor-disable)
NIL

; CHECK THAT NOTHING CHANGES

>(foo3)

FOO1
FOO2
FOO3
FOO3

; NO COUNT HAS CHANGED

>(monitor-results)
(#S(MONITOR-DATA NAME FOO1 COUNT 3 MONITORP NIL 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 NIL SOURCEFILE
       "/u/daly/testmon.lisp"))
 #S(MONITOR-DATA NAME FOO4 COUNT 0 MONITORP T SOURCEFILE
       "/u/daly/testmon.lisp"))

; MONITOR ONLY CALLS TO FOO1

>(monitor-enable 'foo1)
T

; FOO3 CALLS FOO1

>(foo3)

FOO1
FOO2
FOO3
FOO3

; FOO1 HAS CHANGED BUT NOT FOO2 OR FOO3

>(monitor-results)
(#S(MONITOR-DATA NAME FOO1 COUNT 4 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 NIL SOURCEFILE
```

```
       "/u/daly/testmon.lisp"))
 #S(MONITOR-DATA NAME FOO4 COUNT 0 MONITORP T SOURCEFILE
       "/u/daly/testmon.lisp"))

; MONITOR EVERYBODY

>(monitor-enable)
NIL

; CHECK THAT EVERYBODY CHANGES

>(foo3)

FOO1
FOO2
FOO3
FOO3

; EVERYBODY WAS BUMPED

>(monitor-results)
(#S(MONITOR-DATA NAME FOO1 COUNT 5 MONITORP T SOURCEFILE
       "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME FOO2 COUNT 3 MONITORP T SOURCEFILE
       "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME FOO3 COUNT 3 MONITORP T SOURCEFILE
       "/u/daly/testmon.lisp"))
 #S(MONITOR-DATA NAME FOO4 COUNT 0 MONITORP T SOURCEFILE
       "/u/daly/testmon.lisp"))

; WHAT FUNCTIONS WERE TESTED?

>(monitor-tested)
(FOO1 FOO2 FOO3)

; WHAT FUNCTIONS WERE NOT TESTED?

>(monitor-untested)
(FOO4)

; UNTRACE THE WHOLE WORLD, MONITORING CANNOT RESTART

>(monitor-end)
NIL

; CHECK THE RESULTS

>(monitor-results)
(#S(MONITOR-DATA NAME FOO1 COUNT 5 MONITORP T SOURCEFILE
       "/u/daly/testmon.lisp")
```

```
 #S(MONITOR-DATA NAME FOO2 COUNT 3 MONITORP T SOURCEFILE
       "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME FOO3 COUNT 3 MONITORP T SOURCEFILE
       "/u/daly/testmon.lisp"))
 #S(MONITOR-DATA NAME FOO4 COUNT 0 MONITORP T SOURCEFILE
       "/u/daly/testmon.lisp"))

; CHECK THAT THE FUNCTIONS STILL WORK

>(foo3)

FOO1
FOO2
FOO3
FOO3

; CHECK THAT MONITORING IS NOT OCCURING

>(monitor-results)
(#S(MONITOR-DATA NAME FOO1 COUNT 5 MONITORP T SOURCEFILE
       "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME FOO2 COUNT 3 MONITORP T SOURCEFILE
       "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME FOO3 COUNT 3 MONITORP T SOURCEFILE
       "/u/daly/testmon.lisp"))
 #S(MONITOR-DATA NAME FOO4 COUNT 0 MONITORP T SOURCEFILE
       "/u/daly/testmon.lisp"))
```

67.0.50 defvar $*monitor-domains*

⟨*initvars*⟩+≡

```
  (defvar *monitor-domains* nil "a list of domains to report")
```

67.0.51 defvar $*monitor-nrlibs*

⟨*initvars*⟩+≡

```
  (defvar *monitor-nrlibs* nil "a list of nrlibs that have been traced")
```

67.0.52 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)))
```

67.0.53 defstruct $monitor-data

⟨*initvars*⟩+≡
```
(defstruct monitor-data name count monitorp sourcefile)
```

67.0.54 defstruct $libstream

⟨*initvars*⟩+≡
```
(defstruct libstream  mode dirname (indextable nil)  (indexstream nil))
```

67.0.55 defun Initialize the monitor statistics hashtable

[*monitor-table* p1153]

⟨*defun monitor-inittable 0*⟩≡
```
(defun monitor-inittable ()
 "initialize the monitor statistics hashtable"
 (declare (special *monitor-table*))
 (setq *monitor-table* (make-hash-table)))
```

67.0.56 defun End the monitoring process, we cannot restart

[*monitor-table* p1153]

⟨*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*))
```

67.0.57 defun Return a list of the monitor-data structures

[*monitor-table* p1153]

⟨*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)) result)))
```

67.0.58 defun Add a function to be monitored

[monitor-delete p1156]
[make-monitor-data p??]
[*monitor-table* p1153]

⟨*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)))))
```

67.0.59 defun Remove a function being monitored

[*monitor-table* p1153]

⟨*defun monitor-delete 0*⟩≡
```
(defun monitor-delete (fn)
 "Remove a function being monitored"
 (declare (special *monitor-table*))
 (eval `(untrace ,fn))
 (remhash fn *monitor-table*))
```

67.0.60 defun Enable all (or optionally one) function for monitoring

[*monitor-table* p1153]

⟨*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*)))
```

67.0.61 defun Disable all (optionally one) function for monitoring

[*monitor-table* p1153]

⟨*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*)))
```

67.0.62 defun Reset the table count for the table (or a function)

[*monitor-table* p1153]

⟨*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*)))
```

67.0.63 defun Incr the count of fn by 1

[*monitor-table* p1153]

⟨*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))))
```

67.0.64 defun Decr the count of fn by 1

[*monitor-table* p1153]

⟨*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))))
```

67.0.65 defun Return the monitor information for a function

[*monitor-table* p1153]

⟨*defun monitor-info 0*⟩≡
```
(defun monitor-info (fn)
 "return the monitor information for a function"
 (declare (special *monitor-table*))
 (gethash fn *monitor-table*))
```

67.0.66 defun Hang a monitor call on all of the defuns in a file

[done p**??**]
[done p**??**]
[monitor-add p1156]

⟨*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)))))))))
```

67.0.67 defun Return a list of the functions with zero count fields

[*monitor-table* p1153]

⟨*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*)
 result))
```

67.0.68 defun Return a list of functions with non-zero counts

[monitor-delete p1156]
[*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*)
 result))
```

67.0.69 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))))))
```

67.0.70 defun Save the *monitor-table* in loadable form

[*monitor-table* p1153]
[*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))))))
```

67.0.71 defun restore a checkpointed file

⟨*defun monitor-restore 0*⟩≡
```
(defun monitor-restore (file)
 "restore a checkpointed file"
 (load file))
```

67.0.72 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 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-nrlib (nrlib)                          FUNCTION
;;;   takes an nrlib 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)
```

67.0.73 Monitoring algebra files

67.0.74 defun Monitoring algebra code.lsp files

[*monitor-nrlibs* p1153]

⟨*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))))
```

67.0.75 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))))
```

67.0.76 defun Monitor an nrlib

[*monitor-table* p1153]

⟨*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))
```

67.0.77 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))))))
```

67.0.78 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))
```

67.0.79 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* p1153]

⟨*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*)))))))))
```

67.0.80 defun Generate a report of the monitored domains

[monitor-readinterp p1167]
[*monitor-domains* p1153]

⟨*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))
```

67.0.81 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)))
```

67.0.82 defun Given a spad file, report all nrlibs it creates

[done p**??**]
[done p**??**]
[monitor-parse p1169]
[*monitor-domains* p1153]

⟨*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=))))))))
```

67.0.83 defun Print percent of functions tested

[*monitor-table* p1153]

⟨*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)))))
```

67.0.84 defun Find all monitored symbols containing the string

[*monitor-table* p1153]

⟨*defun monitor-apropos 0*⟩≡
```
(defun monitor-apropos (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 68

The Interpreter

⟨*Interpreter*⟩≡
```
(setq *print-array* nil)
(setq *print-circle* nil)
(setq *print-pretty* nil)

(in-package "BOOT")
```
⟨*initvars*⟩

```
;;; level 0 macros
```

⟨*defmacro bit-to-truth 0*⟩
⟨*defmacro bvec-elt 0*⟩
⟨*defmacro idChar? 0*⟩
⟨*defmacro identp 0*⟩

```
;;; above level 0 macros
```

⟨*defmacro assq*⟩
⟨*defmacro bvec-setelt*⟩
⟨*defmacro bvec-size*⟩
⟨*defmacro cdaref2*⟩
⟨*defmacro cdelt*⟩
⟨*defmacro cdlen*⟩
⟨*defmacro cdancols*⟩
⟨*defmacro cdanrows*⟩
⟨*defmacro cdsetaref2*⟩
⟨*defmacro cdsetelt*⟩
⟨*defmacro danrows*⟩
⟨*defmacro dancols*⟩
⟨*defmacro daref2*⟩

⟨*defmacro delt*⟩
⟨*defmacro DFAdd*⟩
⟨*defmacro DFAcos*⟩
⟨*defmacro DFAcosh*⟩
⟨*defmacro DFAsin*⟩
⟨*defmacro DFAsinh*⟩
⟨*defmacro DFAtan*⟩
⟨*defmacro DFAtan2*⟩
⟨*defmacro DFAtanh*⟩
⟨*defmacro DFCos*⟩
⟨*defmacro DFCosh*⟩
⟨*defmacro DFDivide*⟩
⟨*defmacro DFEql*⟩
⟨*defmacro DFExp*⟩
⟨*defmacro DFExpt*⟩
⟨*defmacro DFIntegerDivide*⟩
⟨*defmacro DFIntegerExpt*⟩
⟨*defmacro DFIntegerMultiply*⟩
⟨*defmacro DFLessThan*⟩
⟨*defmacro DFLog*⟩
⟨*defmacro DFLogE*⟩
⟨*defmacro DFMax*⟩
⟨*defmacro DFMin*⟩
⟨*defmacro DFMinusp*⟩
⟨*defmacro DFMultiply*⟩
⟨*defmacro DFSin*⟩
⟨*defmacro DFSinh*⟩
⟨*defmacro DFSqrt*⟩
⟨*defmacro DFSubtract*⟩
⟨*defmacro DFTan*⟩
⟨*defmacro DFTanh*⟩
⟨*defmacro DFUnaryMinus*⟩
⟨*defmacro DFZerop*⟩
⟨*defmacro dlen*⟩
⟨*defmacro dsetaref2*⟩
⟨*defmacro dsetelt*⟩
⟨*defmacro funfind*⟩
⟨*defmacro hget*⟩
⟨*defmacro make-cdouble-matrix*⟩
⟨*defmacro make-cdouble-vector*⟩
⟨*defmacro make-double-matrix*⟩
⟨*defmacro make-double-matrix1*⟩
⟨*defmacro make-double-vector*⟩
⟨*defmacro make-double-vector1*⟩
⟨*defmacro Rest*⟩
⟨*defmacro startsId?*⟩

⟨*defmacro truth-to-bit*⟩
⟨*defmacro while*⟩
⟨*defmacro whileWithResult*⟩

```
;;; layer 0 (all common lisp)
```

⟨*defun acot 0*⟩
⟨*defun acoth 0*⟩
⟨*defun acsc 0*⟩
⟨*defun acsch 0*⟩
⟨*defun asec 0*⟩
⟨*defun asech 0*⟩
⟨*defun axiomVersion 0*⟩

⟨*defun bvec-and 0*⟩
⟨*defun bvec-concat 0*⟩
⟨*defun bvec-copy 0*⟩
⟨*defun bvec-equal 0*⟩
⟨*defun bvec-greater 0*⟩
⟨*defun bvec-make-full 0*⟩
⟨*defun bvec-nand 0*⟩
⟨*defun bvec-nor 0*⟩
⟨*defun bvec-not 0*⟩
⟨*defun bvec-or 0*⟩
⟨*defun bvec-xor 0*⟩

⟨*defun cleanupLine 0*⟩
⟨*defun clearMacroTable 0*⟩
⟨*defun concat 0*⟩
⟨*defun cot 0*⟩
⟨*defun coth 0*⟩
⟨*defun createCurrentInterpreterFrame 0*⟩
⟨*defun credits 0*⟩
⟨*defun csc 0*⟩
⟨*defun csch 0*⟩

⟨*defun Delay 0*⟩
⟨*defun desiredMsg 0*⟩
⟨*defun DirToString 0*⟩
⟨*defun divide2 0*⟩
⟨*defun dqAppend 0*⟩
⟨*defun dqToList 0*⟩
⟨*defun dqUnit 0*⟩

⟨*defun emptyInterpreterFrame 0*⟩

⟨*defun fin 0*⟩
⟨*defun findFrameInRing 0*⟩
⟨*defun flatten 0*⟩
⟨*defun fnameExists? 0*⟩
⟨*defun fnameName 0*⟩
⟨*defun fnameReadable? 0*⟩
⟨*defun fnameType 0*⟩
⟨*defun frameExposureData 0*⟩
⟨*defun frameHiFiAccess 0*⟩
⟨*defun frameHistList 0*⟩
⟨*defun frameHistListAct 0*⟩
⟨*defun frameHistListLen 0*⟩
⟨*defun frameHistoryTable 0*⟩
⟨*defun frameHistRecord 0*⟩
⟨*defun frameInteractive 0*⟩
⟨*defun frameIOIndex 0*⟩
⟨*defun frameName 0*⟩
⟨*defun frameNames 0*⟩
⟨*defun From 0*⟩
⟨*defun FromTo 0*⟩

⟨*defun get-current-directory 0*⟩
⟨*defun getenviron 0*⟩
⟨*defun getLinePos 0*⟩
⟨*defun getLineText 0*⟩
⟨*defun getMsgArgL 0*⟩
⟨*defun getMsgKey 0*⟩
⟨*defun getMsgKey? 0*⟩
⟨*defun getMsgPrefix 0*⟩
⟨*defun getMsgPosTagOb 0*⟩
⟨*defun getMsgPrefix? 0*⟩
⟨*defun getMsgTag 0*⟩
⟨*defun getMsgTag? 0*⟩
⟨*defun getMsgText 0*⟩
⟨*defun getParserMacroNames 0*⟩
⟨*defun getPreStL 0*⟩

⟨*defun hasOptArgs? 0*⟩

⟨*defun incActive? 0*⟩
⟨*defun incCommand? 0*⟩
⟨*defun incDrop 0*⟩
⟨*defun incHandleMessage 0*⟩
⟨*defun inclmsgConsole 0*⟩
⟨*defun inclmsgFinSkipped 0*⟩
⟨*defun inclmsgPrematureEOF 0*⟩

⟨*defun inclmsgCmdBug 0*⟩
⟨*defun inclmsgIfBug 0*⟩
⟨*defun incPrefix? 0*⟩
⟨*defun init-memory-config 0*⟩
⟨*defun insertPos 0*⟩
⟨*defun integer-decode-float-denominator 0*⟩
⟨*defun integer-decode-float-exponent 0*⟩
⟨*defun integer-decode-float-sign 0*⟩
⟨*defun integer-decode-float-numerator 0*⟩
⟨*defun intloopPrefix? 0*⟩
⟨*defun isIntegerString 0*⟩

⟨*defun keyword 0*⟩
⟨*defun keyword? 0*⟩

⟨*defun lfcomment 0*⟩
⟨*defun lferror 0*⟩
⟨*defun lffloat 0*⟩
⟨*defun lfid 0*⟩
⟨*defun lfinteger 0*⟩
⟨*defun lfnegcomment 0*⟩
⟨*defun lfrinteger 0*⟩
⟨*defun lfspaces 0*⟩
⟨*defun lfstring 0*⟩
⟨*defun lnCreate 0*⟩
⟨*defun lnExtraBlanks 0*⟩
⟨*defun lnFileName? 0*⟩
⟨*defun lnGlobalNum 0*⟩
⟨*defun lnImmediate? 0*⟩
⟨*defun lnLocalNum 0*⟩
⟨*defun lnPlaceOfOrigin 0*⟩
⟨*defun lnSetGlobalNum 0*⟩
⟨*defun lnString 0*⟩

⟨*defun mac0Define 0*⟩
⟨*defun mac0InfiniteExpansion,name 0*⟩
⟨*defun make-absolute-filename 0*⟩
⟨*defun makeInitialModemapFrame 0*⟩
⟨*defun manexp 0*⟩
⟨*defun member 0*⟩
⟨*defun monitor-add 0*⟩
⟨*defun monitor-apropos 0*⟩
⟨*defun monitor-autoload 0*⟩
⟨*defun monitor-checkpoint 0*⟩
⟨*defun monitor-decr 0*⟩
⟨*defun monitor-delete 0*⟩

⟨*defun monitor-dirname 0*⟩
⟨*defun monitor-disable 0*⟩
⟨*defun monitor-enable 0*⟩
⟨*defun monitor-end 0*⟩
⟨*defun monitor-exposedp 0*⟩
⟨*defun monitor-file 0*⟩
⟨*defun monitor-help 0*⟩
⟨*defun monitor-incr 0*⟩
⟨*defun monitor-info 0*⟩
⟨*defun monitor-inittable 0*⟩
⟨*defun monitor-libname 0*⟩
⟨*defun monitor-nrlib 0*⟩
⟨*defun monitor-parse 0*⟩
⟨*defun monitor-percent 0*⟩
⟨*defun monitor-readinterp 0*⟩
⟨*defun monitor-report 0*⟩
⟨*defun monitor-reset 0*⟩
⟨*defun monitor-restore 0*⟩
⟨*defun monitor-results 0*⟩
⟨*defun monitor-spadfile 0*⟩
⟨*defun monitor-tested 0*⟩
⟨*defun monitor-untested 0*⟩
⟨*defun monitor-write 0*⟩

⟨*defun ncError 0*⟩
⟨*defun ncloopEscaped 0*⟩
⟨*defun ncloopPrefix? 0*⟩
⟨*defun ncloopPrintLines 0*⟩
⟨*defun nonBlank 0*⟩
⟨*defun npAnyNo 0*⟩
⟨*defun npboot 0*⟩
⟨*defun npEqPeek 0*⟩
⟨*defun nplisp 0*⟩
⟨*defun npPop1 0*⟩
⟨*defun npPop2 0*⟩
⟨*defun npPop3 0*⟩
⟨*defun npPush 0*⟩

⟨*defun opTran 0*⟩

⟨*defun packageTran 0*⟩
⟨*defun pfAndLeft 0*⟩
⟨*defun pfAndRight 0*⟩
⟨*defun pfAppend 0*⟩
⟨*defun pfApplicationArg 0*⟩
⟨*defun pfApplicationOp 0*⟩

⟨*defun pfAssignLhsItems 0*⟩
⟨*defun pf0AssignLhsItems 0*⟩
⟨*defun pfAssignRhs 0*⟩
⟨*defun pfBreakFrom 0*⟩
⟨*defun pfCoercetoExpr 0*⟩
⟨*defun pfCoercetoType 0*⟩
⟨*defun pfCollectBody 0*⟩
⟨*defun pfCollectIterators 0*⟩
⟨*defun pfDefinitionLhsItems 0*⟩
⟨*defun pfDefinitionRhs 0*⟩
⟨*defun pfDoBody 0*⟩
⟨*defun pfExitCond 0*⟩
⟨*defun pfExitExpr 0*⟩
⟨*defun pfFirst 0*⟩
⟨*defun pfFreeItems 0*⟩
⟨*defun pfForinLhs 0*⟩
⟨*defun pfForinWhole 0*⟩
⟨*defun pfFromdomDomain 0*⟩
⟨*defun pfFromdomWhat 0*⟩
⟨*defun pfIfCond 0*⟩
⟨*defun pfIfElse 0*⟩
⟨*defun pfIfThen 0*⟩
⟨*defun pfLambdaArgs 0*⟩
⟨*defun pfLambdaBody 0*⟩
⟨*defun pfLambdaRets 0*⟩
⟨*defun pfLiteral? 0*⟩
⟨*defun pfLocalItems 0*⟩
⟨*defun pfLoopIterators 0*⟩
⟨*defun pfMacroLhs 0*⟩
⟨*defun pfMacroRhs 0*⟩
⟨*defun pfMLambdaArgs 0*⟩
⟨*defun pfMLambdaBody 0*⟩
⟨*defun pfNotArg 0*⟩
⟨*defun pfNovalueExpr 0*⟩
⟨*defun pfOrLeft 0*⟩
⟨*defun pfOrRight 0*⟩
⟨*defun pfParts 0*⟩
⟨*defun pfPile 0*⟩
⟨*defun pfPretendExpr 0*⟩
⟨*defun pfPretendType 0*⟩
⟨*defun pfRestrictExpr 0*⟩
⟨*defun pfRestrictType 0*⟩
⟨*defun pfReturnExpr 0*⟩
⟨*defun pfRuleLhsItems 0*⟩
⟨*defun pfRuleRhs 0*⟩
⟨*defun pfSecond 0*⟩

⟨*defun pfSequenceArgs 0*⟩
⟨*defun pfSuchthatCond 0*⟩
⟨*defun pfTaggedExpr 0*⟩
⟨*defun pfTaggedTag 0*⟩
⟨*defun pfTree 0*⟩
⟨*defun pfTypedId 0*⟩
⟨*defun pfTypedType 0*⟩
⟨*defun pfTupleParts 0*⟩
⟨*defun pfWhereContext 0*⟩
⟨*defun pfWhereExpr 0*⟩
⟨*defun pfWhileCond 0*⟩
⟨*defun pmDontQuote? 0*⟩
⟨*defun poCharPosn 0*⟩
⟨*defun poGetLineObject 0*⟩
⟨*defun poNopos? 0*⟩
⟨*defun poNoPosition 0*⟩
⟨*defun poNoPosition? 0*⟩
⟨*defun printAsTeX 0*⟩

⟨*defun qenum 0*⟩
⟨*defun quotient2 0*⟩

⟨*defun rdigit? 0*⟩
⟨*defun reclaim 0*⟩
⟨*defun remainder2 0*⟩
⟨*defun remLine 0*⟩
⟨*defun rep 0*⟩
⟨*defun resetStackLimits 0*⟩

⟨*defun sameUnionBranch 0*⟩
⟨*defun satisfiesUserLevel 0*⟩
⟨*defun scanCloser? 0*⟩
⟨*defun sec 0*⟩
⟨*defun sech 0*⟩
⟨*defun setCurrentLine 0*⟩
⟨*defun setMsgPrefix 0*⟩
⟨*defun setMsgText 0*⟩
⟨*defun set-restart-hook 0*⟩
⟨*defun showMsgPos? 0*⟩
⟨*defun StreamNull 0*⟩
⟨*defun stripLisp 0*⟩
⟨*defun stripSpaces 0*⟩

⟨*defun theid 0*⟩
⟨*defun thefname 0*⟩
⟨*defun theorigin 0*⟩

⟨*defun tokPart 0*⟩
⟨*defun To 0*⟩
⟨*defun Top? 0*⟩
⟨*defun trademark 0*⟩

⟨*defun zeroOneTran 0*⟩

```
;;; above level 0
```

⟨*defun abbQuery*⟩
⟨*defun abbreviations*⟩
⟨*defun abbreviationsSpad2Cmd*⟩
⟨*defun addBinding*⟩
⟨*defun addBindingInteractive*⟩
⟨*defun addInputLibrary*⟩
⟨*defun addNewInterpreterFrame*⟩
⟨*defun addoperations*⟩
⟨*defun addTraceItem*⟩
⟨*defun allConstructors*⟩
⟨*defun allOperations*⟩
⟨*defun alqlGetOrigin*⟩
⟨*defun alqlGetParams*⟩
⟨*defun alqlGetKindString*⟩
⟨*defun alreadyOpened?*⟩
⟨*defun apropos*⟩
⟨*defun assertCond*⟩
⟨*defun augmentTraceNames*⟩

⟨*defun break*⟩
⟨*defun breaklet*⟩
⟨*defun brightprint*⟩
⟨*defun brightprint-0*⟩
⟨*defun browse*⟩
⟨*defun browseOpen*⟩

⟨*defun cacheKeyedMsg*⟩
⟨*defun categoryOpen*⟩
⟨*defun changeHistListLen*⟩
⟨*defun changeToNamedInterpreterFrame*⟩
⟨*defun charDigitVal*⟩
⟨*defun cleanline*⟩
⟨*defun clear*⟩
⟨*defun clearCmdAll*⟩
⟨*defun clearCmdCompletely*⟩
⟨*defun clearCmdExcept*⟩
⟨*defun clearCmdParts*⟩

⟨*defun clearCmdSortedCaches*⟩
⟨*defun clearFrame*⟩
⟨*defun clearParserMacro*⟩
⟨*defun clearSpad2Cmd*⟩
⟨*defun close*⟩
⟨*defun closeInterpreterFrame*⟩
⟨*defun coerceSpadArgs2E*⟩
⟨*defun coerceSpadFunValue2E*⟩
⟨*defun coerceTraceArgs2E*⟩
⟨*defun coerceTraceFunValue2E*⟩
⟨*defun commandAmbiguityError*⟩
⟨*defun commandError*⟩
⟨*defun commandErrorIfAmbiguous*⟩
⟨*defun commandErrorMessage*⟩
⟨*defun commandsForUserLevel*⟩
⟨*defun commandUserLevelError*⟩
⟨*defun compareposns*⟩
⟨*defun compileBoot*⟩
⟨*defun compressOpen*⟩
⟨*defun constoken*⟩
⟨*defun copyright*⟩
⟨*defun countCache*⟩

⟨*defun DaaseName*⟩
⟨*defun decideHowMuch*⟩
⟨*defun defiostream*⟩
⟨*defun deldatabase*⟩
⟨*defun deleteFile*⟩
⟨*defun describe*⟩
⟨*defun describeFortPersistence*⟩
⟨*defun describeInputLibraryArgs*⟩
⟨*defun describeOutputLibraryArgs*⟩
⟨*defun describeProtectedSymbolsWarning*⟩
⟨*defun describeProtectSymbols*⟩
⟨*defun describeSetFortDir*⟩
⟨*defun describeSetFortTmpDir*⟩
⟨*defun describeSetFunctionsCache*⟩
⟨*defun describeSetLinkerArgs*⟩
⟨*defun describeSetNagHost*⟩
⟨*defun describeSetOutputAlgebra*⟩
⟨*defun describeSetOutputFormula*⟩
⟨*defun describeSetOutputFortran*⟩
⟨*defun describeSetOutputHtml*⟩
⟨*defun describeSetOutputMathml*⟩
⟨*defun describeSetOutputOpenMath*⟩
⟨*defun describeSetOutputTex*⟩

⟨*defun describeSetStreamsCalculate*⟩
⟨*defun describeSpad2Cmd*⟩
⟨*defun dewritify*⟩
⟨*defun dewritify,dewritifyInner*⟩
⟨*defun dewritify,is?*⟩
⟨*defun diffAlist*⟩
⟨*defun digit?*⟩
⟨*defun digitp*⟩
⟨*defun disableHist*⟩
⟨*defun display*⟩
⟨*defun displayCondition*⟩
⟨*defun displayExposedConstructors*⟩
⟨*defun displayExposedGroups*⟩
⟨*defun displayFrameNames*⟩
⟨*defun displayHiddenConstructors*⟩
⟨*defun displayMacro*⟩
⟨*defun displayMacros*⟩
⟨*defun displayMode*⟩
⟨*defun displayModemap*⟩
⟨*defun displayOperations*⟩
⟨*defun displayOperationsFromLisplib*⟩
⟨*defun displayParserMacro*⟩
⟨*defun displayProperties*⟩
⟨*defun displayProperties,sayFunctionDeps*⟩
⟨*defun displaySetOptionInformation*⟩
⟨*defun displaySetVariableSettings*⟩
⟨*defun displaySpad2Cmd*⟩
⟨*defun displayType*⟩
⟨*defun displayValue*⟩
⟨*defun displayWorkspaceNames*⟩
⟨*defun domainToGenvar*⟩
⟨*defun doSystemCommand*⟩
⟨*defun dqConcat*⟩
⟨*defun dropInputLibrary*⟩
⟨*defun dumbTokenize*⟩

⟨*defun edit*⟩
⟨*defun editFile*⟩
⟨*defun editSpad2Cmd*⟩
⟨*defun Else?*⟩
⟨*defun Elseif?*⟩
⟨*defun enPile*⟩
⟨*defun eofp*⟩
⟨*defun eqpileTree*⟩
⟨*defun erMsgCompare*⟩
⟨*defun erMsgSep*⟩

⟨*defun erMsgSort*⟩
⟨*defun ExecuteInterpSystemCommand*⟩
⟨*defun executeQuietCommand*⟩

⟨*defun fetchKeyedMsg*⟩
⟨*defun fetchOutput*⟩
⟨*defun fillerSpaces*⟩
⟨*defun filterAndFormatConstructors*⟩
⟨*defun filterListOfStrings*⟩
⟨*defun filterListOfStringsWithFn*⟩
⟨*defun firstTokPosn*⟩
⟨*defun fixObjectForPrinting*⟩
⟨*defun flattenOperationAlist*⟩
⟨*defun float2Sex*⟩
⟨*defun fnameDirectory*⟩
⟨*defun fnameMake*⟩
⟨*defun fnameNew*⟩
⟨*defun fnameWritable?*⟩
⟨*defun frame*⟩
⟨*defun frameEnvironment*⟩
⟨*defun frameSpad2Cmd*⟩
⟨*defun functionp*⟩
⟨*defun funfind,LAM*⟩

⟨*defun genDomainTraceName*⟩
⟨*defun gensymInt*⟩
⟨*defun getAliasIfTracedMapParameter*⟩
⟨*defun getAndSay*⟩
⟨*defun getBpiNameIfTracedMap*⟩
⟨*defun getBrowseDatabase*⟩
⟨*defun getdatabase*⟩
⟨*defun getDirectoryList*⟩
⟨*defun getFirstWord*⟩
⟨*defun getKeyedMsg*⟩
⟨*defun getMapSig*⟩
⟨*defun getMapSubNames*⟩
⟨*defun getMsgCatAttr*⟩
⟨*defun getMsgFTTag?*⟩
⟨*defun getMsgInfoFromKey*⟩
⟨*defun getMsgLitSym*⟩
⟨*defun getMsgPos*⟩
⟨*defun getMsgPos2*⟩
⟨*defun getMsgToWhere*⟩
⟨*defun getOption*⟩
⟨*defun getPosStL*⟩
⟨*defun getPreviousMapSubNames*⟩

⟨*defun getProplist*⟩
⟨*defun getStFromMsg*⟩
⟨*defun getSystemCommandLine*⟩
⟨*defun getTraceOption*⟩
⟨*defun getTraceOption,hn*⟩
⟨*defun getTraceOptions*⟩
⟨*defun getWorkspaceNames*⟩

⟨*defun handleNoParseCommands*⟩
⟨*defun handleParsedSystemCommands*⟩
⟨*defun handleTokensizeSystemCommands*⟩
⟨*defun hashable*⟩
⟨*defun hasOption*⟩
⟨*defun hasPair*⟩
⟨*defun help*⟩
⟨*defun helpSpad2Cmd*⟩
⟨*defun histFileErase*⟩
⟨*defun histFileName*⟩
⟨*defun histInputFileName*⟩
⟨*defun history*⟩
⟨*defun historySpad2Cmd*⟩
⟨*defun hkeys*⟩
⟨*defun hput*⟩

⟨*defun If?*⟩
⟨*defun ifCond*⟩
⟨*defun importFromFrame*⟩
⟨*defun incAppend*⟩
⟨*defun incAppend1*⟩
⟨*defun incBiteOff*⟩
⟨*defun incClassify*⟩
⟨*defun incCommandTail*⟩
⟨*defun incConsoleInput*⟩
⟨*defun incFileInput*⟩
⟨*defun incFileName*⟩
⟨*defun incIgen*⟩
⟨*defun incIgen1*⟩
⟨*defun inclFname*⟩
⟨*defun incLine*⟩
⟨*defun incLine1*⟩
⟨*defun inclmsgCannotRead*⟩
⟨*defun inclmsgFileCycle*⟩
⟨*defun inclmsgPrematureFin*⟩
⟨*defun incLude*⟩
⟨*defun incLude1*⟩
⟨*defun inclmsgConActive*⟩

⟨*defun inclmsgConStill*⟩
⟨*defun inclmsgIfSyntax*⟩
⟨*defun inclmsgNoSuchFile*⟩
⟨*defun inclmsgSay*⟩
⟨*defun incNConsoles*⟩
⟨*defun incRenumber*⟩
⟨*defun incRenumberItem*⟩
⟨*defun incRenumberLine*⟩
⟨*defun incRgen*⟩
⟨*defun incRgen1*⟩
⟨*defun incStream*⟩
⟨*defun incString*⟩
⟨*defun incZip*⟩
⟨*defun incZip1*⟩
⟨*defun init-boot/spad-reader*⟩
⟨*defun initHist*⟩
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⟨*defun initial-getdatabase*⟩
⟨*defun initializeInterpreterFrameRing*⟩
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⟨*defun initializeSetVariables*⟩
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⟨*defun interpFunctionDepAlists*⟩
⟨*defun interpOpen*⟩
⟨*defun interpret*⟩
⟨*defun interpret1*⟩
⟨*defun interpret2*⟩
⟨*defun interpretTopLevel*⟩
⟨*defun intInterpretPform*⟩
⟨*defun intloop*⟩
⟨*defun intloopEchoParse*⟩
⟨*defun intloopInclude*⟩
⟨*defun intloopInclude0*⟩
⟨*defun intnplisp*⟩
⟨*defun intloopProcess*⟩
⟨*defun intloopProcessString*⟩
⟨*defun intloopReadConsole*⟩
⟨*defun intloopSpadProcess*⟩
⟨*defun intloopSpadProcess,interp*⟩
⟨*defun intProcessSynonyms*⟩
⟨*defun intSayKeyedMsg*⟩
⟨*defun isDomainOrPackage*⟩

⟨*defun isgenvar*⟩
⟨*defun isInterpOnlyMap*⟩
⟨*defun isListOfIdentifiers*⟩
⟨*defun isListOfIdentifiersOrStrings*⟩
⟨*defun isSharpVar*⟩
⟨*defun isSharpVarWithNum*⟩
⟨*defun isSubForRedundantMapName*⟩
⟨*defun isTraceGensym*⟩
⟨*defun isUncompiledMap*⟩

⟨*defun justifyMyType*⟩

⟨*defun KeepPart?*⟩

⟨*defun lassocSub*⟩
⟨*defun lastTokPosn*⟩
⟨*defun leader?*⟩
⟨*defun leaveScratchpad*⟩
⟨*defun letPrint*⟩
⟨*defun letPrint2*⟩
⟨*defun letPrint3*⟩
⟨*defun lfkey*⟩
⟨*defun library*⟩
⟨*defun line?*⟩
⟨*defun lineoftoks*⟩
⟨*defun listConstructorAbbreviations*⟩
⟨*defun listDecideHowMuch*⟩
⟨*defun listOutputter*⟩
⟨*defun lnFileName*⟩
⟨*defun load*⟩
⟨*defun localdatabase*⟩
⟨*defun localnrlib*⟩
⟨*defun loopIters2Sex*⟩
⟨*defun lotsof*⟩
⟨*defun ltrace*⟩

⟨*defun macApplication*⟩
⟨*defun macExpand*⟩
⟨*defun macId*⟩
⟨*defun macLambda*⟩
⟨*defun macLambda,mac*⟩
⟨*defun macLambdaParameterHandling*⟩
⟨*defun macMacro*⟩
⟨*defun macSubstituteId*⟩
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⟨*defun macroExpanded*⟩

⟨*defun macWhere*⟩
⟨*defun macWhere,mac*⟩
⟨*defun mac0ExpandBody*⟩
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⟨*defun msgText*⟩
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⟨*defun namestring*⟩
⟨*defun ncAlist*⟩
⟨*defun ncBug*⟩
⟨*defun ncConversationPhase*⟩
⟨*defun ncConversationPhase,wrapup*⟩
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⟨*defun ncHardError*⟩
⟨*defun ncIntLoop*⟩
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⟨*defun ncloopIncFileName*⟩
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⟨*defun ncloopInclude0*⟩

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⟨*defun newHelpSpad2Cmd*⟩
⟨*defun next*⟩
⟨*defun next1*⟩
⟨*defun nextInterpreterFrame*⟩
⟨*defun nextline*⟩
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⟨*defun npAdd*⟩
⟨*defun npADD*⟩
⟨*defun npAmpersand*⟩
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⟨*defun npAngleBared*⟩
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⟨*defun npDecl*⟩
⟨*defun npDef*⟩
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⟨*defun npDefaultItem*⟩
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⟨*defun npExpress*⟩
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⟨*defun npForIn*⟩
⟨*defun npFree*⟩
⟨*defun npFromdom*⟩
⟨*defun npFromdom1*⟩
⟨*defun npGives*⟩
⟨*defun npId*⟩
⟨*defun npImport*⟩
⟨*defun npInfGeneric*⟩
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⟨*defun npInfixOperator*⟩
⟨*defun npInfKey*⟩
⟨*defun npInline*⟩
⟨*defun npInterval*⟩
⟨*defun npItem*⟩
⟨*defun npItem1*⟩
⟨*defun npIterate*⟩
⟨*defun npIterator*⟩

⟨*defun npIterators*⟩
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⟨*defun npLeftAssoc*⟩
⟨*defun npLet*⟩
⟨*defun npLetQualified*⟩
⟨*defun npList*⟩
⟨*defun npListAndRecover*⟩
⟨*defun npListing*⟩
⟨*defun npListofFun*⟩
⟨*defun npLocal*⟩
⟨*defun npLocalDecl*⟩
⟨*defun npLocalItem*⟩
⟨*defun npLocalItemlist*⟩
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⟨*defun npMdef*⟩
⟨*defun npMDEF*⟩
⟨*defun npMDEFinition*⟩
⟨*defun npMissing*⟩
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⟨*defun npMoveTo*⟩
⟨*defun npName*⟩
⟨*defun npNext*⟩
⟨*defun npNull*⟩
⟨*defun npParened*⟩
⟨*defun npParenthesize*⟩
⟨*defun npParenthesized*⟩
⟨*defun npParse*⟩
⟨*defun npPDefinition*⟩
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⟨*defun npPileDefinitionlist*⟩
⟨*defun npPileExit*⟩
⟨*defun npPower*⟩
⟨*defun npPP*⟩
⟨*defun npPPf*⟩
⟨*defun npPPff*⟩
⟨*defun npPPg*⟩
⟨*defun npPrefixColon*⟩
⟨*defun npPretend*⟩
⟨*defun npPrimary*⟩
⟨*defun npPrimary1*⟩
⟨*defun npPrimary2*⟩
⟨*defun npProcessSynonym*⟩
⟨*defun npProduct*⟩

⟨*defun npPushId*⟩
⟨*defun npRelation*⟩
⟨*defun npRemainder*⟩
⟨*defun npQualDef*⟩
⟨*defun npQualified*⟩
⟨*defun npQualifiedDefinition*⟩
⟨*defun npQualType*⟩
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⟨*defun npRecoverTrap*⟩
⟨*defun npRestore*⟩
⟨*defun npRestrict*⟩
⟨*defun npReturn*⟩
⟨*defun npRightAssoc*⟩
⟨*defun npRule*⟩
⟨*defun npSCategory*⟩
⟨*defun npSDefaultItem*⟩
⟨*defun npSegment*⟩
⟨*defun npSelector*⟩
⟨*defun npSemiBackSet*⟩
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⟨*defun npSigDecl*⟩
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⟨*defun npSigItemlist*⟩
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⟨*defun npTrapForm*⟩
⟨*defun npTuple*⟩
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⟨*defun pfBreak*⟩
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⟨*defun pfCharPosn*⟩
⟨*defun pfCheckArg*⟩
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⟨*defun pfCoerceto*⟩
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⟨*defun pfCollect*⟩
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⟨*defun pfCollectVariable1*⟩
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⟨*defun pfTyped?*⟩
⟨*defun pfTyping*⟩
⟨*defun pfTuple?*⟩
⟨*defun pfUnSequence*⟩

⟨*defun pfWDec*⟩
⟨*defun pfWDeclare*⟩
⟨*defun pfWhere*⟩
⟨*defun pfWhere?*⟩
⟨*defun pfWhile*⟩
⟨*defun pfWhile?*⟩
⟨*defun pfWith*⟩
⟨*defun pfWrong*⟩
⟨*defun pfWrong?*⟩
⟨*defun pf0ApplicationArgs*⟩
⟨*defun pf0DefinitionLhsItems*⟩
⟨*defun pf0FlattenSyntacticTuple*⟩
⟨*defun pf0ForinLhs*⟩
⟨*defun pf0FreeItems*⟩
⟨*defun pf0LambdaArgs*⟩
⟨*defun pf0LocalItems*⟩
⟨*defun pf0LoopIterators*⟩
⟨*defun pf0MLambdaArgs*⟩
⟨*defun pf0SequenceArgs*⟩
⟨*defun pf0TupleParts*⟩
⟨*defun pf0WhereContext*⟩
⟨*defun pf2Sex*⟩
⟨*defun pf2Sex1*⟩
⟨*defun phMacro*⟩
⟨*defun phParse*⟩
⟨*defun phInterpret*⟩
⟨*defun phIntReportMsgs*⟩
⟨*defun pileCforest*⟩
⟨*defun pileColumn*⟩
⟨*defun pileCtree*⟩
⟨*defun pileForest*⟩
⟨*defun pileForest1*⟩
⟨*defun pileForests*⟩
⟨*defun pilePlusComment*⟩
⟨*defun pilePlusComments*⟩
⟨*defun pileTree*⟩
⟨*defun poFileName*⟩
⟨*defun poGlobalLinePosn*⟩
⟨*defun poLinePosn*⟩
⟨*defun poPosImmediate?*⟩
⟨*defun porigin*⟩
⟨*defun posend*⟩
⟨*defun posPointers*⟩
⟨*defun ppos*⟩
⟨*defun pquit*⟩
⟨*defun pquitSpad2Cmd*⟩

⟨*defun preparse*⟩
⟨*defun preparse1*⟩
⟨*defun previousInterpreterFrame*⟩
⟨*defun printLabelledList*⟩
⟨*defun printStatisticsSummary*⟩
⟨*defun printStorage*⟩
⟨*defun printSynonyms*⟩
⟨*defun printTypeAndTime*⟩
⟨*defun printTypeAndTimeNormal*⟩
⟨*defun printTypeAndTimeSaturn*⟩
⟨*defun probeName*⟩
⟨*defun processChPosesForOneLine*⟩
⟨*defun processInteractive*⟩
⟨*defun processInteractive1*⟩
⟨*defun processKeyedError*⟩
⟨*defun processMsgList*⟩
⟨*defun protectedSymbolsWarning*⟩
⟨*defun protectedEVAL*⟩
⟨*defun processSynonymLine*⟩
⟨*defun processSynonymLine,removeKeyFromLine*⟩
⟨*defun processSynonyms*⟩
⟨*defun protectSymbols*⟩
⟨*defun prTraceNames*⟩
⟨*defun prTraceNames,fn*⟩
⟨*defun pspacers*⟩
⟨*defun ptimers*⟩
⟨*defun putFTText*⟩
⟨*defun punctuation?*⟩
⟨*defun putDatabaseStuff*⟩
⟨*defun putHist*⟩
⟨*defun pvarPredTran*⟩

⟨*defun queryClients*⟩
⟨*defun queueUpErrors*⟩
⟨*defun quit*⟩
⟨*defun quitSpad2Cmd*⟩

⟨*defun rassocSub*⟩
⟨*defun rdefinstream*⟩
⟨*defun rdefoutstream*⟩
⟨*defun read*⟩
⟨*defun /read*⟩
⟨*defun readHiFi*⟩
⟨*defun readSpadProfileIfThere*⟩
⟨*defun readSpad2Cmd*⟩
⟨*defun recordAndPrint*⟩

⟨*defun recordFrame*⟩
⟨*defun recordNewValue*⟩
⟨*defun recordNewValue0*⟩
⟨*defun recordOldValue*⟩
⟨*defun recordOldValue0*⟩
⟨*defun redundant*⟩
⟨*defun remFile*⟩
⟨*defun removeOption*⟩
⟨*defun removeTracedMapSigs*⟩
⟨*defun removeUndoLines*⟩
⟨*defun replaceFile*⟩
⟨*defun reportOperations*⟩
⟨*defun reportOpsFromLisplib*⟩
⟨*defun reportOpsFromLisplib0*⟩
⟨*defun reportOpsFromLisplib1*⟩
⟨*defun reportOpsFromUnitDirectly*⟩
⟨*defun reportOpsFromUnitDirectly0*⟩
⟨*defun reportOpsFromUnitDirectly1*⟩
⟨*defun reportSpadTrace*⟩
⟨*defun reportUndo*⟩
⟨*defun reportWhatOptions*⟩
⟨*defun reroot*⟩
⟨*defun resetCounters*⟩
⟨*defun resethashtables*⟩
⟨*defun resetInCoreHist*⟩
⟨*defun resetSpacers*⟩
⟨*defun resetTimers*⟩
⟨*defun resetWorkspaceVariables*⟩
⟨*defun restart*⟩
⟨*defun restart0*⟩
⟨*defun restoreHistory*⟩
⟨*defun /rf*⟩
⟨*defun /rq*⟩
⟨*defun rread*⟩
⟨*defun ruleLhsTran*⟩
⟨*defun rulePredicateTran*⟩
⟨*defun runspad*⟩
⟨*defun rwrite*⟩

⟨*defun safeWritify*⟩
⟨*defun sameMsg?*⟩
⟨*defun satisfiesRegularExpressions*⟩
⟨*defun saveHistory*⟩
⟨*defun saveMapSig*⟩
⟨*defun savesystem*⟩
⟨*defun sayAllCacheCounts*⟩

⟨*defun sayBrightly1*⟩
⟨*defun sayCacheCount*⟩
⟨*defun sayExample*⟩
⟨*defun sayKeyedMsg*⟩
⟨*defun sayKeyedMsgLocal*⟩
⟨*defun sayMSG*⟩
⟨*defun sayMSG2File*⟩
⟨*defun sayShowWarning*⟩
⟨*defun scanCheckRadix*⟩
⟨*defun scanComment*⟩
⟨*defun scanDictCons*⟩
⟨*defun scanError*⟩
⟨*defun scanEsc*⟩
⟨*defun scanEscape*⟩
⟨*defun scanExponent*⟩
⟨*defun scanIgnoreLine*⟩
⟨*defun scanInsert*⟩
⟨*defun scanKeyTr*⟩
⟨*defun scanNegComment*⟩
⟨*defun scanNumber*⟩
⟨*defun ScanOrPairVec*⟩
⟨*defun ScanOrPairVec,ScanOrInner*⟩
⟨*defun scanPossFloat*⟩
⟨*defun scanPunct*⟩
⟨*defun scanPunCons*⟩
⟨*defun scanS*⟩
⟨*defun scanSpace*⟩
⟨*defun scanString*⟩
⟨*defun scanKeyTableCons*⟩
⟨*defun scanToken*⟩
⟨*defun scanTransform*⟩
⟨*defun scanW*⟩
⟨*defun scanWord*⟩
⟨*defun search*⟩
⟨*defun searchCurrentEnv*⟩
⟨*defun searchTailEnv*⟩
⟨*defun segmentKeyedMsg*⟩
⟨*defun selectOption*⟩
⟨*defun selectOptionLC*⟩
⟨*defun separatePiles*⟩
⟨*defun serverReadLine*⟩
⟨*defun set*⟩
⟨*defun set1*⟩
⟨*defun setdatabase*⟩
⟨*defun setExpose*⟩
⟨*defun setExposeAdd*⟩

⟨*defun setExposeAddConstr*⟩
⟨*defun setExposeAddGroup*⟩
⟨*defun setExposeDrop*⟩
⟨*defun setExposeDropConstr*⟩
⟨*defun setExposeDropGroup*⟩
⟨*defun setFortDir*⟩
⟨*defun setFortPers*⟩
⟨*defun setFortTmpDir*⟩
⟨*defun setFunctionsCache*⟩
⟨*defun setHistoryCore*⟩
⟨*defun setInputLibrary*⟩
⟨*defun setIOindex*⟩
⟨*defun setLinkerArgs*⟩
⟨*defun setMsgCatlessAttr*⟩
⟨*defun setMsgForcedAttr*⟩
⟨*defun setMsgForcedAttrList*⟩
⟨*defun setMsgUnforcedAttr*⟩
⟨*defun setMsgUnforcedAttrList*⟩
⟨*defun setNagHost*⟩
⟨*defun setOutputAlgebra*⟩
⟨*defun setOutputCharacters*⟩
⟨*defun setOutputFormula*⟩
⟨*defun setOutputFortran*⟩
⟨*defun setOutputLibrary*⟩
⟨*defun setOutputHtml*⟩
⟨*defun setOutputMathml*⟩
⟨*defun setOutputOpenMath*⟩
⟨*defun setOutputTex*⟩
⟨*defun setStreamsCalculate*⟩
⟨*defun shortenForPrinting*⟩
⟨*defun show*⟩
⟨*defun showdatabase*⟩
⟨*defun showInOut*⟩
⟨*defun showInput*⟩
⟨*defun showSpad2Cmd*⟩
⟨*defun shut*⟩
⟨*defun size*⟩
⟨*defun SkipEnd?*⟩
⟨*defun SkipPart?*⟩
⟨*defun Skipping?*⟩
⟨*defun spad*⟩
⟨*defun spadClosure?*⟩
⟨*defun SpadInterpretStream*⟩
⟨*defun spadReply*⟩
⟨*defun spadReply,printName*⟩
⟨*defun spadrread*⟩

⟨*defun spadrwrite*⟩
⟨*defun spadrwrite0*⟩
⟨*defun spad-save*⟩
⟨*defun spadStartUpMsgs*⟩
⟨*defun spadTrace*⟩
⟨*defun spadTraceAlias*⟩
⟨*defun spadTrace,g*⟩
⟨*defun spadTrace,isTraceable*⟩
⟨*defun spadUntrace*⟩
⟨*defun specialChar*⟩
⟨*defun spleI*⟩
⟨*defun spleI1*⟩
⟨*defun splitIntoOptionBlocks*⟩
⟨*defun squeeze*⟩
⟨*defun stackTraceOptionError*⟩
⟨*defun startsComment?*⟩
⟨*defun startsNegComment?*⟩
⟨*defun statisticsInitialization*⟩
⟨*defun streamChop*⟩
⟨*defun stringMatches?*⟩
⟨*defun StringToDir*⟩
⟨*defun strpos*⟩
⟨*defun strposl*⟩
⟨*defun stupidIsSpadFunction*⟩
⟨*defun subMatch*⟩
⟨*defun substringMatch*⟩
⟨*defun subTypes*⟩
⟨*defun summary*⟩
⟨*defun syGeneralErrorHere*⟩
⟨*defun syIgnoredFromTo*⟩
⟨*defun synonym*⟩
⟨*defun synonymsForUserLevel*⟩
⟨*defun synonymSpad2Cmd*⟩
⟨*defun sySpecificErrorAtToken*⟩
⟨*defun sySpecificErrorHere*⟩
⟨*defun systemCommand*⟩

⟨*defun ?t*⟩
⟨*defun tabbing*⟩
⟨*defun terminateSystemCommand*⟩
⟨*defun tersyscommand*⟩
⟨*defun thisPosIsEqual*⟩
⟨*defun thisPosIsLess*⟩
⟨*defun toFile?*⟩
⟨*defun tokConstruct*⟩
⟨*defun tokPosn*⟩

⟨*defun tokTran*⟩
⟨*defun tokType*⟩
⟨*defun toScreen?*⟩
⟨*defun trace*⟩
⟨*defun trace1*⟩
⟨*defun traceDomainConstructor*⟩
⟨*defun traceDomainLocalOps*⟩
⟨*defun tracelet*⟩
⟨*defun traceOptionError*⟩
⟨*defun /tracereply*⟩
⟨*defun traceReply*⟩
⟨*defun traceSpad2Cmd*⟩
⟨*defun translateTrueFalse2YesNo*⟩
⟨*defun translateYesNo2TrueFalse*⟩
⟨*defun transOnlyOption*⟩
⟨*defun transTraceItem*⟩

⟨*defun unAbbreviateKeyword*⟩
⟨*defun undo*⟩
⟨*defun undoChanges*⟩
⟨*defun undoCount*⟩
⟨*defun undoFromFile*⟩
⟨*defun undoInCore*⟩
⟨*defun undoLocalModemapHack*⟩
⟨*defun undoSingleStep*⟩
⟨*defun undoSteps*⟩
⟨*defun unescapeStringsInForm*⟩
⟨*defun unsqueeze*⟩
⟨*defun untrace*⟩
⟨*defun untraceDomainConstructor*⟩
⟨*defun untraceDomainConstructor,keepTraced?*⟩
⟨*defun untraceDomainLocalOps*⟩
⟨*defun untraceMapSubNames*⟩
⟨*defun unwritable?*⟩
⟨*defun updateCurrentInterpreterFrame*⟩
⟨*defun updateFromCurrentInterpreterFrame*⟩
⟨*defun updateHist*⟩
⟨*defun updateInCoreHist*⟩
⟨*defun updateSourceFiles*⟩
⟨*defun userLevelErrorMessage*⟩

⟨*defun validateOutputDirectory*⟩

⟨*defun what*⟩
⟨*defun whatCommands*⟩
⟨*defun whatConstructors*⟩

⟨*defun whatSpad2Cmd*⟩
⟨*defun whatSpad2Cmd,fixpat*⟩
⟨*defun whichCat*⟩
⟨*defun with*⟩
⟨*defun workfiles*⟩
⟨*defun workfilesSpad2Cmd*⟩
⟨*defun wrap*⟩
⟨*defun write-browsedb*⟩
⟨*defun write-categorydb*⟩
⟨*defun write-compress*⟩
⟨*defun writeHiFi*⟩
⟨*defun writeHistModesAndValues*⟩
⟨*defun writeInputLines*⟩
⟨*defun write-interpdb*⟩
⟨*defun write-operationdb*⟩
⟨*defun write-warmdata*⟩
⟨*defun writify*⟩
⟨*defun writifyComplain*⟩
⟨*defun writify,writifyInner*⟩

⟨*defun xlCannotRead*⟩
⟨*defun xlCmdBug*⟩
⟨*defun xlConActive*⟩
⟨*defun xlConsole*⟩
⟨*defun xlConStill*⟩
⟨*defun xlFileCycle*⟩
⟨*defun xlIfBug*⟩
⟨*defun xlIfSyntax*⟩
⟨*defun xlMsg*⟩
⟨*defun xlNoSuchFile*⟩
⟨*defun xlOK*⟩
⟨*defun xlOK1*⟩
⟨*defun xlPrematureEOF*⟩
⟨*defun xlPrematureFin*⟩
⟨*defun xlSay*⟩
⟨*defun xlSkip*⟩
⟨*defun xlSkippingFin*⟩

⟨*defun yesanswer*⟩

⟨*defun zsystemdevelopment*⟩
⟨*defun zsystemdevelopment1*⟩
⟨*defun zsystemDevelopmentSpad2Cmd*⟩

⟨*postvars*⟩

Chapter 69

The Global Variables

69.1 Star Global Variables

NAME	SET	USE
eof*	ncTopLevel	
features*		restart
package*		restart
standard-input*		ncIntLoop
standard-output*		ncIntLoop
top-level-hook*	set-restart-hook	

69.1.1 *eof*

The `*eof*` variable is set to NIL in ncTopLevel.

69.1.2 *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.

69.1.3 *package*

The `*package*` variable, from common lisp, is set in restart to the BOOT package where the intepreter lives.

69.1.4 *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.

69.1.5 *standard-output*

The `*standard-output*` common lisp variable is used to set the curoutstream variable in ncIntLoop.

69.1.6 *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.

69.2 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	
$nopos		SpadInterpretStream
$okToExecuteMachineCode	SpadInterpretStream	
$oldHistoryFileName	initvars	oldHistFileName
$options		history
	historySpad2Cmd	historySpad2Cmd
		undo

69.2.1 $boot

The `$boot` variable is set to NIL in ncTopLevel.

69.2.2 coerceFailure

The coerceFailure symbol is a catch tag used in runspad to catch an exit from ncTopLevel.

69.2.3 $currentLine

The `$currentLine` line is set to NIL in restart. It is used in removeUndoLines in the undo mechanism.

69.2.4 $displayStartMsgs

The `$displayStartMsgs` variable is used in restart but is not set so this is likely a bug.

69.2.5 $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.

69.2.6 $erMsgToss

The `$erMsgToss` variable is set to NIL in SpadInterpretStream.

69.2.7 $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.

69.2.8 $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 a system command is given which alters the environment.

Note: 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.

69.2.9 $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.

69.2.10 $HistList

Thie `$HistList` variable is set by initHistList to an initial value of NIL elements. The last element of the list is smashed to point to the first element to make the list circular. This is a circular list of length `$HistListLen`.

69.2.11 $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.

69.2.12 $HistListLen

The `$HistListLen` variable is set by initHistList to 20. This is the length of a circular list maintained in the variable `$HistList`.

69.2.13 $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.

69.2.14 $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.

69.2.15 $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.

69.2.16 $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.

69.2.17 $interpreterFrameRing

The `$interpreterFrameRing` is set to a pair whose car is set to the result of emptyInterpreterFrame

69.2.18 $InteractiveFrame

The `$InteractiveFrame` is set in restart to the value of the call to the makeInitialModemapFrame function. This function simply returns a copy of the variable `$InitialModemapFrame`

69.2.19 $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.

69.2.20 $intTopLevel

The `$intTopLevel` is a catch tag. Throwing to this tags which is caught in the intloop will restart the SpadInterpretStream function.

69.2.21 $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 then have already happened.

69.2.22 $lastPos

The `$lastPos` variable is set in SpadInterpretStream to the value of the `$nopos` variable. Since `$nopos` appears to have no value this is likely a bug.

69.2.23 $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.

69.2.24 $msgDatabaseName

The `$msgDatabaseName` is set to NIL in reroot.

69.2.25 $ncMsgList

The `$ncMsgList` is set to NIL in SpadInterpretStream.

69.2.26 $newcompErrorCount

The `$newcompErrorCount` is set to 0 in SpadInterpretStream.

69.2.27 $newspad

The `$newspad` is set to T in ncTopLevel.

69.2.28 $nopos

The `$nopos` variable is used in SpadInterpretStream but does not appear to have a value and is likely a bug.

69.2.29 $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.

69.2.30 $okToExecuteMachineCode

The `$okToExecuteMachineCode` is set to T in SpadInterpretStream.

69.2.31 $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.

69.2.32 $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.

69.2.33 $PrintCompilerMessageIfTrue

The `$PrintCompilerMessageIfTrue` variable is set to NIL in spad.

69.2.34 $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.

69.2.35 $spad

The `$spad` variable is set to T in ncTopLevel.

69.2.36 $SpadServer

If an open server is not requested then this variable to T. It has no value before this time (and is thus a bug).

69.2.37 $SpadServerName

The `$SpadServerName` is passed to the openServer function, if the function exists.

69.2.38 $systemCommandFunction

The `$systemCommandFunction` is set in SpadInterpretStream to point to the function InterpExecuteSpadSystemCommand.

69.2.39 top_level

The top_level symbol is a catch tag used in runspad to catch an exit from ncTopLevel.

69.2.40 $quitTag

The `$quitTag` is used as a variable in a catch block. It appears that it can be thrown somewhere below ncTopLevel.

69.2.41 $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.

69.2.42 $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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