STELLA Manual

Painless symbolic programming with
delivery in Common-Lisp, C++ and Java

Version: $Revision$

This manual describes
STELLA 3.4 or later.

The STELLA Development Team
Hans Chalupsky
Robert M. MacGregor
Thomas A. Russ
{hans,tar}@isi.edu

USC Information Sciences Institute

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1 Introduction

This document describes the STELLA programming language. STELLA stands for Strongly-TypEd, Lisp-like LAnguage. It is an object-oriented language that strongly supports symbolic programming tasks. We developed it, since none of the currently "healthy" languages such as C++ or Java adequately support symbolic programming. While Common-Lisp would probably still be today's language of choice for many symbolic programming applications, its dwindling vendor support and user base make it more and more difficult to justify its use.

When we started the development of the PowerLoom knowledge representation system in 1995 we were faced with exactly this problem. PowerLoom had to be delivered in C++, but it was simply incoceivable to write such a large symbolic programming application directly in C++. The solution was to invent a new programming language we called STELLA and write PowerLoom in STELLA instead.

STELLA is a strongly typed, object-oriented, Lisp-like language specifically geared to support artificial intelligence applications. STELLA preserves those features of Common Lisp deemed essential for symbolic programming such as built-in support for dynamic data structures, heterogeneous collections, first-class symbols, powerful iteration constructs, name spaces, an object-oriented type system with a simple meta-object protocol, exception handling, language extensibility through macros and automatic memory management. Maybe the biggest difference between STELLA and Common Lisp is that STELLA is strongly typed. All externally visible interfaces such as slots, function parameters and return values, etc. have to be explicitly typed. Internal objects such as local variables, however, are mostly typed implicitly supported by type inference. This in conjunction with a powerful type coercion mechanism significantly reduces the number of explicit type information that needs to be supplied by the programmer compared to languages such as C++ or Java.

STELLA programs are first translated into a target language such as Common Lisp, C++ or Java, and then compiled with the native target language compiler to generate executable code. The language constructs of STELLA are restricted to those that can be translated fairly directly into native constructs of the intended target languages. This allows STELLA to be translated into efficient, conventional and readable Lisp, C++ and Java code. The resulting native code can be understood and to some extent even maintained by programmers who don't know STELLA, and it can easily be interfaced with other programs not written in STELLA.

As of Fall 2000, we have programmed approximately 100,000 lines of STELLA code - about 50% for the STELLA kernel itself and the other 50% for the PowerLoom knowledge representation system and related systems. Our subjective experience has been that it is only slightly more difficult to write and debug a STELLA program than a Lisp program, and that the inconvenience of having to supply some type information is much outweighed by the benefits such as catching many errors during compile time instead of at run time.

The biggest benefit, however, seems to be that we can still leverage all the incremental code development benefits of Lisp, since we use the Common Lisp-based version of STELLA for prototyping. This allows us to incrementally define and redefine functions, methods and classes and to inspect, debug and fix incorrect code on the fly. Even the most sophisticated C++ or Java IDE's don't yet seem to support this fully incremental development style, i.e., a change in a class (every change in Java is a change to a class) still requires recompilation and restart of the application. But it is the restart that can be the most time consuming if one debugs a complex application that takes a significant time to reach a certain state!

Once a STELLA program has matured, it can be translated into C++ or Java to gain extra efficiency, to deliver it as a stand-alone application, or to link it with other programs.

1.1 Credits and History

Bob MacGregor invented STELLA in 1995 to implement the PowerLoom knowledge representation system. He wrote most of the first Lisp-based kernel system of STELLA and still occasionally writes extensions or provides fixes. Today he is primarily a STELLA user writing his own applications.

Hans Chalupsky completed the first full STELLA bootstrap (STELLA translating itself) in Spring 1996, and then went on to deal with all the changes necessary to handle the many C++ and Java idiosyncrasies that were discovered when the first versions of these translators came online. He is currently one of the principal maintainers of STELLA supporting the STELLA code analyzer and the Lisp and C++ translators.

Eric Melz wrote the first version of the C++ translator under very trying circumstances (i.e., at a stage where the STELLA language changed under him on a daily basis). He got the first C++ version of STELLA running in the Fall of 1996.

Tom Russ wrote the Java translator and got the first Java version of STELLA running in Spring 1999. He is currently one of the principal maintainers of STELLA supporting the STELLA code analyzer and the Lisp and Java translators. He is also still active writing occasional extensions such as the STELLA XML parser.

2 Installation

2.1 System Requirements

To install and use STELLA you'll approximately need the following amounts of disk space:

- 8 MB for the tar-red or zip-ped archive file
- 35 MB for the untarred sources, tanslations, compiled Java files and documentation
- 8 MB to compile a Lisp version
- 11 MB to compile the C++ version (without -g)
- 3 MB to compile the Java version (already included)

This means that you will need approximately 55 MB to work with one Lisp, one C++ and one Java version of STELLA in parallel. If you also want to experiment with the Lisp translation variant that uses structures instead of CLOS instances to implement STELLA objects, then you will need an extra 8 MB to compile that.

The full STELLA development tree is quite large, since for every STELLA source file there are three to four translated versions and as many compiled versions thereof. The actual STELLA libraries that you have to ship with an application, however, are quite small. For example, the Java jar file `stella.jar` is only about 1.3 MB in size. The dynamic C++ library `libstella.so` compiled on a Linux platform is about 4 MB. Additionally, if you don't need all the different translations of STELLA, you can delete some of the versions to keep your development tree smaller (See Section 2.7 [Removing Unneeded Files], page 6).

To run the Lisp version of STELLA you need an ANSI Common-Lisp (or at least one that supports CLOS and logical pathnames). We have successfully tested STELLA with Allegro-CL 4.2, 4.3, 5.0, 6.0 and 7.0, Macintosh MCL 3.0, 4.0 and 5.1, OpenMCL 1.0, SBCL 0.9.4, CMUCL 19c, LispWorks 4.4.6, CLisp 2.37, Lucid CL 4.1 (plus the necessary ANSI extensions and Mark Kantrowitz's logical pathnames implementation) and various others. Our main development platform is Allegro CL running under Sun Solaris and Linux, so, the closer your environment is to ours, the higher are the chances that everything will work right out of the box. Lisp development under Windows should also be no problem.

To run the C++ version of STELLA you need a C++ compiler such as g++ that supports templates and exception handling. We have successfully compiled and run STELLA with g++ 3.2 and later under Linux Redhat 8.0 & 9.0, SunOS and MacOS X, and with CygWin 5.0 and MinGW 5.0 under Windows 2000 and XP. Both CygWin and MinGW provide a GNU Unix environment, but MinGW can generate Windows executables that are fully standalone. We've also managed to compile STELLA under MS Visual C++, however, we never got the Boehm garbage collector to work. The GC claims to be very portable, so this should be solvable for somebody with good knowledge of MS Visual C++.

For the Java version you will need Java JDK 1.2 or later. To get reasonable performance, you should use J2SDK 1.4 or 1.5. We've run the Java version of STELLA on a variety of platforms without any problems.

Any one of the Lisp, C++ or Java implementations of STELLA can be used to develop your own STELLA code and translate it into all three languages, but the most convenient development environment is the one based on Lisp. If you use the C++ or Java version, translating and using your own STELLA macros is possible but not yet very well supported.

2.2 Unpacking the Sources

Uncompress and untar the file `stella-X.Y.Z.tar.gz` (or unzip the file `stella-X.Y.Z.zip`) in the parent directory of where you want to install STELLA ('X.Y.Z' are place holders for the actual version numbers). This will create the STELLA tree in the directory `stella-X.Y.Z/`. All pathnames mentioned below will be relative to that directory which we will usually refer to as the "STELLA directory".

2.3 Lisp Installation

To install the Lisp version startup Lisp and load the file `load-stella.lisp` with:

```
(CL:load "load-stella.lisp")
```

The first time around this will compile all Lisp-translated STELLA files before they are loaded. During subsequent sessions the compiled files will be loaded right away.

If you want to use the version that uses Lisp structs instead of CLOS objects to implement STELLA objects do the following:

```
(CL:setq cl-user::*load-cl-struct-stella?* CL:t)
(CL:load "load-stella.lisp")
```

Alternatively, you can edit the initial value of the variable `*load-cl-struct-stella?*` in the file `load-stella.lisp`. Using structs instead of CLOS objects greatly improves slot access speed, however, it may cause problems with incremental re-definition of STELLA classes. It is therefore recommended to only use this for systems that are in or near the production stage.

Once all the files are loaded, you should see a message like this:

```
Initializing STELLA...
STELLA 3.4.0 loaded.
Type `(in-package "STELLA")' to execute STELLA commands.
USER(2):
```

To reduce startup time, you might want to create a Lisp image that has all of STELLA preloaded.

Now type

```
(in-package "STELLA")
```

to enter the `STELLA` Lisp package where all the STELLA code resides.

IMPORTANT: All unqualified Lisp symbols in this document are assumed to be in the `STELLA` Lisp package. Moreover, the `STELLA` package does **NOT** inherit anything from the `COMMON-LISP` package (see the file `sources/stella/cl-lib/cl-setup.lisp` for the few exceptions), hence, you have to explicitly qualify every Lisp symbol you want to use with `CL:`. For example, to get the result of the previous evaluation you have to type `CL:*` instead of `*`.

2.4 C++ Installation

To compile the C++ version of STELLA change to the native C++ directory and run `make`:

```
% cd native/cpp/stella
% make
```

This will compile all STELLA files, the garbage collector and generate a static or dynamic `libstella` library file in the directory `native/cpp/lib` which can later be linked with your own C++-translated STELLA (or other) code. To test whether the compilation was successful you can run STELLA from the top-level STELLA directory using the `stella` script (or `stella.bat` under a Windows command prompt):

```
% stella c++
Running C++ version of STELLA...
Welcome to STELLA 3.4.0
Running kernel startup code...
Initializing symbol tables...
Initializing quoted constants...
Initializing global variables...
Creating class objects...
Finalizing classes...
Creating method objects...
Finalizing methods...
Running non-phased startup code...
Starting up translators...
Bye!
```

This will simply run various STELLA startup code and exit. See Section 4.1.2 [Hello World in C++], page 14, to see how you can use the STELLA C++ executable to translate STELLA code. The `c++` argument tells the script to run the C++ version of STELLA. If the argument is omitted and the C++ version is installed, it will be run automatically. Otherwise, the Java version will be run.

2.5 Java Installation

Nothing needs to be done to install the Java version. Since Java class files are platform independent, they are already shipped with the STELLA distribution and can be found in the directory `native/java` and its subdirectories. Additionally, they have been collected into the file `native/java/lib/stella.jar`. To try out the Java version of STELLA run the `stella` script in the STELLA directory:

```
% stella java
Running Java version of STELLA...
Welcome to STELLA 3.4.0
Running kernel startup code...
Initializing symbol tables...
Initializing quoted constants...
Initializing global variables...
Creating class objects...
Finalizing classes...
Creating method objects...
Finalizing methods...
Running non-phased startup code...
Starting up translators...
Bye!
```

Similar to the C++ executable, this will simply run various STELLA startup code and exit. See Section 4.1.3 [Hello World in Java], page 16, to see how you can use the STELLA Java executable to translate STELLA code.

2.6 X/Emacs Setup

STELLA development is very similar to Lisp development, and it is best done in an X/Emacs-based Lisp development environment such as the Allegro-CL Emacs interface plus Allegro Composer, or ILISP. If you do use X/Emacs with the Allegro CL interface, add the following to your `.emacs` or `.xemacs/init.el` file:

```
(setq auto-mode-alist
      (cons '("\\.ste$" . fi:common-lisp-mode) auto-mode-alist))
```

If you are using the Allegro CL interface, you might want to install the file `emacs/fi-stella.el`, since it sets up proper indentation for STELLA code and makes looking up STELLA definitions via the *C-c .* or *M-.* commands work better. Look at the file `emacs/fi-stella.el` for specific installation instructions.

2.7 Removing Unneeded Files

To save disk space you can remove files that you don't need. For example, if you are not interested in the C++ version of STELLA, you can delete the directory `native/cpp`. Similarly, you can remove `native/java` to eliminate all Java-related files. You could do the same thing for the Lisp directory `native/lisp`, but (in our opinion) that would make it less convenient for you to develop new STELLA code. Finally, if you don't need any of the STELLA sources, you can delete the directory `sources/stella`. If you don't need local copies of the STELLA documentation, you can delete parts or all of the `sources/stella/doc` directory.

3 The STELLA Language

3.1 Language Overview

STELLA is a strongly typed, object-oriented, Lisp-like language. STELLA programs are first translated into either Common Lisp, C++, or Java, and then compiled with any conventional compiler for the chosen target language to generate executable code. Over 95% of the STELLA system is written in STELLA itself, the rest is written in target-language-specific native code.

The design of STELLA borrows from a variety of programming languages, most prominently from Common Lisp, and to a lesser degree from other object-oriented languages such as Eiffel, Sather, and Dylan. Since STELLA has to be translatable into C++ and Java, various restrictions of these languages also influenced its design.

In the following, we assume that the reader is familiar with basic Common Lisp concepts, and has at least some familiarity with C++ or Java. Let us start with a cursory overview of STELLA's main features:

Syntax: STELLA uses a parenthesized, uniform expression syntax similar to Lisp. Most definitional constructs and control structures are similar to their Common Lisp analogues with variations to support types.

Type system: STELLA is strongly typed and supports efficient static compilation similar to C++. Types are required for the arguments and return values of functions and methods, for global variables, and for slot definitions. Local, lexically scoped variables can be typed implicitly by relying on type inference.

Object system: Types are organized into a single inheritance class hierarchy. Restricted multiple inheritance is allowed via mixin classes. Dynamic method dispatch is based on the runtime type of the first argument (similar to C++ and Java). Slots can be static (native) or dynamic. Dynamic slots can be defined at runtime and do not occupy any space until they are filled. Slots can have both initial and default values, and demons can be triggered by slot accesses. A meta-object protocol allows the control of object creation, initialization, termination, and destruction.

Control structure: Functions and methods are distinguished. They can have multiple (zero or more) return values and a variable number of arguments. Lisp-style macros are supported to facilitate syntax extensions. Expressions and statements are distinguished. Local variables are lexically scoped, but dynamically scoped variables (specials) are also supported. STELLA has an elegant, uniform, and efficient iteration mechanism plus a built-in protocol for iterators. An exception mechanism can be used for error handling and non-local exits.

Symbolic programming: Symbols are first-class objects, and extensive support for dynamic datatypes such as cons-trees, lists, sets, association lists, hash tables, extensible vectors, etc., is available. A backquote mechanism facilitates macro writing and code generation. Interpreted function call, method call, slot access, and object creation is supported, and a restricted evaluator is also available.

Name spaces: Functions, methods, variables, and classes occupy separate name spaces (i.e., the same name can be used for a function and a class). A hierarchical module system compartmentalizes symbol tables and supports large-scale programming.

Memory management: STELLA relies on automatic memory management via a garbage collector. For Lisp and Java the native garbage collector is used. For the C++ version of STELLA we use the Boehm- Weiser conservative garbage collector with good results. Various built-in support for explicit memory management is also available.

The Common Lisp features most prominently absent from STELLA are anonymous functions via lambda abstraction, lexical closures, multi-methods, full-fledged eval (a restricted evaluator is available), optional and keyword arguments, and a modifiable readtable. STELLA does also not allow dynamic re/definition of functions and classes, even though the Lisp-based development environment provides this facility (similar to Dylan). The main influences of C++ and Java onto STELLA are the strong typing, limited multiple inheritance, first-argument polymorphism, and the distinction between statements and expressions.

3.2 Basic Data Types (tbw)

To be written.

3.3 Control Structure (tbc)

To be completed.

3.3.1 Conditionals

STELLA conditionals are very similar to those found in Common-Lisp. The main difference is that most STELLA conditionals are statements and therefore do not return a value. For this reason, a C++-style `choose` directive has been added to the language to allow value conditionalization based on a boolean expression.

`if` *condition then-statement else-statement* [Statement]

Evaluate the boolean expression *condition*. If the result is true execute *then-statement*, otherwise, execute *else-statement*. Note that unlike the Common-Lisp version of `if` the *else-statement* is not optional in STELLA. Example:

```
(if (> x y)
    (print "x is greater than y" EOL)
  (print "x is less than or equal to y" EOL))
```

`when` *condition statement...* [Statement]

Evaluate the boolean expression *condition*. Only if the result is true execute the *statement*'s in the body. Example:

```
(when (symbol? x)
  (print "x is a symbol, ")
  (print "its name is " (symbol-name (cast x SYMBOL)) EOL))
```

`unless` *condition statement...* [Statement]

Evaluate the boolean expression *condition*. Only if the result is false execute the *statement*'s in the body. Therefore, `(unless test ...)` is equivalent to `(when (not test) ...)`. Example:

```
(unless (symbol? x)
  (print "x is not a symbol, ")
  (print "hence, its name is unknown" EOL))
```

`cond` *clause...* [Statement]

`cond` is a conditional with an arbitrary number of conditions each represented by a *clause*. Each `cond` clause has to be of the following form:

```
(condition statement...)
```

The first *clause* whose *condition* evaluates to true will be selected and its *statement*'s will be executed. Each clause can have 0 or more statements. The special condition `otherwise` always evaluates to true and can be used for the catch-all case. Example:

```
(cond ((symbol? x)
       (print "x is a symbol" EOL))
      ((cons? x)
       (print "x is a cons" EOL))
      (otherwise
       (print "x is an object" EOL)))
```

`choose` *condition true-expression false-expression* [Expression]

Evaluate the boolean expression *condition*. If the result is true return the value of *true-expression*, otherwise, return the value of *false-expression*. STELLA computes the most specific common supertype of *true-expression* and *false-expression* and uses that as the type returned by the `choose` expression. If no such type exists, a translation error will be signaled. Example:

```
(setq face (choose happy? :smile :frown))
```

`case` *expression clause...* [Statement]

Each `case` clause has to be of one of the following forms:

```
(key statement...)
((key...) statement...)
```

`case` selects the first *clause* whose *key* (or one of the listed *key*'s) matches the result of *expression* and executes the clause's *statement*'s. Each `case` *key* has to be a constant such as a number, character, string, symbol, keyword or surrogate. Keys are compared with `eql?` (or `string-eql?` for strings). All keys in a `case` statement have to be of the same type. The special key `otherwise` can be used to catch everything. It is a run-time error if no clause with a matching key exists. Therefore, a STELLA `case` without an `otherwise` clause corresponds to a Common Lisp `ecase`. An empty `otherwise` clause can always be specified via `(otherwise NULL)`. Example:

```
(case car-make
  ("Yugo"
   (setq price :cheap))
  ("VW"
   (setq price :medium))
  (("Ferrari" "Rolls Royce")
   (setq price :expensive))
  (otherwise
   (setq price :unknown)))
```

`typecase` *expression clause...* [Statement]

Each `typecase` clause has to be of one of the following forms:

```
(type statement...)
```

```
((type...) statement...)
```

`typecase` selects the first *clause* whose *type* (or one of the listed *type*'s) equals or is a supertype of the run-time type of the result of *expression* and then executes the clause's *statement*'s. Therefore, `typecase` can be used to implement a type dispatch for cases where the run-time type of an expression can be different from the static type known at translation time. Currently, the static type of *expression* is required to be a subtype of `OBJECT`.

Each *type* expression has to be a symbol describing a simple type (i.e., parametric or anchored types are not allowed). Similar to `case`, the special key `otherwise` can be used to catch everything. It is a run-time error if no clause with a matching type exists. Therefore, a STELLA `typecase` without an `otherwise` clause corresponds to a Common Lisp `etypecase`. An empty `otherwise` clause can always be specified via `(otherwise NULL)`. `typecase` does allow the value of *expression* to be undefined, in which case the `otherwise` clause is selected. Example:

```
(typecase (first list)
  (CONS
   (print "it is a cons"))
  ((SYMBOL KEYWORD)
   (print "it is a symbol"))
  (STANDARD-OBJECT
   (print "it is a regular object"))
  (otherwise NULL))
```

Note that in the example above it is important to list `STANDARD-OBJECT` after `SYMBOL` and `CONS`, since it subsumes the preceding types. Otherwise, it would always shadow the clauses with the more specific types.

The semantics of `typecase` is slightly extended for the case where *expression* is a local variable. In that case each reference to the variable within a `typecase` clause is automatically casted to the appropriate narrower type. For example, in the code snippet below method calls such as `first` or slot accesses such as `symbol-name` are translated correctly without needing to explicitly downcast `x` which is assumed to be of type `OBJECT`:

```
(typecase x
  (CONS
   (print "it is a cons with value " (first x)))
  ((SYMBOL KEYWORD)
   (print "it is a symbol with name " (symbol-name x)))
  (STANDARD-OBJECT
   (print "it is a regular object"))
  (otherwise NULL))
```

Since the `typecase` *expression* has to be a subtype of `OBJECT`, a `typecase` cannot be used to test against literal types such as `STRING` or `INTEGER`. If such type names are encountered as keys in a `typecase`, they are automatically converted to their wrapped version, e.g., `STRING-WRAPPER`, `INTEGER-WRAPPER`, etc.

3.4 Functions (tbw)

To be written.

3.5 Classes (tbw)

To be written.

3.6 Methods (tbw)

To be written.

3.7 Macros (tbw)

To be written.

3.8 Modules (tbw)

To be written.

4 Programming in STELLA

4.1 Hello World in STELLA

Included with the STELLA distribution is a simple Hello World application that shows you how to organize your own STELLA code and build a working STELLA application. The sources for the Hello World system consist of the following files:

```
sources/systems/hello-world-system.ste
sources/hello-world/file-a.ste
sources/hello-world/file-b.ste
```

STELLA organizes code modules with a simple system facility. Translation always operates on a complete system, so you always need to create a system definition for the STELLA files comprising your application (somewhat similar to what you would put in a Unix Makefile).

For the Hello World system the system definition already exists and resides in the file `sources/systems/hello-world-system.ste`. By default, STELLA looks in the directory `sources/systems` to find the definition of a particular system. `hello-world-system.ste` defines two things:

(1) The `HELLO-WORLD` module which defines a namespace for all objects in the Hello World systems. STELLA modules are mapped onto corresponding native namespace constructs, i.e., Lisp packages, C++ namespaces or Java packages. The exact mapping for each language can be defined via the keyword options `:lisp-package`, `:cpp-package` and `:java-package` in the module definition, for example:

```
(defmodule "HELLO-WORLD"
  :lisp-package "STELLA"
  :cpp-package "hello_world"
  :java-package "edu.isi.hello_world"
  :uses ("STELLA"))
```

The `:uses` directive tells STELLA from what other modules this one inherits.

(2) The actual system definitions defining what source files comprise the system, and what parent systems this one depends on, plus a variety of other options:

```
(defsystem HELLO-WORLD
  :directory "hello-world"
  :required-systems ("stella")
  :cardinal-module "HELLO-WORLD"
  :production-settings (1 0 3 3)
  :development-settings (3 2 3 3)
  :files ("file-a"
          "file-b"))
```

4.1.1 Hello World in Lisp

To generate a Lisp translation of Hello World you can use either the Lisp, C++ or Java version of STELLA. Before you can translate you have to make sure the following native directories exist:

```
native/lisp/hello-world/
```

```
bin/acl7.0/hello-world/
```

The directory `native/lisp/hello-world/` will hold the Lisp translations of the corresponding STELLA source files. The directory `bin/acl7.0/hello-world/` will hold the compiled Lisp files if you are using Allegro CL 7.0. If you are using a different Lisp, one of the other binary directories as defined in the top-level file `translations.lisp` will be used. The directory `bin/lisp/hello-world/` will be used as a fall-back if your version of Lisp is not yet handled in `translations.lisp`.

If you create your own system, you will need to create those directories by hand (future versions of STELLA might do that automatically). For the Hello World system these directories already exist.

To generate a Lisp translation of Hello World using Lisp startup a Lisp version of STELLA (see Section 2.3 [Lisp Installation], page 4). The following idiom will then translate the system into Lisp and also Lisp-compile and load it. The first argument to `make-system` is the name of the system, and the second argument indicates into what language it should be translated:

```
STELLA(3): (make-system "hello-world" :common-lisp)
Processing ‘/tmp/stella-3.1.0/sources/hello-world/file-a.ste’:
*** Pass 1, generating objects...
Processing ‘/tmp/stella-3.1.0/sources/hello-world/file-b.ste’:
*** Pass 1, generating objects...
   .........................................
;;; Writing fasl file
;;;   /tmp/stella-3.1.0/native/lisp/bin/acl7.0/hello-world/startup-system.fasl
;;; Fasl write complete
; Fast loading
;    /tmp/stella-3.1.0/native/lisp/bin/acl7.0/hello-world/startup-system.fasl
CL:T
STELLA(4):
```

After the system is loaded you can call its `main` function:

```
STELLA(10): (main)
Hello World A
Hello World B
bye
()
STELLA(11):
```

Using `main` in the Lisp version will not always make sense, since you can call any function directly at the Lisp top level, but both C++ and Java always need a `main` function as a top-level entry point.

While this would be somewhat unusual, you could also generate the Lisp translation using the C++ or Java version of STELLA. The easiest way to do that is to run the `stella` script in the STELLA directory like this:

```
% ./stella -e ’(make-system "hello-world" :common-lisp)’
Running C++ version of STELLA...
Welcome to STELLA 3.4.0
Processing ‘sources/hello-world/file-a.ste’:
```

```
*** Pass 1, generating objects...
Processing ‘sources/hello-world/file-b.ste’:
*** Pass 1, generating objects...
  ..........................................
Translating ‘sources/hello-world/file-a.ste’ to ‘Common Lisp’...
Writing ‘native/lisp/hello-world/file-a.lisp’...
Translating ‘sources/hello-world/startup-system.ste’ to ‘Common Lisp’...
Writing ‘native/lisp/hello-world/startup-system.lisp’...
```

The `-e` command line option is used to evaluate an evaluable STELLA command. Conveniently, `make-system` is such a command, so you can supply a `make-system` form to the C++ or Java version of STELLA just as you would do in Lisp. Note the extra quotes around the expression to protect the characters from interpretation by the Unix shell.

To compile and load the translated Lisp files into Lisp you then have to startup a Lisp version of STELLA and call `make-system` again which now will only compile and load the necessary files, since the translations have already been generated in the previous step.

4.1.2 Hello World in C++

To generate a C++ translation of Hello World you can use either the Lisp, C++ or Java version of STELLA. Before you can translate you have to make sure the following native directory exists:

```
native/cpp/hello-world/
```

The directory `native/cpp/hello-world/` will hold the C++ translations of the corresponding STELLA source files. If you create your own system, you will need to create this directory by hand (future versions of STELLA might do that automatically). For the Hello World system the directory already exist.

To generate a C++ translation of Hello World using Lisp startup a Lisp version of STELLA (see Section 2.3 [Lisp Installation], page 4). The following idiom will then translate the system into C++. The first argument to `make-system` is the name of the system, and the second argument indicates into what language it should be translated:

```
STELLA(4): (make-system "hello-world" :cpp)
Processing ‘/tmp/stella-3.1.0/sources/hello-world/file-a.ste’:
*** Pass 1, generating objects...
Processing ‘/tmp/stella-3.1.0/sources/hello-world/file-b.ste’:
*** Pass 1, generating objects...
  ..........................................
Writing ‘/tmp/stella-3.1.0/native/cpp/hello-world/file-b.hh’...
Writing ‘/tmp/stella-3.1.0/native/cpp/hello-world/file-b.cc’...
Translating ‘/tmp/stella-3.1.0/sources/hello-world/startup-system.ste’.
Writing ‘/tmp/stella-3.1.0/native/cpp/hello-world/startup-system.hh’...
Writing ‘/tmp/stella-3.1.0/native/cpp/hello-world/startup-system.cc’...
:VOID
STELLA(5):
```

Alternatively, you can generate the translation using the C++ or Java version of STELLA. The easiest way to do that is to run the `stella` script in the STELLA directory like this:

```
% ./stella -e '(make-system "hello-world" :cpp)'
```

```
Running C++ version of STELLA...
Welcome to STELLA 3.4.0
Processing `sources/hello-world/file-a.ste':
*** Pass 1, generating objects...
Processing `sources/hello-world/file-b.ste':
*** Pass 1, generating objects...
  ..........................................
Writing `native/cpp/hello-world/file-b.hh'...
Writing `native/cpp/hello-world/file-b.cc'...
Translating `sources/hello-world/startup-system.ste'.
Writing `native/cpp/hello-world/startup-system.hh'...
Writing `native/cpp/hello-world/startup-system.cc'...
```

The `-e` command line option is used to evaluate an evaluable STELLA command. Conveniently, `make-system` is such a command, so you can supply a `make-system` form to the C++ or Java version of STELLA just as you would do in Lisp. Note the extra quotes around the expression to protect the characters from interpretation by the Unix shell.

Different from Lisp, neither of the above idioms will compile and load the generated C++ code. Instead you have to use the Unix `make` facility to compile and link the C++ sources. First change into the native `hello-world` directory and then call `make` (**important**: the generated Makefiles currently require the GNU version of `make`):

```
% cd native/cpp/hello-world/
% make
g++ -w -g -O2  -DSTELLA_USE_GC -I../stella/cpp-lib/gc/include \
    -c -I.. main.cc
g++ -w -g -O2  -DSTELLA_USE_GC -I../stella/cpp-lib/gc/include \
    -c -I.. file-a.cc
g++ -w -g -O2  -DSTELLA_USE_GC -I../stella/cpp-lib/gc/include \
    -c -I.. file-b.cc
g++ -w -g -O2  -DSTELLA_USE_GC -I../stella/cpp-lib/gc/include \
    -c -I.. startup-system.cc
  .................................
g++ -dynamic  -L../stella/cpp-lib/gc -Xlinker -rpath -Xlinker \
       '../lib:/tmp/stella-3.1.0/native/cpp/lib' \
       main.o -o hello-world \
       -L../lib -lhello-world -L../lib -lstella -lgc -lm
```

The first time around this will also compile the C++ version of STELLA and the C++ garbage collector and create a STELLA library file. Future builds of the Hello World and other systems will use the STELLA library file directly. To run the Hello World system simply run the `hello-world` executable that was built in the previous step:

```
% ./hello-world
Hello World A
Hello World B
bye
```

4.1.3 Hello World in Java

To generate a Java translation of Hello World you can use either the Lisp, C++ or Java version of STELLA. Before you can translate you have to make sure the following native directory exists:

```
native/java/edu/isi/hello-world/
```

The directory `native/java/edu/isi/hello-world/` will hold the Java translations of the corresponding STELLA source files. If you create your own system, you will need to create this directory by hand (future versions of STELLA might do that automatically). For the Hello World system the directory already exist.

Note that following Java convention we use the package `edu.isi.hello_world` to hold the Hello World system. This was specified via the `:java-package` option in the definition of the `HELLO-WORLD` module. Also note that we use `hello_world` instead of `hello-world` as the package name, since a dash cannot legally appear as part of a Java identifier.

To generate a Java translation of Hello World using Lisp startup a Lisp version of STELLA (see Section 2.3 [Lisp Installation], page 4). The following idiom will then translate the system into Java. The first argument to `make-system` is the name of the system, and the second argument indicates into what language it should be translated:

```
STELLA(5): (make-system "hello-world" :java)
Processing '/tmp/stella-3.1.0/sources/hello-world/file-a.ste':
*** Pass 1, generating objects...
   ..............................................
Writing '/tmp/stella-3.1.0/native/java/hello_world/Startup_Hello_...
:VOID
STELLA(6):
```

Alternatively, you can generate the translation using the C++ or Java version of STELLA. The easiest way to do that is to run the `stella` script in the STELLA directory like this:

```
% ./stella -e '(make-system "hello-world" :java)'
Running C++ version of STELLA...
Welcome to STELLA 3.4.0
Processing 'sources/hello-world/file-a.ste':
*** Pass 1, generating objects...
Processing 'sources/hello-world/file-b.ste':
*** Pass 1, generating objects...
  ...............................................
Writing 'native/java/edu/isi/hello_world/HelloWorld.java'...
Writing 'native/java/edu/isi/hello_world/StartupFileA.java'...
Writing 'native/java/edu/isi/hello_world/StartupFileB.java'...
Writing 'native/java/edu/isi/hello_world/StartupHelloWorldSystem.java'...
```

The `-e` command line option is used to evaluate an evaluable STELLA command. Conveniently, `make-system` is such a command, so you can supply a `make-system` form to the C++ or Java version of STELLA just as you would do in Lisp. Note the extra quotes around the expression to protect the characters from interpretation by the Unix shell.

Different from Lisp, neither of the above idioms will compile and load the generated C++ code. Instead you have to use the Java compiler to compile and Java to run the compiled

Java sources. First change into the top-level native Java directory `native/java` and then compile and run the Hello World system like this:

```
% cd native/java/
% javac edu/isi/hello_world/*.java
% java edu.isi.hello_world.HelloWorld
Hello World A
Hello World B
bye
```

It is not necessary to Java-compile STELLA first, since STELLA already ships with a Java compilation of the STELLA system.

4.2 Incrementally Developing STELLA Code

The preferred method of STELLA code development is to use a Lisp-based version of STELLA for all the prototyping and testing, since that allows you to exploit most (or all) of the rapid-prototyping advantages of Lisp. Once a system has reached a certain point of stability, it can be translated into C++ or Java for delivery or to interface it with other C++ or Java code.

In the following, we assume an X/Emacs-based Lisp development environment such as the Allegro CL Emacs interface, where Lisp is run in an Emacs subprocess, and Lisp source can be compiled and evaluated directly from the source buffers. By "Lisp buffer" we mean the listener buffer in which Lisp is actually running, and by "source buffer" we mean a buffer that is used to edit a file that contains STELLA source.

Included in the distribution is the Hello World system comprised of the files

```
sources/systems/hello-world-system.ste
sources/hello-world/file-a.ste
sources/hello-world/file-b.ste
```

To get started, simply add your code to either `file-a.ste` or `file-b.ste`, since all the necessary definitions and directories for these files are already set up properly. See section ??? on how to setup your own system.

Make sure the Hello World system is loaded into Lisp by doing the following:

```
(make-system "hello-world" :common-lisp)
```

This will make sure that the system definition is loaded and the necessary module definition is evaluated.

Now suppose you add the following function to `file-a.ste`:

```
(defun (factorial INTEGER) ((n INTEGER))
  (if (eql? n 0)
      (return 1)
    (return (* n (factorial (1- n))))))
```

There are various options for translating and evaluating this definition. For example, you can simply remake the complete system similar to what you would do for a C++ or Java program:

```
(make-system "hello-world" :common-lisp)
```

This will retranslate the modified files, recompile them and reload them into your Lisp image.

Instead of retranslating and recompiling everything, you can incrementally evaluate the definition of `factorial` from your Emacs-to-Lisp interface. Simply put your cursor somewhere inside the definition in the source buffer and evaluate it by typing *M-C-x*. This translates the STELLA code into Lisp and compiles (or evaluates) the resulting Lisp code. Now you can actually try it out in the Lisp buffer, for example:

```
STELLA(4): (factorial 6)
720
```

Finally, instead of evaluating the definition in the source buffer, you can also enter it directly at the Lisp prompt with the same effect.

The way this works is that the Lisp symbol `stella::defun` is actually bound to a Lisp macro that calls all the necessary translation machinery to convert the STELLA `defun` into Lisp code. Look at the file `sources/stella/cl-lib/stella-to-cl.ste` for the complete set of such macros. This might be a bit confusing, since there are now three different bindings (or meanings) of `defun`:

1. The STELLA operator `defun` used to define STELLA functions.
2. The Lisp macro `stella::defun` that resides in the `STELLA` Lisp package and is only available for convenience in Lisp versions of STELLA.
3. The Lisp macro `CL:defun` which is the standard Common Lisp macro used to define Lisp functions.

We'll try to explicitly qualify which meaning is used wherever there might be some doubt which one is meant. In general, every unqualified symbol mentioned below is either part of the STELLA language or resides in the STELLA Lisp package.

Since a newly-written STELLA function might have errors, it is prudent to first only translate it without actually executing the result of the translation. In the source buffer you can do that by macro-expanding the `defun`. For example, if you use the Allegro CL interface you would position the cursor on the opening parenthesis of the `defun` and then type *M-M*. Any errors discovered by the STELLA translator are reported in the Lisp buffer window. The expansion will be a `CL:progn` that contains the translated definition as the first element plus various startup-time (initialization) code following it.

In the Lisp buffer you can achieve a similar effect with the `lptrans` macro. For example, executing

```
(lptrans
 (defun (factorial INTEGER) ((n INTEGER))
   (if (eql? n 0)
       (return 1)
     (return (* n (factorial (1- n)))))))
```

in the Lisp buffer first Lisp-translates the definition, and then prints the translation. To see the C++ translation you can use `cpptrans`, calling `jptrans` will generate the Java translation.

You can also use `lptrans/cpptrans/jptrans` to translate code fragments that are not top-level definitions such as `defun` and its friends. For example:

```
STELLA(8): (lptrans
```

```
            (foreach element in (list 1 2 3)
                do (print element EOL)))

(CL:LET* ((ELEMENT NULL)
          (ITER-003
           (%THE-CONS-LIST (LIST (WRAP-INTEGER 1) (WRAP-INTEGER 2)
                                 (WRAP-INTEGER 3)))))
  (CL:LOOP WHILE (CL:NOT (CL:EQ ITER-003 NIL)) DO
           (CL:PROGN (SETQ ELEMENT (%%VALUE ITER-003))
                     (SETQ ITER-003 (%%REST ITER-003)))
           (%%PRINT-STREAM (%NATIVE-STREAM STANDARD-OUTPUT)
                           ELEMENT EOL)))
()
STELLA(9): (cpptrans
            (foreach element in (list 1 2 3)
                do (print element EOL)))
{ Object* element = NULL;
  Cons* iter004 = list(3, wrapInteger(1), wrapInteger(2),
                          wrapInteger(3))-> theConsList;

  while (!(iter004 == NIL)) {
    element = iter004->value;
    iter004 = iter004->rest;
    cout << element << endl;
  }
}
:VOID
STELLA(10): (jptrans
             (foreach element in (list 1 2 3)
                 do (print element EOL)))
{ Stella_Object element = null;
  Cons iter005 = Stella.list
                  (Stella_Object.cons
                    (IntegerWrapper.wrapInteger(1),
                     Stella_Object.cons
                      (IntegerWrapper.wrapInteger(2),
                       Stella_Object.cons
                        (IntegerWrapper.wrapInteger(3),
                         Stella.NIL)))).theConsList;

  while (!(iter005 == Stella.NIL)) {
    {
      element = iter005.value;
      iter005 = iter005.rest;
    }
    java.lang.System.out.println(element);
  }
```

```
}
:VOID
```

The use of `lptrans` is really necessary here, since there is no Lisp macro `foreach` that knows how to translate STELLA `foreach` loops (those Lisp macros only exist for top-level definition commands such as `defun`). In order to translate such code fragments without error messages, they need to be self-contained, i.e., all referenced variables have to be either bound by a surrounding `let`, or they must be globally defined variables. Otherwise, the STELLA translator will generate various "undefined variable" error messages.

You can use the STELLA Lisp macro `eval` (i.e., `stella::eval` not `CL:eval`) to actually execute such a code fragment. For example:

```
STELLA(11): (eval
             (foreach element in (list 1 2 3)
                 do (print element EOL)))
|L|1
|L|2
|L|3
()
```

This translates the loop and executes the result, which prints the wrapped numbers (hence, the `|L|` prefix) to standard output. The `()` at the end is the resulting Lisp value returned by the loop (in Lisp everything returns a value, even though for STELLA `foreach` is a statement, not an expression).

Make it a habit to wrap `eval` around any STELLA code you incrementally evaluate in the Lips buffer. This makes sure that all the arguments to a function, etc., are translated into the appropriate STELLA objects. For example, evaluating

```
(eval (list :a :b :c))
```

in the Lisp buffer generates a STELLA list that points to the STELLA keywords `:a`, `:b` and `:c`. If you don't use `eval`, for example,

```
(list :a :b :c)
```

a STELLA list containing the Lisp keywords ':a', ':b' and ':c' will be created. Lisp keywords are a completely different data structure than STELLA keywords, and any STELLA code expecting a STELLA keyword but finding a Lisp keyword will break, since Lisp keywords are not a legal STELLA data structure. Unfortunately, such cases can be very confusing, since Lisp and STELLA keywords look/print exactly alike.

`eval` is also necessary to access STELLA symbols and surrogates in the Lisp buffer. For example, to access a STELLA symbol, you can use `quote` (again, this is the STELLA `quote` not `CL:quote`):

```
(eval (quote foo))
```

This returns the STELLA symbol `foo`. We explicitly used `quote` here, since code typed at the Lisp prompt is first passed through the Lisp reader before the STELLA translator sees it, and the default Lisp reader interprets the `'` character differently than the STELLA reader. Within a STELLA file you can use the syntax `'foo`, since it will be read directly by the STELLA reader that knows how to interpret it correctly.

`lptrans`, `cpptrans` and `jptrans` are evaluable STELLA commands that can also be evaluated by the C++ and Java version of STELLA. For example, to generate a Java translation of a little STELLA code fragment you could run the `stella` script in the STELLA directory like this (the output below has been additionally indented by hand for clarity):

```
% ./stella -e '(jptrans\
                 (foreach element in (list 1 2 3)\
                    do (print element EOL)))'
Running C++ version of STELLA...
Welcome to STELLA 3.4.0
{ Stella_Object element = null;
  Cons iter001 = Stella.list
                  (Stella_Object.cons
                    (IntegerWrapper.wrapInteger(1),
                     Stella_Object.cons
                      (IntegerWrapper.wrapInteger(2),
                       Stella_Object.cons
                        (IntegerWrapper.wrapInteger(3),
                         Stella.NIL)))).theConsList;

  while (!(iter001 == Stella.NIL)) {
    {
      element = iter001.value;
      iter001 = iter001.rest;
    }
    java.lang.System.out.println(element);
  }
}
```

4.3 Performance Hints

Here are a few things to watch out for once you get serious about the performance of your translated STELLA programs:

Safety checks: The STELLA variable `*safety*` controls whether certain safety code is added to your translated STELLA program. For Lisp translations it also controls whether `cast`'s will be translated into run-time type checks or not. There is no run-time type checking performed in C++. In Java native casts will always perform runtime type tests. The default `*safety*` level is 3 which enables the translation of all `safety` clauses with level 3 or lower. A safety level of 1 or lower disables the generation of calls to the `cast` function in Lisp. `cast` performs run-time type checks which are somewhat expensive. However, you should not disable run-time type checking in Lisp until you have fully debugged your program. Once you are confident that your program works correctly, you can set `*safety*` to 0 before you translate it. That way you will avoid the generation and execution of any safety code at all. All of the core STELLA system was translated with `*safety*` set to 1.

Quoted cons trees: Access to quoted constants that are not symbols is somewhat slow, since it currently uses hashing to find them in a table. Hence, access to quoted constants such as `(quote (foo bar fum))` should be avoided in inner loops. Access to quoted symbols such as `(quote foo)` is fast and does not cause any performance problems. The use of `quote` for constant cons trees is rare in STELLA (and somewhat deprecated), which is the reason why this mechanism is not all that well supported. Future versions of STELLA might re-implement the handling of constants and alleviate this performance problem.

Equality tests: The standard equality test in STELLA is `eql?`, which the translator will translate into the most efficient equality test for the particular types of operands (`eql?` is somewhat similar to the Lisp function `CL:eql` with the exception of comparing strings). If the translator can determine that at least one of the operands is a subtype of `STANDARD-OBJECT`, it will translate the test into a fast pointer comparison with the Lisp function `CL:eq` or the C++/Java `==` operator. However, if both operands are of type `OBJECT`, they might be wrapped literals such as wrapped integers or strings. In that case the equality test translates into a call to the function `eql?` which in turn uses method calls to handle comparison of different types of wrapped literals (two wrapped literals are equal if their wrapped content is equal). This is of course a lot less efficient than a simple pointer comparison. It also means that if you can restrict the type of a variable that will be tested with `eql?` to `STANDARD-OBJECT`, you probably should do so for performance reasons.

Type tests: Run-time type tests as used implicitly within a `typecase` or explicitly with functions such as `cons?` have to use a call to the method `primary-type`. Hence, in performance-critical portions of your code you should try to keep the number of such tests as small as possible.

Wrapping and unwrapping literals: The STELLA translator automatically wraps (or objectifies) literals such as numbers or strings when they are stored in a variable or slot of type `OBJECT`. Similarly, it unwraps wrapped literals automatically to operate on the literal directly. This is very convenient, since it relieves the programmer from having to perform these conversions by hand and makes the code less cluttered. For example, consider the following code fragment:

```
(let ((l (cons "foo" nil))
      (x (concatenate "bar" (first l))))
  (print x EOL)))
```

Here is its C++ translation:

```
{ Cons* l = cons(wrapString("foo"), NIL);
   char* x = stringConcatenate
               ("bar", ((StringWrapper*)(l->value))->wrapperValue, 0);

  std::cout << x << std::endl;
}
```

Notice how the string literal `"foo"` is first wrapped so it can be inserted into the `CONS` list `l` and then automatically unwrapped in the call to `concatenate`. While this is very convenient, it does cause a certain overhead that should be avoided in performance critical loops, etc. In such situations, it often helps to use auxiliary variables of the appropriate literal type to avoid unnecessary wrap/unwrap operations.

Lisp-style property lists: Lisp programs often use property lists for fast retrieval of information that is linked to symbols. To support the easy translation of existing Lisp programs that use this paradigm into STELLA, a similar mechanism implemented by the functions `symbol-value`, `symbol-plist`, and `symbol-property` is available that preserves the performance benefits of this storage scheme (see the file `sources/stella/symbols.ste`).

However, property lists do not fit the object-oriented programming paradigm supported by STELLA, and, hence, are frowned upon.

Compiler optimization: The optimization settings used with the native Lisp or C++ compiler can greatly influence performance results. In particular, using high optimization settings with the Lisp compiler can greatly improve slot access time on STELLA objects.

4.3.1 Lisp Performance Hints

The standard Lisp implementation for STELLA objects are CLOS objects, since CLOS provides the most natural Lisp implementation for the STELLA object system. However, there is a price to pay, since in Lisp slot access on CLOS objects is a lot slower than slot access on structs. For example, in Allegro CL 4.3, the access to the `value` slot of a STELLA CONS cell takes about 4 times longer on a CLOS object implementation of `CONS` than on a struct implementation. Unfortunately, the struct implementation itself takes about 3 times longer than calling `CL:car` on a Lisp cons, which is why we are actually using Lisp conses as the Lisp implementation for STELLA `CONS`es. Note, that in the C++ and Java translation these slot-access performance problems are nonexistent.

In order to get the maximum performance out of the Lisp version of STELLA, you can tell the translator to use structs as the implementation for STELLA objects. It does so by using `CL:defstruct` instead of `CL:defclass` and dispatches methods directly on the structure object.

To use the struct translation scheme evaluate

```
(set-stella-feature :use-common-lisp-structs)
```

before you translate a STELLA system. This will generate translated files with a `.slisp` extension. Make sure that after you translated all the files you are interested in, you disable the above feature with

```
(unset-stella-feature :use-common-lisp-structs)
```

Otherwise, subsequent incremental translations in that Lisp image might fail, since different translation schemes cannot be mixed. If you already are using the struct version of STELLA, all systems will be translated in struct mode by default.

To use the struct translation of your system you have to use the struct version of STELLA. To do so do the following:

```
(CL:setq cl-user::*load-cl-struct-stella?* CL:t)
(CL:load "load-stella.lisp")
```

Alternatively, you can edit the initial value of the variable `*load-cl-struct-stella?*` in the file `load-stella.lisp` (see also Section 2.3 [Lisp Installation], page 4).

The reasons why the struct translation scheme is not enabled by default are the following:

- Incremental redefinition of STELLA classes does not redefine any objects created with the old definition, and, hence, slot accessors might simply break or retrieve the value of a different slot when applied to such an old object. The programmer therefore has to be very careful when redefining a STELLA class while in struct mode. This means, that you should view the usage of the struct-translation scheme for Lisp as a kind of delivery option, similar to translating into C++. Part of the reason why slot access on CLOS object is expensive is the indirection machinery that allows redefinition of classes and their associated instances. This is great for code development, but the flexibility and expense is usually not needed or warranted for delivered code.

- The performance trade-offs between CLOS and struct versions might be different in different versions of Lisp. For example, in older version of Allegro CL slot access on structs was fast, but method dispatch was significantly slower than for CLOS objects which eliminated some/all of the performance gains.

5 Library Classes (tbw)

To be written.

6 Library Functions

6.1 Basic Constants and Predicates

`null?` (x) : BOOLEAN [Method on OBJECT]
Return true if x is undefined (handled specially by all translators).

`null?` (x) : BOOLEAN [Method on SECOND-CLASS-OBJECT]
Return true if x is undefined (handled specially by all translators).

`null?` (x) : BOOLEAN [Method on NATIVE-VECTOR]
Return true if x is undefined (handled specially by all translators).

`null?` (x) : BOOLEAN [Method on STRING]
Return true if x is undefined (handled specially by all translators).

`null?` (x) : BOOLEAN [Method on MUTABLE-STRING]
Return true if x is undefined (handled specially by all translators).

`null?` (x) : BOOLEAN [Method on CHARACTER]
Return true if x is undefined (handled specially by all translators).

`null?` (x) : BOOLEAN [Method on CODE]
Return true if x is undefined (handled specially by all translators).

`null?` (x) : BOOLEAN [Method on INTEGER]
Return true if x is undefined (handled specially by all translators).

`null?` (x) : BOOLEAN [Method on FLOAT]
Return true if x is undefined (handled specially by all translators).

`defined?` (x) : BOOLEAN [Method on OBJECT]
Return true if x is defined (handled specially by all translators).

`defined?` (x) : BOOLEAN [Method on SECOND-CLASS-OBJECT]
Return true if x is defined (handled specially by all translators).

`defined?` (x) : BOOLEAN [Method on NATIVE-VECTOR]
Return true if x is defined (handled specially by all translators).

`defined?` (x) : BOOLEAN [Method on STRING]
Return true if x is defined (handled specially by all translators).

`defined?` (x) : BOOLEAN [Method on MUTABLE-STRING]
Return true if x is defined (handled specially by all translators).

`defined?` (x) : BOOLEAN [Method on CHARACTER]
Return true if x is defined (handled specially by all translators).

`defined?` (x) : BOOLEAN [Method on CODE]
Return true if x is defined (handled specially by all translators).

`defined?` (*x*) : BOOLEAN [Method on INTEGER]
Return true if *x* is defined (handled specially by all translators).

`defined?` (*x*) : BOOLEAN [Method on FLOAT]
Return true if *x* is defined (handled specially by all translators).

`eq?` ((*x* UNKNOWN) (*y* UNKNOWN)) : BOOLEAN [Function]
Return true if *x* and *y* are literally the same object (or simple number). Analogue to the Common Lisp EQL and C++ and Java's ==.

`eql?` ((*x* OBJECT) (*y* OBJECT)) : BOOLEAN [Function]
Return true if *x* and *y* are `eq?` or equivalent literals such as strings that also might be wrapped in non-identical wrappers. For the case where *x* or *y* are plain literals such as strings or integers, the STELLA translator substitutes the equality test appropriate for the particular target language and does not actually call this function. For cases where *x* or *y* are known to be of type STANDARD-OBJECT, the STELLA translator substitutes the faster `eq?` test inline.

`equal?` ((*x* OBJECT) (*y* OBJECT)) : BOOLEAN [Function]
Return true if *x* and *y* are `eql?` or considered equal by a user-defined `object-equal?` method. This implements a fully extensible equality test similar to Java's `equals` method. Note that writers of custom `object-equal?` methods must also implement a corresponding `equal-hash-code` method.

`object-equal?` (*x* (*y* OBJECT)) : BOOLEAN [Method on OBJECT]
Return true if *x* and *y* are `eq?`.

`object-equal?` (*x* (*y* OBJECT)) : BOOLEAN [Method on WRAPPER]
Return true if *x* and *y* are literal wrappers whose literals are considered `eql?`.

6.2 Numbers

`pi` : FLOAT [Constant]
A float approximation of the mathematical constant pi.

`+` (**&rest** (*arguments* NUMBER)) : NUMBER [Function]
Return the sum of all *arguments*.

`-` ((*x* NUMBER) **&rest** (*arguments* NUMBER)) : NUMBER [Function]
If only *x* was supplied return the result of 0 - *x*. Otherwise, return the result of (...((*x* - arg1) - arg2) - ... - argN).

`*` (**&rest** (*arguments* NUMBER)) : NUMBER [Function]
Return the product of all *arguments*.

`/` ((*x* NUMBER) **&rest** (*arguments* NUMBER)) : NUMBER [Function]
If only *x* was supplied return the result of 1 / *x*. Otherwise, return the result of (...((*x* / arg1) / arg2) / ... / argN).

`1+` ((*expression* OBJECT)) : OBJECT [Macro]
Add 1 to *expression* and return the result.

`1-` ((*expression* OBJECT)) : OBJECT [Macro]
Subtract 1 from *expression* and return the result.

`++` ((*place* OBJECT) **&body** (*increment* CONS)) : OBJECT [Macro]
Increment the value of *place* and return the result. *place* can be either a variable name or a slot reference. Increment by the optional *increment* (which can be a float) or 1 otherwise.

`--` ((*place* OBJECT) **&body** (*decrement* CONS)) : OBJECT [Macro]
Decrement the value of *place* and return the result. *place* can be either a variable name or a slot reference. Decrement by the optional *decrement* (which can be a float) or 1 otherwise.

`=` ((*x* NUMBER) (*y* NUMBER)) : BOOLEAN [Function]
Return true if *x* and *y* are numbers of exactly the same magnitude.

`<` ((*x* NUMBER) (*y* NUMBER)) : BOOLEAN [Function]
Return true if *x* is less than *y*.

`<=` ((*x* NUMBER) (*y* NUMBER)) : BOOLEAN [Function]
Return true if *x* is less than or equal to *y*.

`>=` ((*x* NUMBER) (*y* NUMBER)) : BOOLEAN [Function]
Return true if *x* is greater than or equal to *y*.

`>` ((*x* NUMBER) (*y* NUMBER)) : BOOLEAN [Function]
Return true if *x* is greater than *y*.

`zero?` [???]
Not yet implemented.

`plus?` [???]
Not yet implemented.

`even?` [???]
Not yet implemented.

`odd?` [???]
Not yet implemented.

`div` [???]
Not yet implemented.

`rem` [???]
Not yet implemented.

`mod` [???]
Not yet implemented.

`gcd` ((*x* LONG-INTEGER) (*y* LONG-INTEGER)) : LONG-INTEGER [Function]
Return the greatest common divisor of *x* and *y*.

`ceiling` ((*n* NUMBER)) *:* INTEGER [Function]
Return the smallest integer >= *n*.

`floor` ((*n* NUMBER)) *:* INTEGER [Function]
Return the biggest integer <= *n*.

`round` ((*n* NUMBER)) *:* INTEGER [Function]
Round *n* to the closest integer and return the result.

`abs` (*x*) *:* INTEGER [Method on INTEGER]
Return the absolute value of *x*.

`abs` (*x*) *:* FLOAT [Method on FLOAT]
Return the absolute value of *x*.

`min` [???]
Not yet implemented.

`max` [???]
Not yet implemented.

`sqrt` ((*n* FLOAT)) *:* FLOAT [Function]
Return the square root of *n*.

`exp` ((*n* FLOAT)) *:* FLOAT [Function]
Return the e to the power *n*.

`expt` ((*x* FLOAT) (*y* FLOAT)) *:* FLOAT [Function]
Return *x* ^ *y*.

`log` ((*n* FLOAT)) *:* FLOAT [Function]
Return the natural logarithm (base e) of *n*.

`log10` ((*n* FLOAT)) *:* FLOAT [Function]
Return the logarithm (base 10) of *n*.

`sin` ((*n* FLOAT)) *:* FLOAT [Function]
Return the sine of *n* radians.

`cos` ((*n* FLOAT)) *:* FLOAT [Function]
Return the cosine of *n* radians.

`tan` ((*n* FLOAT)) *:* FLOAT [Function]
Return the tangent of *n* radians.

`asin` ((*n* FLOAT)) *:* FLOAT [Function]
Return the arcsine of *n* in radians.

`acos` ((*n* FLOAT)) *:* FLOAT [Function]
Return the arccosine of *n* in radians.

`atan` ((*n* FLOAT)) *:* FLOAT [Function]
Return the arc tangent of *n* in radians.

`atan2` ((*x* FLOAT) (*y* FLOAT)) : FLOAT [Function]
Return the arc tangent of *x* / *y* in radians.

`random` ((*n* INTEGER)) : INTEGER [Function]
Generate a random integer in the interval [0..n-1]. The random number generator is seeded based on the current time every time STELLA starts up; however, your mileage may vary depending on the native language implementation.

`integer-to-string` ((*i* LONG-INTEGER)) : STRING [Function]
Convert *i* to its string representation and return the result. This is more efficient than using a string stream.

`string-to-integer` ((*string* STRING)) : LONG-INTEGER [Function]
Convert a *string* representation of an integer into an integer. Use `parse-long-integer` if the syntax of *string* needs to be checked for errors.

`float-to-string` ((*f* FLOAT)) : STRING [Function]
Convert *f* to its string representation and return the result. This is more efficient than using a string stream.

`string-to-float` ((*string* STRING)) : FLOAT [Function]
Convert a *string* representation of a float into a float. Use `parse-float` if the syntax of *string* needs to be checked for errors.

`format-float` ((*f* FLOAT) (*nDecimals* INTEGER)) : STRING [Function]
Print *f* in fixed-point format with *nDecimals* behind the decimal point and return the result as a string.

`wrap-integer` ((*value* INTEGER)) : INTEGER-WRAPPER [Function]
Return a literal object whose value is the INTEGER *value*.

`unwrap-integer` ((*wrapper* INTEGER-WRAPPER)) : INTEGER [Function]
Unwrap *wrapper* and return the result. Return NULL if *wrapper* is NULL.

`wrap-float` ((*value* FLOAT)) : FLOAT-WRAPPER [Function]
Return a literal object whose value is the FLOAT *value*.

`unwrap-float` ((*wrapper* FLOAT-WRAPPER)) : FLOAT [Function]
Unwrap *wrapper* and return the result. Return NULL if *wrapper* is NULL.

6.3 Characters

`character-code` ((*ch* CHARACTER)) : INTEGER [Function]
Return the 8-bit ASCII code of *ch* as an integer.

`code-character` ((*code* INTEGER)) : CHARACTER [Function]
Return the character encoded by *code* (0 `<=` *code* `<=` 255).

`digit-character?` ((*ch* CHARACTER)) : BOOLEAN [Function]
Return TRUE if *ch* represents a digit.

`letter-character?` ((*ch* CHARACTER)) : BOOLEAN [Function]
Return TRUE if *ch* represents a letter.

`upper-case-character?` ((*ch* CHARACTER)) : BOOLEAN [Function]
Return TRUE if *ch* represents an upper-case character.

`lower-case-character?` ((*ch* CHARACTER)) : BOOLEAN [Function]
Return TRUE if *ch* represents a lower-case character.

`white-space-character?` ((*ch* CHARACTER)) : BOOLEAN [Function]
Return TRUE if *ch* is a white space character.

`character-downcase` ((*ch* CHARACTER)) : CHARACTER [Function]
If *ch* is lowercase, return its uppercase version, otherwise, return *ch* unmodified.

`character-upcase` ((*ch* CHARACTER)) : CHARACTER [Function]
If *ch* is uppercase, return its lowercase version, otherwise, return *ch* unmodified. If only the first character of a sequence of characters is to be capitalized, `character-capitalize` should be used instead.

`character-capitalize` ((*ch* CHARACTER)) : CHARACTER [Function]
Return the capitalized character for *ch*. This is generally the same as the uppercase character, except for obscure non-English characters in Java. It should be used if only the first character of a sequence of characters is to be capitalized.

`character-to-string` ((*c* CHARACTER)) : STRING [Function]
Convert *c* into a one-element string and return the result.

`wrap-character` ((*value* CHARACTER)) : CHARACTER-WRAPPER [Function]
Return a literal object whose value is the CHARACTER *value*.

`unwrap-character` ((*wrapper* CHARACTER-WRAPPER)) : CHARACTER [Function]
Unwrap *wrapper* and return the result. Return NULL if *wrapper* is NULL.

6.4 Strings

`string-eql?` ((*x* STRING) (*y* STRING)) : BOOLEAN [Function]
Return true if *x* and *y* are equal strings or are both undefined. This test is substituted automatically by the STELLA translator if `eql?` is applied to strings.

`string-equal?` ((*x* STRING) (*y* STRING)) : BOOLEAN [Function]
Return true if *x* and *y* are equal strings ignoring character case or are both undefined.

`empty?` (*x*) : BOOLEAN [Method on STRING]
Return true if *x* is the empty string `""`

`non-empty?` (*x*) : BOOLEAN [Method on STRING]
Return true if *x* is not the empty string `""`

`string-compare` ((*x* STRING) (*y* STRING) (*case-sensitive?* BOOLEAN)) : INTEGER [Function]

Compare *x* and *y* lexicographically, and return -1, 0, or 1, depending on whether *x* is less than, equal, or greater than *y*. If *case-sensitive?* is true, then case does matter for the comparison

`string<` ((*x* STRING) (*y* STRING)) : BOOLEAN [Function]

Return true if *x* is lexicographically `<` *y*, considering case.

`string<=` ((*x* STRING) (*y* STRING)) : BOOLEAN [Function]

Return true if *x* is lexicographically <= *y*, considering case.

`string>=` ((*x* STRING) (*y* STRING)) : BOOLEAN [Function]

Return true if *x* is lexicographically >= *y*, considering case.

`string>` ((*x* STRING) (*y* STRING)) : BOOLEAN [Function]

Return true if *x* is lexicographically `>` *y*, considering case.

`string-less?` ((*x* STRING) (*y* STRING)) : BOOLEAN [Function]

Return true if *x* is lexicographically `<` *y*, ignoring case.

`string-less-equal?` ((*x* STRING) (*y* STRING)) : BOOLEAN [Function]

Return true if *x* is lexicographically <= *y*, ignoring case.

`string-greater-equal?` ((*x* STRING) (*y* STRING)) : BOOLEAN [Function]

Return true if *x* is lexicographically >= *y*, ignoring case.

`string-greater?` ((*x* STRING) (*y* STRING)) : BOOLEAN [Function]

Return true if *x* is lexicographically `>` *y*, ignoring case.

`all-upper-case-string?` ((*s* STRING)) : BOOLEAN [Function]

Return TRUE if all letters in *s* are upper case.

`all-lower-case-string?` ((*s* STRING)) : BOOLEAN [Function]

Return TRUE if all letters in *s* are lower case.

`make-string` ((*size* INTEGER) (*initchar* CHARACTER)) : STRING [Function]

Return a new string filled with *size* *initchar*s.

`make-mutable-string` ((*size* INTEGER) (*initchar* CHARACTER)) : MUTABLE-STRING [Function]

Return a new mutable string filled with *size* *initchar*s.

`make-raw-mutable-string` ((*size* INTEGER)) : MUTABLE-STRING [Function]

Return a new uninitialized mutable string of *size*.

`first` (*self*) : CHARACTER [Method on STRING]

Return the first character of *self*.

`first` (*self*) : CHARACTER [Method on MUTABLE-STRING]

Return the first character of *self* (settable via `setf`).

`second` (*self*) : CHARACTER [Method on STRING]
Return the second character of *self*.

`second` (*self*) : CHARACTER [Method on MUTABLE-STRING]
Return the second character of *self* (settable via `setf`).

`third` (*self*) : CHARACTER [Method on STRING]
Return the third character of *self*.

`third` (*self*) : CHARACTER [Method on MUTABLE-STRING]
Return the third character of *self* (settable via `setf`).

`fourth` (*self*) : CHARACTER [Method on STRING]
Return the fourth character of *self*.

`fourth` (*self*) : CHARACTER [Method on MUTABLE-STRING]
Return the fourth character of *self* (settable via `setf`).

`fifth` (*self*) : CHARACTER [Method on STRING]
Return the fifth character of *self*.

`fifth` (*self*) : CHARACTER [Method on MUTABLE-STRING]
Return the fifth character of *self* (settable via `setf`).

`nth` (*self* (*position* INTEGER)) : CHARACTER [Method on STRING]
Return the character in *self* at *position*.

`nth` (*self* (*position* INTEGER)) : CHARACTER [Method on MUTABLE-STRING]
Return the character in *self* at *position*.

`rest` (*self*) : STRING [Method on STRING]
Not documented.

`length` (*self*) : INTEGER [Method on STRING]
Return the length of the string *self*.

`length` (*self*) : INTEGER [Method on MUTABLE-STRING]
Return the length of the string *self*.

`member?` (*self* (*char* CHARACTER)) : BOOLEAN [Method on STRING]
Not documented.

`position` (*string* (*character* CHARACTER) (*start* INTEGER)) : INTEGER [Method on STRING]
Return the position of *character* within *string* (counting from zero); or return NULL if *character* does not occur within *string*. If *start* was supplied as non-NULL, only consider the substring starting at *start*, however, the returned position will always be relative to the entire string.

`last-position` (*string* (*character* CHARACTER) (*end* INTEGER)) *:* INTEGER [Method on STRING]

Return the last position of *character* within *string* (counting from zero); or return NULL if *character* does not occur within *string*. If *end* was supplied as non-NULL, only consider the substring ending at *end*, however, the returned position will always be relative to the entire string.

`string-search` ((*string* STRING) (*substring* STRING) (*start* INTEGER)) *:* INTEGER [Function]

Return start position of the left-most occurrence of *substring* in *string*, beginning from *start*. Return NULL if it is not a substring. The comparison is exact.

`copy` (*string*) *:* STRING [Method on STRING]

Return a copy of *string*.

`string-upcase` ((*string* STRING)) *:* STRING [Function]

Return an upper-case copy of *string*.

`string-downcase` ((*string* STRING)) *:* STRING [Function]

Return a lower-case copy of *string*.

`string-capitalize` ((*string* STRING)) *:* STRING [Function]

Return a capitalized version of *string*.

`concatenate` (*string1* (*string2* STRING) **&rest** *(otherStrings* STRING*)*) *:* STRING [Method on STRING]

Return a new string representing the concatenation of *string1*, *string2*, and *otherStrings*. The two mandatory parameters allow us to optimize the common binary case by not relying on the somewhat less efficient variable arguments mechanism.

`subsequence` (*string* (*start* INTEGER) (*end* INTEGER)) *:* STRING [Method on STRING]

Return a substring of *string* beginning at position *start* and ending up to but not including position *end*, counting from zero. An *end* value of NULL stands for the rest of the string.

`remove` (*string* (*char* CHARACTER)) *:* STRING [Method on STRING]

Remove all occurences of *char* from *string*.

`substitute` (*self* (*new-char* CHARACTER) (*old-char* CHARACTER)) *:* STRING [Method on STRING]

Substitute all occurences of *old-char* with *new-char* in the string *self*.

`substitute` (*self* (*new-char* CHARACTER) (*old-char* CHARACTER)) *:* MUTABLE-STRING [Method on MUTABLE-STRING]

Substitute all occurences of *old-char* with *new-char* in the string *self*.

`replace-substrings` ((*string* STRING) (*new* STRING) (*old* STRING)) *:* STRING [Function]

Replace all occurrences of *old* in *string* with *new*.

`instantiate-string-template` ((*template* STRING) **&rest** (*vars***&values** STRING)) : STRING [Function]

For each occurrence of a <var> string from *vars&values* in *template* replace it with its corresponding <value> string. Replacement is done in sequence which means (part of) a value might be replaced further with a later <var> and <value>.

`insert-string` ((*source* STRING) (*start* INTEGER) (*end* INTEGER) (*target* MUTABLE-STRING) (*target-index* INTEGER) (*case-conversion* KEYWORD)) : INTEGER [Function]

Inserts characters from *source* begining at *start* and ending at *end* into *target* starting at *target-index*. If *end* is `null`, then the entire length of the string is used. The copy of characters is affected by the *case-conversion* keyword which should be one of :UPCASE :DOWNCASE :CAPITALIZE :PRESERVE.

The final value of target-index is returned.

`wrap-string` ((*value* STRING)) : STRING-WRAPPER [Function]

Return a literal object whose value is the STRING *value*.

`wrap-mutable-string` ((*value* MUTABLE-STRING)) : MUTABLE-STRING-WRAPPER [Function]

Return a literal object whose value is the MUTABLE-STRING *value*.

`unwrap-string` ((*wrapper* STRING-WRAPPER)) : STRING [Function]

Unwrap *wrapper* and return the result. Return NULL if *wrapper* is NULL.

`unwrap-mutable-string` ((*wrapper* MUTABLE-STRING-WRAPPER)) : MUTABLE-STRING [Function]

Unwrap *wrapper* and return the result. Return NULL if *wrapper* is NULL.

`string-to-mutable-string` ((*s* STRING)) : MUTABLE-STRING [Function]

Copy *s* into a mutable string with the same content. In Lisp and C++ this simply copies *s*.

`mutable-string-to-string` ((*s* MUTABLE-STRING)) : STRING [Function]

Convert *s* into a regular string with the same content. In Lisp and C++ this is a no-op.

`integer-to-string` ((*i* LONG-INTEGER)) : STRING [Function]

Convert *i* to its string representation and return the result. This is more efficient than using a string stream.

`string-to-integer` ((*string* STRING)) : LONG-INTEGER [Function]

Convert a *string* representation of an integer into an integer. Use `parse-long-integer` if the syntax of *string* needs to be checked for errors.

`float-to-string` ((*f* FLOAT)) : STRING [Function]

Convert *f* to its string representation and return the result. This is more efficient than using a string stream.

`string-to-float` ((*string* STRING)) : FLOAT [Function]

Convert a *string* representation of a float into a float. Use `parse-float` if the syntax of *string* needs to be checked for errors.

format-float ((*f* FLOAT) (*nDecimals* INTEGER)) : STRING [Function]
Print *f* in fixed-point format with *nDecimals* behind the decimal point and return the result as a string.

character-to-string ((*c* CHARACTER)) : STRING [Function]
Convert *c* into a one-element string and return the result.

stringify ((*expression* OBJECT)) : STRING [Function]
Print *expression* onto a string and return the result. Printing is done with `*printReadably?*` set to true and with `*printPretty?*` set to false.

stringify-in-module ((*tree* OBJECT) (*module* MODULE)) : STRING [Function]
Stringify a parse *tree* relative to *module*, or `*module*` if no module is specified.

unstringify ((*string* STRING)) : OBJECT [Function]
Read a STELLA expression from *string* and return the result. This is identical to `read-s-expression-from-string`.

unstringify-in-module ((*string* STRING) (*module* MODULE)) : OBJECT [Function]
Unstringify relative to *module*, or `*MODULE*` if no module is specified.

6.5 CONS Lists and Trees

CONS : STANDARD-OBJECT [Class]
Not documented.

any-value : OBJECT [Class Parameter of]
Not documented.

value : (LIKE (ANY-VALUE SELF)) [Slot of]
Not documented.

rest : (CONS OF (LIKE (ANY-VALUE SELF))) [Slot of]
Not documented.

nil : CONS [Variable]
Not documented.

empty? (*self*) : BOOLEAN [Method on CONS]
Return `true` iff *self* equals `nil`.

non-empty? (*self*) : BOOLEAN [Method on CONS]
Return `true` iff *self* is not equal to `nil`.

nil? ((*x* OBJECT)) : BOOLEAN [Function]
Return `true` iff *x* equals `nil`.

equal-cons-trees? ((*tree1* OBJECT) (*tree2* OBJECT)) : BOOLEAN [Function]
Return `true` iff the cons trees *tree1* and *tree2* are structurally equivalent. Uses an `eql?` test.

`object-equal?` (*tree1* (*tree2* OBJECT)) : BOOLEAN [Method on CONS]
Return `true` iff the cons trees *tree1* and *tree2* are structurally equivalent. Uses `equal?` to test equality of subtrees.

`equal-hash-code` (*self*) : INTEGER [Method on CONS]
Return an `equal?` hash code for *self*. Note that this is O(N) in the number of elements of *self*.

`cons` ((*value* OBJECT) (*rest* CONS)) : CONS [Function]
Return a cons record that points to *value* and *rest*.

`first` (*self*) : (LIKE (ANY-VALUE SELF)) [Method on CONS]
Return the first element of *self*. The first element of *self* can be set with `setf`. Note that `(first NIL)` = `null`.

`second` (*self*) : (LIKE (ANY-VALUE SELF)) [Method on CONS]
Return the second element of *self*. The second element of *self* can be set with `setf`. Note that `(second NIL)` = `null`.

`third` (*self*) : (LIKE (ANY-VALUE SELF)) [Method on CONS]
Return the third element of *self*. The third element of *self* can be set with `setf`. Note that `(third NIL)` = `null`.

`fourth` (*self*) : (LIKE (ANY-VALUE SELF)) [Method on CONS]
Return the fourth element of *self*. The fourth element of *self* can be set with `setf`. Note that `(fourth NIL)` = `null`.

`fifth` (*self*) : (LIKE (ANY-VALUE SELF)) [Method on CONS]
Return the fifth element of *self*. The fifth element of *self* can be set with `setf`. Note, that `(fifth NIL)` = `null`.

`nth` (*self* (*position* INTEGER)) : (LIKE (ANY-VALUE SELF)) [Method on CONS]
Return the element of *self* at *position*. The nth element of *self* can be set with `setf`. Note, that `(nth NIL <pos>)` = `null`.

`nth-rest` (*self* (*position* INTEGER)) : (LIKE SELF) [Method on CONS]
Apply `rest` *position* times to *self*.

`last` (*self*) : (LIKE (ANY-VALUE SELF)) [Method on CONS]
Return the last element of *self*.

`but-last` (*self*) : (ITERATOR OF (LIKE (ANY-VALUE SELF))) [Method on CONS]
Generate all but the last element of the cons list *self*.

`last-cons` ((*self* CONS)) : (CONS OF (LIKE (ANY-VALUE SELF))) [Function]
Return the last cons of *self*.

`length` (*self*) : INTEGER [Method on CONS]
Return the length of the CONS list *self*.

`member?` (*self* (*object* OBJECT)) : BOOLEAN [Method on CONS]
Return `true` iff *object* is a member of the cons list *self* (uses an `eql?` test).

`memb?` (*self* (*object* OBJECT)) *:* BOOLEAN [Method on CONS]
Return `true` iff *object* is a member of the cons list *self* (uses an `eq?` test).

`position` (*self* (*object* OBJECT) (*start* INTEGER)) *:* INTEGER [Method on CONS]
Return the position of *object* within the cons-list *self* (counting from zero); or return `null` if *object* does not occur within *self* (uses an `eql?` test). If *start* was supplied as non-'null', only consider the sublist starting at *start*, however, the returned position will always be relative to the entire list.

`last-position` (*self* (*object* OBJECT) (*end* INTEGER)) *:* INTEGER [Method on CONS]
Return the position of *object* within the cons-list *self* (counting from zero); or return `null` if *object* does not occur within *self* (uses an `eql?` test). If `start` was supplied as non-'null', only consider the sublist ending at *end*, however, the returned position will always be relative to the entire list.

`reverse` (*self*) *:* (LIKE SELF) [Method on CONS]
Destructively reverse the members of the cons list *self*.

`remove` (*self* (*value* OBJECT)) *:* (LIKE SELF) [Method on CONS]
Destructively remove all entries in the cons list *self* that match *value*. Unless the remaining list is `nil`, insure that the cons that heads the list is unchanged.

`remove-duplicates` (*self*) *:* (LIKE SELF) [Method on CONS]
Destructively remove duplicates from *self* and return the result. Removes all but the first occurrence of items in the list. Preserves the original order of the remaining members. Runs in linear time.

`remove-if` (*self* (*test?* FUNCTION-CODE)) *:* (LIKE SELF) [Method on CONS]
Destructively removes all members of the cons list *self* for which *test?* evaluates to `true`. `test` takes a single argument of type OBJECT and returns `true` or `false`. Returns a cons list. In case the first element is removed, the return result should be assigned to a variable.

`substitute` (*self* (*inValue* OBJECT) (*outValue* OBJECT)) *:* CONS [Method on CONS]
Destructively replace each appearance of *outValue* by *inValue* in the cons list *self*.

`concatenate` (*list1* (*list2* CONS) **&rest** *(otherLists* CONS*)*) *:* CONS [Method on CONS]
Return a cons list consisting of the concatenation of *list1*, *list2*, and *otherLists*. The operation is destructive wrt all but the last list argument which is left intact. The two mandatory parameters allow us to optimize the common binary case by not relying on the somewhat less efficient variable arguments mechanism.

`append` ((*consList1* CONS) (*consList2* CONS)) *:* CONS [Function]
Return a cons list representing the concatenation of *consList1* and *consList2*. The concatenation is NOT destructive.

`prepend` (*self* (*list1* CONS)) *:* CONS [Method on CONS]
Return a cons list consisting of the concatenation of *list1* and *self*. A copy of *list1* is prepended to *self*. This operation results in structure sharing of *self*; to avoid this, *self* should not be pointed to by anything other than the tail of the prepended copy.

`pushq` ((*variable* SYMBOL) (*value* OBJECT)) : OBJECT [Macro]
Push *value* onto the cons list *variable*.

`pushq-new` ((*variable* SYMBOL) (*value* OBJECT)) : OBJECT [Macro]
Push *value* onto the cons list *variable*, unless *value* is already a member of the list.

`popq` ((*variable* SYMBOL)) : OBJECT [Macro]
Pops a value from the cons list *variable*.

`cons-list` (**&rest** (*values* OBJECT)) : CONS [Function]
Return a cons list containing *values*, in order.

`list*` (**&rest** (*values* OBJECT)) : CONS [Function]
Return a list of conses that make up the list *values*, terminated by the last value rather than by `nil`. Assumes that at least one value is passed in.

`copy-cons-list` ((*self* CONS)) : (LIKE SELF) [Function]
Return a copy of the cons list *self*.

`copy-cons-tree` ((*self* OBJECT)) : (LIKE SELF) [Function]
Return a copy of the cons tree *self*.

`substitute-cons-tree` ((*tree* OBJECT) (*newValue* OBJECT) (*oldValue* OBJECT)) : OBJECT [Function]
Destructively replace each appearance of *oldValue* by *newValue* in the cons tree *tree*. Return the tree. Uses an `eql?` test.

`search-cons-tree?` ((*tree* OBJECT) (*value* OBJECT)) : BOOLEAN [Function]
Return `true` iff the value *value* is embedded within the cons tree *tree*. Uses an `eql?` test.

`tree-size` ((*self* OBJECT)) : INTEGER [Function]
Not documented.

`safe-tree-size` ((*tree* CONS)) : INTEGER STRING [Function]
Not documented.

`cons-tree-nth` ((*tree* CONS) **&rest** (*index* INTEGER)) : OBJECT [Function]
Access an arbitrary element of *tree* identified by a path specified as a list of *index* values. The first *index* specifies the *index*-th element of *tree*, the second *index* the *index*-th subelement of that element, etc. Example:

```
(cons-tree-nth (quote (a (b (c d e) f) g)) 1 1 2) => e
```

`cons-tree-nth-rest` ((*tree* CONS) **&rest** (*index* INTEGER)) : CONS [Function]
Access an arbitrary sublist of *tree* identified by a path specified as a list of *index* values. The first *index* specifies the *index*-th element of *tree*, the second *index* the *index*-th subelement of that element, ..., the last index specifies the `nth-rest` of the previous element (different from `cons-tree-nth`). Example:

```
(cons-tree-nth-rest (quote (a (b (c d e) f) g)) 1 1 1) => (d e)
```

`match-cons-tree` ((*tree* OBJECT) (*pattern* OBJECT) (*bindings* KEY-VALUE-LIST)) : KEY-VALUE-LIST [Function]

Match *pattern* against *tree* and return a list of variable bindings if they match, or NULL otherwise. *bindings* can be NULL or an initial list of bindings to consider. Pattern variables use KIF syntax, i.e., they need to start with a `?` character. A single question mark is interpreted as the anonymous variable. Example:

```
(match-cons-tree (quote (a (b (a d) e) (a d) f g))
                 (quote (a (?x ?y ?) ?y ? g))
                 NULL)
=> |kv|(<?Y,(A D)> <?X,B>)
```

Variables can't be quoted but quoting can effectively be achieved by inserting to-be-quoted variables bound to themselves into *bindings*.

`cons-tree-match?` ((*tree* OBJECT) (*pattern* OBJECT)) : BOOLEAN [Function]

Predicate version of `match-cons-tree` (which see).

`consify` (*self*) : (CONS OF (LIKE (ANY-VALUE SELF))) [Method on CONS]

Return *self*.

`allocate-iterator` (*self*) : (CONS-ITERATOR OF (LIKE (ANY-VALUE SELF))) [Method on CONS]

Not documented.

`next?` (*self*) : BOOLEAN [Method on CONS-ITERATOR]

Not documented.

`sort` (*self* (*predicate* FUNCTION-CODE)) : (CONS OF (LIKE (ANY-VALUE SELF))) [Method on CONS]

Perform a stable, destructive sort of *self* according to *predicate*, and return the result. If *predicate* has a `<` semantics, the result will be in ascending order. It is not guaranteed that *self* will point to the beginning of the sorted result. If *predicate* is `null`, a suitable `<` predicate is chosen depending on the first element of *self*, and it is assumed that all elements of *self* have the same type (supported element types are GENERALIZED-SYMBOL, STRING, INTEGER, and FLOAT).

`sort-tuples` (*self* (*n* INTEGER) (*predicate* FUNCTION-CODE)) : (CONS OF (LIKE (ANY-VALUE SELF))) [Method on CONS]

Just like `sort` but assumes each element of *self* is a tuple (a cons) whose *n*-th element (0-based) will be used for comparison.

`map-null-to-nil` ((*self* CONS)) : (LIKE SELF) [Function]

Return `nil` iff *self* is `null` or *self* otherwise.

`*printpretty?*` : BOOLEAN [Special Variable]

If `true` conses will be pretty printed.

`*printreadably?*` : BOOLEAN [Special Variable]

If `true` conses will be printed as readable Stella code.

`*printprettycode?*` *:* BOOLEAN [Special Variable]

When `true` pretty-print Stella and translated code. Since (Lisp) pretty-printing is somewhat slow, turning this off speeds up file translation, but it also makes translated output very unreadable.

6.5.1 CONS Lists as Sets

`subset?` (*self* (*otherList* CONS)) *:* BOOLEAN [Method on CONS]

Return true if every element of *self* also occurs in *otherList*. Uses an `eql?` test and a simple quadratic-time algorithm. Note that this does not check whether *self* and *otherList* actually are sets.

`equivalent-sets?` (*self* (*otherList* CONS)) *:* BOOLEAN [Method on CONS]

Return true if every element of *self* occurs in *otherList* and vice versa. Uses an `eql?` test and a simple quadratic-time algorithm. Note that this does not check whether *self* and *otherList* actually are sets.

`union` (*self* (*otherList* CONS)) *:* CONS [Method on CONS]

Return the set union of *self* and *otherList*. Uses an `eql?` test and a simple quadratic-time algorithm. Note that the result is only guaranteed to be a set if both *self* and *otherList* are sets.

`intersection` (*self* (*otherList* CONS)) *:* CONS [Method on CONS]

Return the set intersection of *self* and *otherList*. Uses an `eql?` test and a simple quadratic-time algorithm. Note that the result is only guaranteed to be a set if both *self* and *otherList* are sets.

`difference` (*self* (*otherList* CONS)) *:* CONS [Method on CONS]

Return the set difference of *self* and *otherList* (i.e., all elements that are in *self* but not in `otherSet`). Uses an `eql?` test and a simple quadratic-time algorithm. Note that the result is only guaranteed to be a set if both *self* and *otherList* are sets.

`subtract` (*self* (*otherList* CONS)) *:* CONS [Method on CONS]

Return the set difference of *self* and *otherList* by destructively removing elements from *self* that also occur in *otherList*. Uses an `eql?` test and a simple quadratic-time algorithm. Note that the result is only guaranteed to be a set if *self* is a set.

6.6 Lists

LIST *:* SEQUENCE [Class]

Not documented.

`any-value` *:* OBJECT [Class Parameter of]

Not documented.

`the-cons-list` *:* (CONS OF (LIKE (ANY-VALUE SELF))) [Slot of]

Not documented.

`nil-list` *:* LIST [Variable]

Not documented.

`defined-list?` ((*self* LIST)) : BOOLEAN [Function]
Return TRUE unless *self* is NULL or the `NIL-LIST`.

`null-list?` ((*self* LIST)) : BOOLEAN [Function]
Return TRUE iff *self* is NULL or the `NIL-LIST`.

`empty?` (*self*) : BOOLEAN [Method on LIST]
Return TRUE if the list *self* has no members.

`non-empty?` (*self*) : BOOLEAN [Method on LIST]
Return TRUE if the list *self* has at least one member.

`object-equal?` (*x* (*y* OBJECT)) : BOOLEAN [Method on LIST]
Return TRUE iff the lists *x* and *y* are structurally equivalent. Uses `equal?` to test equality of elements.

`equal-hash-code` (*self*) : INTEGER [Method on LIST]
Return an `equal?` hash code for *self*. Note that this is O(N) in the number of elements of *self*.

`list` (**&rest** (*values* OBJECT)) : LIST [Function]
Return a list containing *values*, in order.

`first` (*self*) : (LIKE (ANY-VALUE SELF)) [Method on LIST]
Return the first item in the list *self*, or NULL if empty.

`second` (*self*) : (LIKE (ANY-VALUE SELF)) [Method on LIST]
Return the second item in the list *self*, or NULL if empty.

`third` (*self*) : (LIKE (ANY-VALUE SELF)) [Method on LIST]
Return the third item in the list *self*, or NULL if empty.

`fourth` (*self*) : (LIKE (ANY-VALUE SELF)) [Method on LIST]
Return the fourth item in the list *self*, or NULL if empty.

`fifth` (*self*) : (LIKE (ANY-VALUE SELF)) [Method on LIST]
Return the fifth item in the list *self*, or NULL if empty.

`nth` (*self* (*position* INTEGER)) : (LIKE (ANY-VALUE SELF)) [Method on LIST]
Return the nth item in the list *self*, or NULL if empty.

`rest` (*self*) : (CONS OF (LIKE (ANY-VALUE SELF))) [Method on LIST]
Return a cons list of all but the first item in the list *self*.

`last` (*self*) : (LIKE (ANY-VALUE SELF)) [Method on LIST]
Return the last element of *self*.

`but-last` (*self*) : (ITERATOR OF (LIKE (ANY-VALUE SELF))) [Method on LIST]
Generate all but the last element of the list *self*.

`length` (*self*) : INTEGER [Method on LIST]
Not documented.

`member?` (*self* (*object* OBJECT)) *:* BOOLEAN [Method on LIST]
Return TRUE iff *object* is a member of the list *self* (uses an `eql?` test).

`memb?` (*self* (*object* (LIKE (ANY-VALUE SELF)))) *:* BOOLEAN [Method on LIST]
Return TRUE iff *object* is a member of the cons list *self* (uses an `eq?` test).

`position` (*self* (*object* OBJECT) (*start* INTEGER)) *:* INTEGER [Method on LIST]
Return the position of *object* within the list *self* (counting from zero); or return NULL if *object* does not occur within *self* (uses an `eql?` test). If *start* was supplied as non-NULL, only consider the sublist starting at *start*, however, the returned position will always be relative to the entire list.

`last-position` (*self* (*object* OBJECT) (*end* INTEGER)) *:* INTEGER [Method on LIST]
Return the position of *object* within the list *self* (counting from zero); or return NULL if *object* does not occur within *self* (uses an `eql?` test). If *end* was supplied as non-NULL, only consider the sublist ending at *end*, however, the returned position will always be relative to the entire list.

`insert` (*self* (*value* (LIKE (ANY-VALUE SELF)))) *:* [Method on LIST]
Add *value* to the front of the list *self*.

`push` (*self* (*value* (LIKE (ANY-VALUE SELF)))) *:* [Method on LIST]
Add *value* to the front of the list *self*.

`insert-new` (*self* (*value* (LIKE (ANY-VALUE SELF)))) *:* [Method on LIST]
Add *value* to the front of the list *self* unless its already a member.

`insert-last` (*self* (*value* (LIKE (ANY-VALUE SELF)))) *:* [Method on LIST]
Insert *value* as the last entry in the list *self*.

`reverse` (*self*) *:* (LIKE SELF) [Method on LIST]
Reverse the members of *self* (in place).

`remove` (*self* (*value* (LIKE (ANY-VALUE SELF)))) *:* (LIKE SELF) [Method on LIST]
Destructively remove all entries in *self* that match *value*.

`remove-duplicates` (*self*) *:* (LIKE SELF) [Method on LIST]
Destructively remove duplicates from *self* and return the result. Preserves the original order of the remaining members.

`remove-deleted-members` (*self*) *:* (LIKE SELF) [Method on LIST]
Not documented.

`remove-if` (*self* (*test?* FUNCTION-CODE)) *:* (LIKE SELF) [Method on LIST]
Destructively remove all members of the list *self* for which *test?* evaluates to TRUE. `test` takes a single argument of type OBJECT and returns TRUE or FALSE. Returns *self*.

`pop` (*self*) *:* (LIKE (ANY-VALUE SELF)) [Method on LIST]
Remove and return the first element in the list *self*. Return NULL if the list is empty.

`substitute` (*self* (*inValue* OBJECT) (*outValue* OBJECT)) *:* (LIKE SELF) [Method on LIST]
Destructively replace each appearance of *outValue* by *inValue* in the list *self*.

`concatenate` (*list1* (*list2* LIST) **&rest** *(otherLists* LIST*)) :* LIST [Method on LIST]
Copy *list2* and all *otherLists* onto the end of *list1*. The operation is destructive wrt *list1*, but leaves all other lists intact. The two mandatory parameters allow us to optimize the common binary case by not relying on the somewhat less efficient variable arguments mechanism.

`prepend` (*self* (*list2* LIST)) *:* (LIKE SELF) [Method on LIST]
Copy *list2* onto the front of the list *self*. The operation is destructive wrt *self*, but leaves *list2* intact.

`copy` (*self*) *:* (LIST OF (LIKE (ANY-VALUE SELF))) [Method on LIST]
Return a copy of the list *self*. The conses in the copy are freshly allocated.

`clear` (*self*) *:* [Method on LIST]
Make *self* an empty list.

`consify` (*self*) *:* (CONS OF (LIKE (ANY-VALUE SELF))) [Method on LIST]
Return a list of elements in *self*.

`allocate-iterator` (*self*) *:* (LIST-ITERATOR OF (LIKE (ANY-VALUE SELF))) [Method on LIST]
Not documented.

`next?` (*self*) *:* BOOLEAN [Method on LIST-ITERATOR]
Not documented.

`sort` (*self* (*predicate* FUNCTION-CODE)) *:* (LIST OF (LIKE (ANY-VALUE SELF))) [Method on LIST]
Perform a stable, destructive sort of *self* according to *predicate*, and return the result. If *predicate* has a `<` semantics, the result will be in ascending order. If *predicate* is NULL, a suitable `<` predicate is chosen depending on the first element of *self*, and it is assumed that all elements of *self* have the same type (supported element types are GENERALIZED-SYMBOL, STRING, INTEGER, and FLOAT).

`map-null-to-nil-list` ((*self* LIST)) *:* LIST [Function]
Return NIL-LIST iff *self* is NULL or *self* otherwise.

6.6.1 Lists as Sets

Similar to `CONS` lists `LIST`'s can also be treated as sets and support the set manipulations below. Note that `LIST` constructors do not check for proper set-hood and may have surprising results if a list contains duplicate elements.

`subset?` (*self* (*otherList* LIST)) *:* BOOLEAN [Method on LIST]
Return true if every element of *self* also occurs in *otherList*. Uses an `eql?` test and a simple quadratic-time algorithm. Note that this does not check whether *self* and *otherList* actually are sets.

`equivalent-sets?` (*self* (*otherList* LIST)) *:* BOOLEAN [Method on LIST]
Return true if every element of *self* occurs in *otherList* and vice versa. Uses an `eql?` test and a simple quadratic-time algorithm. Note that this does not check whether *self* and *otherList* actually are sets.

`union` (*self* (*otherList* LIST)) *:* LIST [Method on LIST]
Return the set union of *self* and *otherList*. Uses an `eql?` test and a simple quadratic-time algorithm. Note that the result is only guaranteed to be a set if both *self* and *otherList* are sets.

`intersection` (*self* (*otherList* LIST)) *:* LIST [Method on LIST]
Return the set intersection of *self* and *otherList*. Uses an `eql?` test and a simple quadratic-time algorithm. Note that the result is only guaranteed to be a set if both *self* and *otherList* are sets.

`difference` (*self* (*otherList* LIST)) *:* LIST [Method on LIST]
Return the set difference of *self* and *otherList* (i.e., all elements that are in *self* but not in `otherSet`). Uses an `eql?` test and a simple quadratic-time algorithm. Note that the result is only guaranteed to be a set if both *self* and *otherList* are sets.

`subtract` (*self* (*otherList* LIST)) *:* LIST [Method on LIST]
Return the set difference of *self* and *otherList* by destructively removing elements from *self* that also occur in *otherList*. Uses an `eql?` test and a simple quadratic-time algorithm. Note that the result is only guaranteed to be a set if *self* is a set.

`SET` is a subclass of `LIST` that overrides certain `LIST` operations to prevent duplicate elements. The following additional or modified operations are supported:

SET *:* LIST, SET-MIXIN [Class]
Not documented.

`any-value` *:* OBJECT [Class Parameter of]
Not documented.

`insert` (*self* (*value* (LIKE (ANY-VALUE SELF)))) *:* [Method on SET]
Add *value* to the set *self* unless it is already a member.

`push` (*self* (*value* (LIKE (ANY-VALUE SELF)))) *:* [Method on SET]
Add *value* to the front of set *self* unless it is already a member.

`insert-last` (*self* (*value* (LIKE (ANY-VALUE SELF)))) *:* [Method on SET]
Add *value* to the end of set *self* unless it is already a member.

`substitute` (*self* (*new* OBJECT) (*old* OBJECT)) *:* (LIKE SELF) [Method on SET]
Destructively replace *old* with *new* in the set *self* unless *new* is already a member.

`concatenate` (*set1* (*set2* LIST) **&rest** (*otherSets* LIST)) *:* SET [Method on SET]
Union *set2* and all *otherSets* onto the end of *set1*. The operation is destructive wrt *set1*, but leaves all other sets intact. The two mandatory parameters allow us to optimize the common binary case by not relying on the somewhat less efficient variable arguments mechanism.

`object-equal?` (*x* (*y* OBJECT)) *:* BOOLEAN [Method on SET]

Return TRUE iff *x* and *y* are SET's with equivalent members. Uses `equal?` to test equality of elements. This is more general than `equivalent-sets?`, since that only uses an `eql?` test.

`equal-hash-code` (*self*) *:* INTEGER [Method on SET]

Return an `equal?` hash code for *self*. Note that this is O(N) in the number of elements of *self*.

`set` (**&rest** (*values* OBJECT)) *:* SET [Function]

Return a set containing *values*, in order.

6.7 Property and Key-Value Lists

PROPERTY-LIST *:* DICTIONARY [Class]

Not documented.

`any-key` *:* OBJECT [Class Parameter of]

Not documented.

`any-value` *:* OBJECT [Class Parameter of]

Not documented.

`the-plist` *:* CONS [Slot of]

Not documented.

`empty?` (*self*) *:* BOOLEAN [Method on PROPERTY-LIST]

Not documented.

`non-empty?` (*self*) *:* BOOLEAN [Method on PROPERTY-LIST]

Not documented.

`object-equal?` (*x* (*y* OBJECT)) *:* BOOLEAN [Method on PROPERTY-LIST]

Return TRUE if *x* and *y* represent the same set of key/value pairs..

`equal-hash-code` (*self*) *:* INTEGER [Method on PROPERTY-LIST]

Return an `equal?` hash code for *self*. Note that this is O(N) in the number of entries of *self*.

`length` (*self*) *:* INTEGER [Method on PROPERTY-LIST]

Not documented.

`lookup` (*self* (*key* (LIKE (ANY-KEY SELF)))) *:* (LIKE (ANY-VALUE SELF)) [Method on PROPERTY-LIST]

Not documented.

`insert-at` (*self* (*key* (LIKE (ANY-KEY SELF))) (*value* (LIKE (ANY-VALUE SELF)))) *:* [Method on PROPERTY-LIST]

Insert the entry <'key', *value*> into the property list *self*. If a previous entry existed with key *key*, that entry is replaced.

`remove-at` (*self* (*key* (LIKE (ANY-KEY SELF)))) : OBJECT [Method on PROPERTY-LIST]

Remove the entry that matches the key *key*. Return the value of the matching entry, or NULL if there is no matching entry. Assumes that at most one entry matches *key*.

`copy` (*self*) : (LIKE SELF) [Method on PROPERTY-LIST]

Return a copy of the list *self*. The conses in the copy are freshly allocated.

`clear` (*self*) : [Method on PROPERTY-LIST]

Make *self* an empty property list.

`allocate-iterator` (*self*) : (PROPERTY-LIST-ITERATOR OF (LIKE (ANY-KEY SELF)) (LIKE (ANY-VALUE SELF))) [Method on PROPERTY-LIST]

Not documented.

`next?` (*self*) : BOOLEAN [Method on PROPERTY-LIST-ITERATOR]

Not documented.

KV-CONS : STANDARD-OBJECT [Class]

Not documented.

`any-key` : OBJECT [Class Parameter of]

Not documented.

`any-value` : OBJECT [Class Parameter of]

Not documented.

`key` : OBJECT [Slot of]

Not documented.

`value` : OBJECT [Slot of]

Not documented.

`rest` : KV-CONS [Slot of]

Not documented.

`kv-cons` ((*key* OBJECT) (*value* OBJECT) (*rest* KV-CONS)) : KV-CONS [Function]

Create, fill-in, and return a new KV-CONS.

`copy-kv-cons-list` ((*kvconslist* KV-CONS)) : KV-CONS [Function]

Return a copy of the cons list `consList`.

KEY-VALUE-LIST : DICTIONARY [Class]

Not documented.

`any-key` : OBJECT [Class Parameter of]

Not documented.

`any-value` : OBJECT [Class Parameter of]

Not documented.

`the-kv-list` *:* KV-CONS [Slot of]

Not documented.

`empty?` (*self*) *:* BOOLEAN [Method on KEY-VALUE-LIST]

Not documented.

`non-empty?` (*self*) *:* BOOLEAN [Method on KEY-VALUE-LIST]

Not documented.

`object-equal?` (*x* (*y* OBJECT)) *:* BOOLEAN [Method on KEY-VALUE-LIST]

Return TRUE if *x* and *y* represent the same set of key/value pairs.

`equal-hash-code` (*self*) *:* INTEGER [Method on KEY-VALUE-LIST]

Return an `equal?` hash code for *self*. Note that this is O(N) in the number of entries of *self*.

`length` (*self*) *:* INTEGER [Method on KEY-VALUE-LIST]

Not documented.

`lookup` (*self* (*key* (LIKE (ANY-KEY SELF)))) *:* (LIKE (ANY-VALUE SELF)) [Method on KEY-VALUE-LIST]

Not documented.

`reverse` (*self*) *:* (LIKE SELF) [Method on KEY-VALUE-LIST]

Destructively reverse the members of the list *self*.

`insert-at` (*self* (*key* (LIKE (ANY-KEY SELF))) (*value* (LIKE (ANY-VALUE SELF)))) *:* [Method on KEY-VALUE-LIST]

Insert the entry <‘key’, *value*> into the association *self*. If a previous entry existed with key *key*, that entry is replaced.

`remove-at` (*self* (*key* (LIKE (ANY-KEY SELF)))) *:* OBJECT [Method on KEY-VALUE-LIST]

Remove the entry that matches the key *key*. Return the value of the matching entry, or NULL if there is no matching entry. Assumes that at most one entry matches *key*.

`insert-entry` (*self* (*key* (LIKE (ANY-KEY SELF))) (*value* (LIKE (ANY-VALUE SELF)))) *:* [Method on KEY-VALUE-LIST]

Insert an entry <‘key’,*value*> to *self* unless an identical entry already exists. This can generate duplicate entries for *key*.

`remove-entry` (*self* (*key* (LIKE (ANY-KEY SELF))) (*value* (LIKE (ANY-VALUE SELF)))) *:* [Method on KEY-VALUE-LIST]

Remove the entry that matches <‘key’,*value*>. Assumes that more than one entry can match *key*.

`push` (*self* (*value* KV-CONS)) *:* [Method on KEY-VALUE-LIST]

Make *value* be the new first element of *self*. Note that the `rest` slot of *value* should be `null`, since it will be overwritten. This might duplicate an existing entry. If a previous entry existed with the same key as *value*, that entry is retained, but shadowed by this new entry.

`kv-push` (*self* (*key* (LIKE (ANY-KEY SELF))) (*value* (LIKE (ANY-VALUE SELF)))) *:* [Method on KEY-VALUE-LIST]
Add a new entry <'key', *value*> to the front of the association *self*. This might duplicate an existing entry. If a previous entry existed with key *key*, that entry is retained, but shadowed by this new entry.

`pop` (*self*) *:* (LIKE (ANY-VALUE SELF)) [Method on KEY-VALUE-LIST]
Remove and return the value of the first element of the kv-list *self*. It does NOT return the KV-CONS object. Return `null` if the list is empty.

`copy` (*self*) *:* (LIKE SELF) [Method on KEY-VALUE-LIST]
Return a copy of the kv-list *self*. The kv-conses in the copy are freshly allocated.

`clear` (*self*) *:* [Method on KEY-VALUE-LIST]
Make *self* an empty dictionary.

`consify` (*self*) *:* (CONS OF (LIKE (ANY-VALUE SELF))) [Method on KEY-VALUE-LIST]
Return a list of key-value pairs in *self*.

`allocate-iterator` (*self*) *:* (KV-LIST-ITERATOR OF (LIKE (ANY-KEY SELF)) (LIKE (ANY-VALUE SELF))) [Method on KEY-VALUE-LIST]
Not documented.

`next?` (*self*) *:* BOOLEAN [Method on KV-LIST-ITERATOR]
Not documented.

6.8 Vectors

VECTOR *:* SEQUENCE [Class]
Not documented.

`any-value` *:* OBJECT [Class Parameter of]
Not documented.

`array-size` *:* INTEGER [Slot of]
Not documented.

`the-array` *:* (NATIVE-VECTOR OF (LIKE (ANY-VALUE SELF))) [Slot of]
Not documented.

EXTENSIBLE-VECTOR *:* VECTOR [Class]
Not documented.

`empty?` (*self*) *:* BOOLEAN [Method on VECTOR]
Return `true` if *self* has length 0.

`non-empty?` (*self*) *:* BOOLEAN [Method on VECTOR]
Return `true` if *self* has length > 0.

`object-equal?` (*x* (*y* OBJECT)) *:* BOOLEAN [Method on VECTOR]
Return TRUE iff the vectors *x* and *y* are structurally equivalent. Uses `equal?` to test equality of elements.

`equal-hash-code` (*self*) *:* INTEGER [Method on VECTOR]
Return an `equal?` hash code for *self*.

`vector` (**&rest** *(values* OBJECT*))* *:* VECTOR [Function]
Return a vector containing *values*, in order.

`first` (*self*) *:* (LIKE (ANY-VALUE SELF)) [Method on VECTOR]
Not documented.

`second` (*self*) *:* (LIKE (ANY-VALUE SELF)) [Method on VECTOR]
Not documented.

`third` (*self*) *:* (LIKE (ANY-VALUE SELF)) [Method on VECTOR]
Not documented.

`fourth` (*self*) *:* (LIKE (ANY-VALUE SELF)) [Method on VECTOR]
Not documented.

`fifth` (*self*) *:* (LIKE (ANY-VALUE SELF)) [Method on VECTOR]
Not documented.

`nth` (*self* (*position* INTEGER)) *:* (LIKE (ANY-VALUE SELF)) [Method on VECTOR]
Not documented.

`last` (*self*) *:* (LIKE (ANY-VALUE SELF)) [Method on VECTOR]
Return the last item in the vector *self*.

`but-last` (*self*) *:* (ITERATOR OF (LIKE (ANY-VALUE SELF))) [Method on VECTOR]
Generate all but the last element of the vector *self*.

`length` (*self*) *:* INTEGER [Method on VECTOR]
Not documented.

`member?` (*self* (*object* OBJECT)) *:* BOOLEAN [Method on VECTOR]
Not documented.

`position` (*self* (*object* OBJECT) (*start* INTEGER)) *:* INTEGER [Method on VECTOR]
Return the position of *object* within the vector *self* (counting from zero); or return `null` if *object* does not occur within *self* (uses an `eql?` test). If *start* was supplied as non-'null', only consider the portion starting at *start*, however, the returned position will always be relative to the entire vector.

`last-position` (*self* (*object* OBJECT) (*end* INTEGER)) *:* INTEGER [Method on VECTOR]
Return the position of *object* within the vector *self* (counting from zero); or return `null` if *object* does not occur within *self* (uses an `eql?` test). If *end* was supplied as non-'null', only consider the portion ending at index *end*, however, the returned position will always be relative to the entire vector.

`insert-at` (*self* (*offset* INTEGER) (*value* (LIKE (ANY-VALUE SELF)))) *:* [Method on VECTOR]
Not documented.

`copy` (*self*) *:* (VECTOR OF (LIKE (ANY-VALUE SELF))) [Method on VECTOR]
Return a copy of the vector *self*.

`clear` (*self*) *:* [Method on VECTOR]
Not documented.

`resize-vector` ((*self* VECTOR) (*size* INTEGER)) *:* [Function]
Change the size of *self* to *size*. If *size* is smaller than the current size of *self* the vector will be truncated. Otherwise, the internal array of *self* will be grown to *size* and unused elements will be initialized to NULL.

`consify` (*self*) *:* (CONS OF (LIKE (ANY-VALUE SELF))) [Method on VECTOR]
Return a list of elements in *self*.

`insert-at` (*self* (*offset* INTEGER) (*value* (LIKE (ANY-VALUE SELF)))) *:* [Method on EXTENSIBLE-VECTOR]
Not documented.

`insert` (*self* (*value* (LIKE (ANY-VALUE SELF)))) *:* [Method on VECTOR-SEQUENCE]
Append *value* to the END of the sequence *self*. Resize the array if necessary.

`remove` (*self* (*value* (LIKE (ANY-VALUE SELF)))) *:* VECTOR-SEQUENCE [Method on VECTOR-SEQUENCE]
Remove *value* from the sequence *self*, and left shift the values after it to close the gap.

`length` (*self*) *:* INTEGER [Method on VECTOR-SEQUENCE]
Not documented.

6.9 Hash Tables

HASH-TABLE *:* ABSTRACT-HASH-TABLE [Class]
Not documented.

`any-key` *:* OBJECT [Class Parameter of]
Not documented.

`any-value` *:* OBJECT [Class Parameter of]
Not documented.

STRING-HASH-TABLE *:* ABSTRACT-HASH-TABLE [Class]
Not documented.

`any-key` *:* STRING [Class Parameter of]
Not documented.

`any-value` *:* OBJECT [Class Parameter of]
Not documented.

STRING-TO-INTEGER-HASH-TABLE *:* ABSTRACT-HASH-TABLE [Class]
Not documented.

any-key *:* STRING [Class Parameter of]
Not documented.

any-value *:* INTEGER [Class Parameter of]
Not documented.

INTEGER-HASH-TABLE *:* ABSTRACT-HASH-TABLE [Class]
Not documented.

any-key *:* INTEGER [Class Parameter of]
Not documented.

any-value *:* OBJECT [Class Parameter of]
Not documented.

FLOAT-HASH-TABLE *:* ABSTRACT-HASH-TABLE [Class]
Not documented.

any-key *:* FLOAT [Class Parameter of]
Not documented.

any-value *:* OBJECT [Class Parameter of]
Not documented.

lookup (*self* (*key* (LIKE (ANY-KEY SELF)))) *:* (LIKE (ANY-VALUE SELF)) [Method on HASH-TABLE]
Not documented.

insert-at (*self* (*key* (LIKE (ANY-KEY SELF))) (*value* (LIKE (ANY-VALUE SELF)))) *:* [Method on HASH-TABLE]
Not documented.

remove-at (*self* (*key* (LIKE (ANY-KEY SELF)))) *:* [Method on HASH-TABLE]
Not documented.

lookup (*self* (*key* STRING)) *:* (LIKE (ANY-VALUE SELF)) [Method on STRING-HASH-TABLE]
Not documented.

insert-at (*self* (*key* STRING) (*value* OBJECT)) *:* [Method on STRING-HASH-TABLE]
Not documented.

remove-at (*self* (*key* STRING)) *:* [Method on STRING-HASH-TABLE]
Not documented.

lookup (*self* (*key* STRING)) *:* INTEGER [Method on STRING-TO-INTEGER-HASH-TABLE]
Not documented.

insert-at (*self* (*key* STRING) (*value* INTEGER)) *:* [Method on STRING-TO-INTEGER-HASH-TABLE]
Not documented.

`lookup` (*self* (*key* INTEGER)) *:* (LIKE (ANY-VALUE SELF)) [Method on INTEGER-HASH-TABLE]
Not documented.

`insert-at` (*self* (*key* INTEGER) (*value* OBJECT)) *:* [Method on INTEGER-HASH-TABLE]
Not documented.

`insert-at` (*self* (*key* FLOAT) (*value* OBJECT)) *:* [Method on FLOAT-HASH-TABLE]
Not documented.

STELLA provides its own implementation of hash tables for cases where language-native implementations are not available, or where additional features are needed.

STELLA-HASH-TABLE *:* ABSTRACT-HASH-TABLE [Class]
Not documented.

`any-key` *:* OBJECT [Class Parameter of]
Not documented.

`any-value` *:* OBJECT [Class Parameter of]
Not documented.

`the-table` *:* (ARRAY SIZE () OF KV-CONS) [Slot of]
Not documented.

`size` *:* INTEGER [Slot of]
Not documented.

`initial-size` *:* INTEGER [Slot of]
If supplied, the initial hash table will be sized to hold at least that many elements.

`free-elements` *:* INTEGER [Slot of]
Not documented.

`equal-test?` *:* BOOLEAN [Slot of]
If true use `equal?` as the equality test and `equal-hash-code` as the hash function, otherwise, use `eql?` and `hash-code` (the default).

`lookup` (*self* (*key* (LIKE (ANY-KEY SELF)))) *:* (LIKE (ANY-VALUE SELF)) [Method on STELLA-HASH-TABLE]
Lookup the entry identified by *key* in *self* and return its value, or NULL if no such entry exists. Uses an `eql?` test by default or `equal?` if `equal-test?` of *self* is TRUE.

`insert-at` (*self* (*key* (LIKE (ANY-KEY SELF))) (*value* (LIKE (ANY-VALUE SELF)))) *:* [Method on STELLA-HASH-TABLE]
Set the value of the entry identified by *key* in *self* to *value* or add a new entry if no entry with *key* exists yet. Uses an `eql?` test by default or `equal?` if `equal-test?` of *self* is TRUE.

`remove-at` (*self* (*key* (LIKE (ANY-KEY SELF)))) : [Method on STELLA-HASH-TABLE]
Remove the entry identified by *key* from *self*. Uses an `eql?` test by default or `equal?` if `equal-test?` of *self* is TRUE.

`length` (*self*) : INTEGER [Method on STELLA-HASH-TABLE]
Return the number of entries in *self*.

`empty?` (*self*) : BOOLEAN [Method on STELLA-HASH-TABLE]
Return TRUE if *self* has zero entries.

`non-empty?` (*self*) : BOOLEAN [Method on STELLA-HASH-TABLE]
Return TRUE if *self* has at least 1 entry.

`copy` (*self*) : (LIKE SELF) [Method on STELLA-HASH-TABLE]
Return a copy of the hash table *self*. The bucket table and buckets are freshly allocated, however, the keys and values of entries are not copied themselves (similar to what we do for lists, etc.).

`clear` (*self*) : [Method on STELLA-HASH-TABLE]
Remove all entries from *self*. This will result in a re-initialization of the table upon the first insertion into *self*.

`consify` (*self*) : (CONS OF CONS) [Method on STELLA-HASH-TABLE]
Collect all entries of *self* into a cons list of `(<key> <value>)` pairs and return the result.

`object-equal?` (*x* (*y* OBJECT)) : BOOLEAN [Method on STELLA-HASH-TABLE]
Return TRUE if *x* and *y* represent the same set of key/value pairs.

`equal-hash-code` (*self*) : INTEGER [Method on STELLA-HASH-TABLE]
Return an `equal?` hash code for *self*. Note that this is O(N) in the number of entries of *self*.

`allocate-iterator` (*self*) : [Method on STELLA-HASH-TABLE]
(STELLA-HASH-TABLE-ITERATOR OF (LIKE (ANY-KEY SELF)) (LIKE (ANY-VALUE SELF)))
Allocate an iterator for *self*.

Hashing objects into STELLA hash tables is accomplished via `hash-code` and `equal-hash-code` methods. These methods are implemented for all built-in STELLA types but are user extensible for cases where special functionality on user-defined objects is needed. Defining new `hash-code` methods should only be necessary if new wrapper types are defined, since for all types descending from `STANDARD-OBJECT` the built-in method should be adequate.

`object-hash-code` ((*self* OBJECT)) : INTEGER [Function]
Return a hash code for *self* (can be negative). Two objects that are `eq?` are guaranteed to generate the same hash code. Two objects that are not `eq?` do not necessarily generate different hash codes. Similar to `hash-code` but always hashes on the address of *self* even if it is a wrapper.

`hash-code` (*self*) : INTEGER [Method on OBJECT]
: Return a hash code for *self* (can be negative). Two objects that are `eql?` are guaranteed to generate the same hash code. Two objects that are not `eql?` do not necessarily generate different hash codes.

`hash-code` (*self*) : INTEGER [Method on STANDARD-OBJECT]
: Not documented.

`hash-code` (*self*) : INTEGER [Method on STRING-WRAPPER]
: Not documented.

`hash-code` (*self*) : INTEGER [Method on INTEGER-WRAPPER]
: Not documented.

`hash-code` (*self*) : INTEGER [Method on FLOAT-WRAPPER]
: Not documented.

`hash-code` (*self*) : INTEGER [Method on CHARACTER-WRAPPER]
: Not documented.

`hash-code` (*self*) : INTEGER [Method on BOOLEAN-WRAPPER]
: Not documented.

`hash-code` (*self*) : INTEGER [Method on STRING]
: Not documented.

`hash-code` (*self*) : INTEGER [Method on INTEGER]
: Not documented.

`hash-code` (*self*) : INTEGER [Method on FLOAT]
: Not documented.

`hash-code` (*self*) : INTEGER [Method on CHARACTER]
: Not documented.

`equal-hash-code` (*self*) : INTEGER [Method on OBJECT]
: Return a hash code for *self* (can be negative). Two objects that are `equal?` are guaranteed to generate the same hash code (provided, that writers of `object-equal?` methods also implemented the appropriate `equal-hash-code` method). Two objects that are not `equal?`do not necessarily generate different hash codes.

The following low-level utilities are available to implement specialized hashing schemes or for defining new versions of `equal-hash-code`.

`hashmod` ((*code* INTEGER) (*size* INTEGER)) : INTEGER [Function]
: Map the hash code *code* onto a bucket index for a hash table of *size* (i.e., onto the interval [0..size-1]. This is just like `rem` for positive hash codes but also works for negative hash codes by mapping those onto a positive number first. Note, that the sign conversion mapping is not equivalent to calling the `abs` function (it simply masks the sign bit for speed) and therefore really only makes sense for hash codes.

`rotate-hash-code` ((*arg* INTEGER)) : INTEGER [Function]

Rotate *arg* to the right by 1 position. This means shift *arg* to the right by one and feed in *arg*s bit zero from the left. In Lisp the result will stay in positive FIXNUM range. In C++ and Java this might return a negative value which might be equal to NULL-INTEGER. Important: to make this inlinable, it must be called with an atom (i.e., constant or variable) as its argument. This function is primarily useful for hashing sequences of items where the hash code should take the sequential order of elements into account (e.g., lists).

6.10 Key Value Maps

`KEY-VALUE-MAP` is a full-featured dictionary class that supports `eql?` or extensible `equal?` equality tests, O(1) access operations even for large numbers of entries by using a hash table, light-weight `KV-CONS` representation for small tables and iteration even if the dictionary is represented by a hash table (note that in STELLA we cannot iterate over regular `HASH-TABLE`'s, since native Lisp hash tables do not allow us to implement a hash table iterator). Since large `KEY-VALUE-MAP`'s are implemented via `STELLA-HASH-TABLE`'s, we can support iteration.

KEY-VALUE-MAP : DICTIONARY [Class]

Full-featured dictionary class that supports `eql?` or `equal?` equality tests, O(1) access operations even for large numbers of entries by using a hash table, light-weight KV-CONS representation for small tables and iteration even if the dictionary is represented by a hash table.

`the-map` : OBJECT [Slot of]

Not documented.

`equal-test?` : BOOLEAN [Slot of]

If true use `equal?` as the equality test (and `equal-hash-code` as the hash function), otherwise, use `eql?` (and `hash-code`) (the default).

`initial-size` : INTEGER [Slot of]

If supplied, the initial table will be sized to hold at least that many elements.

`crossover-point` : INTEGER [Slot of]

Not documented.

`lookup` (*self* (*key* (LIKE (ANY-KEY SELF)))) : (LIKE (ANY-VALUE SELF)) [Method on KEY-VALUE-MAP]

Lookup the entry identified by *key* in *self* and return its value, or NULL if no such entry exists. Uses an `eql?` test by default or `equal?` if `equal-test?` of *self* is TRUE.

`insert-at` (*self* (*key* (LIKE (ANY-KEY SELF))) (*value* (LIKE (ANY-VALUE SELF)))) : [Method on KEY-VALUE-MAP]

Set the value of the entry identified by *key* in *self* to *value* or add a new entry if no entry with *key* exists yet. Uses an `eql?` test by default or `equal?` if `equal-test?` of *self* is TRUE.

`remove-at` (*self* (*key* (LIKE (ANY-KEY SELF)))) : [Method on KEY-VALUE-MAP]
Remove the entry identified by *key* from *self*. Uses an `eql?` test by default or `equal?` if `equal-test?` of *self* is TRUE.

`length` (*self*) : INTEGER [Method on KEY-VALUE-MAP]
Return the number of entries in *self*.

`empty?` (*self*) : BOOLEAN [Method on KEY-VALUE-MAP]
Return TRUE if *self* has zero entries.

`non-empty?` (*self*) : BOOLEAN [Method on KEY-VALUE-MAP]
Return TRUE if *self* has at least 1 entry.

`copy` (*self*) : (LIKE SELF) [Method on KEY-VALUE-MAP]
Return a copy of the map *self*. All entries are freshly allocated, however, the keys and values of entries are not copied themselves (similar to what we do for lists, etc.).

`clear` (*self*) : [Method on KEY-VALUE-MAP]
Reset *self* to have zero entries.

`allocate-iterator` (*self*) : (DICTIONARY-ITERATOR OF (LIKE (ANY-KEY SELF)) (LIKE (ANY-VALUE SELF))) [Method on KEY-VALUE-MAP]
Allocate an iterator for *self*. The only modifying operations allowed during iteration are removal of the current element or changing its value. All other removal or insertion operations might lead to corruption or undefined results.

`consify` (*self*) : CONS [Method on KEY-VALUE-MAP]
Collect all entries of *self* into a cons list of `(<key> <value>)` pairs and return the result.

`object-equal?` (*x* (*y* OBJECT)) : BOOLEAN [Method on KEY-VALUE-MAP]
Return TRUE if *x* and *y* represent the same set of key/value pairs.

`equal-hash-code` (*self*) : INTEGER [Method on KEY-VALUE-MAP]
Return an `equal?` hash code for *self*. Note that this is O(N) in the number of entries of *self*.

6.11 Hash Sets

`HASH-SET` is a full-featured set class that supports `eql?` or extensible `equal?` equality tests, O(1) insert and `member?` operations, O(N) `intersection` etc. operations even for large numbers of entries by using a STELLA hash table, light-weight `KV-CONS` representation for small sets and iteration even if the set is represented by a hash table. The only minor drawback right now is that we waste one value slot per entry, since we piggy-back off `KEY-VALUE-MAP`'s, however, that wastes at most 25% space.

HASH-SET : KEY-VALUE-MAP, SET-MIXIN [Class]
Full-featured set class that supports `eql?` or `equal?` equality tests, O(1) insert and `member?` operations & O(N) `intersection` etc. operations even for large numbers of entries by using a hash table, light-weight KV-CONS representation for small sets

and iteration even if the set is represented by a hash table. The only minor drawback right now is that this wastes a value slot per entry, since we piggy-back off KEY-VALUE-MAP's, however, that wastes at most 25% space.

`hash-set` (**&rest** *(values* OBJECT*)*) *:* HASH-SET [Function]
Return an `eql?` HASH-SET containing *values*.

`member?` (*self* (*object* OBJECT)) *:* BOOLEAN [Method on HASH-SET]
Return TRUE iff *object* is a member of the set *self*. Uses an `eql?` test by default or `equal?` if `equal-test?` of *self* is TRUE.

`insert` (*self* (*value* (LIKE (ANY-VALUE SELF)))) *:* [Method on HASH-SET]
Add *value* to the set *self* unless it is already a member. Uses an `eql?` test by default or `equal?` if `equal-test?` of *self* is TRUE.

`remove` (*self* (*value* (LIKE (ANY-VALUE SELF)))) *:* (LIKE SELF) [Method on HASH-SET]
Destructively remove *value* from the set *self* if it is a member and return *self*. Uses an `eql?` test by default or `equal?` if `equal-test?` of *self* is TRUE.

`remove-if` (*self* (*test?* FUNCTION-CODE)) *:* (LIKE SELF) [Method on HASH-SET]
Destructively remove all elements of the set *self* for which *test?* evaluates to TRUE. *test?* takes a single argument of type OBJECT and returns TRUE or FALSE. Returns *self*.

`pop` (*self*) *:* (LIKE (ANY-VALUE SELF)) [Method on HASH-SET]
Remove and return an arbitrary element of the set *self*. Return NULL if the set is empty. Performance note: for large sets implemented via hash tables it takes O(N) to empty out the set with repeated calls to `pop`, since the emptier the table gets, the longer it takes to find an element. Therefore, it is usually better to use iteration with embedded removals for such cases.

`substitute` (*self* (*new* OBJECT) (*old* OBJECT)) *:* (LIKE SELF) [Method on HASH-SET]
Destructively replace *old* with *new* in the set *self* unless *new* is already a member. Uses an `eql?` test by default or `equal?` if `equal-test?` of *self* is TRUE.

`copy` (*self*) *:* (LIKE SELF) [Method on HASH-SET]
Return a copy of the set *self*. All entries are freshly allocated, however, the values are not copied themselves (similar to what we do for lists, etc.).

`consify` (*self*) *:* (CONS OF (LIKE (ANY-VALUE SELF))) [Method on HASH-SET]
Collect all entries of *self* into a cons list and return the result.

`subset?` (*self* (*otherSet* HASH-SET)) *:* BOOLEAN [Method on HASH-SET]
Return true if every element of *self* also occurs in *otherSet*. Uses an `eql?` test by default or `equal?` if `equal-test?` of *self* is TRUE.

`equivalent-sets?` (*self* (*otherSet* HASH-SET)) *:* BOOLEAN [Method on HASH-SET]
Return true if every element of *self* occurs in *otherSet* and vice versa. Uses an `eql?` test by default or `equal?` if `equal-test?` of *self* is TRUE.

`intersection` (*self* (*otherSet* HASH-SET)) : HASH-SET [Method on HASH-SET]
Return the set intersection of *self* and *otherSet* as a new set. Uses an `eql?` test by default or `equal?` if `equal-test?` of *self* is TRUE.

`union` (*self* (*otherSet* HASH-SET)) : HASH-SET [Method on HASH-SET]
Return the set union of *self* and *otherSet* as a new set. Uses an `eql?` test by default or `equal?` if `equal-test?` of *self* is TRUE.

`difference` (*self* (*otherSet* HASH-SET)) : HASH-SET [Method on HASH-SET]
Return the set difference of *self* and *otherSet* as a new set (i.e., all elements that are in *self* but not in *otherSet*). Uses an `eql?` test by default or `equal?` if `equal-test?` of *self* is TRUE.

`subtract` (*self* (*otherSet* HASH-SET)) : HASH-SET [Method on HASH-SET]
Return the set difference of *self* and *otherSet* by destructively removing elements from *self* that also occur in *otherSet*. Uses an `eql?` test by default or `equal?` if `equal-test?` of *self* is TRUE.

`object-equal?` (*x* (*y* OBJECT)) : BOOLEAN [Method on HASH-SET]
Return TRUE iff sets *x* and *y* are HASH-SET's with equivalent members. Uses an `eql?` test by default or `equal?` if `equal-test?` of `self` is TRUE. This is equivalent to calling `equivalent-sets?`.

`equal-hash-code` (*self*) : INTEGER [Method on HASH-SET]
Return an `equal?` hash code for *self*. Note that this is O(N) in the number of elements of *self*.

6.12 Iterators

`empty?` (*self*) : BOOLEAN [Method on ITERATOR]
Return TRUE if the sequence represented by *self* has no elements. Side-effect free.

`member?` (*self* (*value* OBJECT)) : BOOLEAN [Method on ITERATOR]
Iterate over values of *self*, returning TRUE if one of them is `eql` to 'value.

`length` (*self*) : INTEGER [Method on ABSTRACT-ITERATOR]
Iterate over *self*, and count how many items there are. Bad idea if *self* iterates over an infinite collection, since in that case it will run forever.'

`pop` (*self*) : (LIKE (ANY-VALUE SELF)) [Method on ITERATOR]
Return the first item of the sequence represented by *self*, or NULL if it is empty. Destructively uses up the first iteration element.

`advance` (*self* (*n* INTEGER)) : (LIKE SELF) [Method on ITERATOR]
Return *self* after skipping over the first *n* elements in the (remainder of the) iteration.

`concatenate` (*iterator1* (*iterator2* ITERATOR) [Method on ITERATOR]
&rest (*otherIterators* ITERATOR)) : ALL-PURPOSE-ITERATOR
Return an iterator that first generates all values of *iterator1*, then those of *iterator2*, and then those of all *otherIterators*. The generated values can be filtered by supplying a filter function to the resulting iterator.

`consify` (*self*) *:* (CONS OF (LIKE (ANY-VALUE SELF))) [Method on ITERATOR]

Return a list of elements generated by *self*.

`next?` (*self*) *:* BOOLEAN [Method on ALL-PURPOSE-ITERATOR]

Apply the stored `next?` function to *self*.

6.13 Symbols

`lookup-symbol` ((*name* STRING)) *:* SYMBOL [Function]

Return the first symbol with *name* visible from the current module.

`intern-symbol` ((*name* STRING)) *:* SYMBOL [Function]

Return a newly-created or existing symbol with name *name*.

`unintern-symbol` ((*self* SYMBOL)) *:* [Function]

Remove *self* from its home module and the symbol table.

`lookup-symbol-in-module` ((*name* STRING) (*module* MODULE) (*local?* BOOLEAN)) *:* SYMBOL [Function]

Return the first symbol with *name* visible from *module*. If *local?* only consider symbols directly interned in *module*. If *module* is `null`, use `*MODULE*` instead.

`intern-symbol-in-module` ((*name* STRING) (*module* MODULE) (*local?* BOOLEAN)) *:* SYMBOL [Function]

Look for a symbol named *name* in *module* (if *local?* do not consider inherited modules). If none exists, intern it locally in *module*. Return the existing or newly-created symbol.

`intern-derived-symbol` ((*baseSymbol* GENERALIZED-SYMBOL) (*newName* STRING)) *:* SYMBOL [Function]

Return a newly-created or existing symbol with name *newName* which is interned in the same module as *baseSymbol*.

`visible-symbol?` ((*self* SYMBOL)) *:* BOOLEAN [Function]

Return `true` if *self* is visible from the current module.

`lookup-visible-symbols-in-module` ((*name* STRING) (*module* MODULE) (*enforceShadowing?* BOOLEAN)) *:* (CONS OF SYMBOL) [Function]

Return the list of symbols with *name* visible from *module*. More specific symbols (relative to the module precedence order defined by `visible-modules`) come earlier in the list. If *module* is `null`, start from `*MODULE*` instead. If *enforceShadowing?* is true, do not return any symbols that are shadowed due to some :SHADOW declaration.

`import-symbol` ((*symbol* SYMBOL) (*module* MODULE)) *:* SYMBOL [Function]

Import *symbol* into *module* and return the imported *symbol*. Signal an error if a different symbol with the same name already exists locally in *module*. Any symbol with the same name visible in *module* by inheritance will be shadowed by the newly imported *symbol*.

`safe-import-symbol` ((*symbol* SYMBOL) (*module* MODULE)) *:* SYMBOL [Function]
Safe version of `import-symbol` (which see). Only imports *symbol* if no symbol with that name is currently interned or visible in *module*. Returns *symbol* if it was imported or the conflicting symbol in *module* otherwise.

`lookup-surrogate` ((*name* STRING)) *:* SURROGATE [Function]
Return the first surrogate with *name* visible from the current module.

`intern-surrogate` ((*name* STRING)) *:* SURROGATE [Function]
Return a newly-created or existing surrogate with name *name*.

`unintern-surrogate` ((*self* SURROGATE)) *:* [Function]
Remove *self* from its home module and the surrogate table.

`lookup-surrogate-in-module` ((*name* STRING) (*module* MODULE) (*local?* BOOLEAN)) *:* SURROGATE [Function]
Return the first surrogate with *name* visible from *module*. If *local?* only consider surrogates directly interned in *module*. If *module* is `null`, use `*MODULE*` instead.

`intern-surrogate-in-module` ((*name* STRING) (*module* MODULE) (*local?* BOOLEAN)) *:* SURROGATE [Function]
Look for a symbol named *name* in *module* (if *local?* do not consider inherited modules). If none exists, intern it locally in *module*. Return the existing or newly-created symbol.

`intern-derived-surrogate` ((*baseSymbol* GENERALIZED-SYMBOL) (*newName* STRING)) *:* SURROGATE [Function]
Return a newly-created or existing surrogate with name *newName* which is interned in the same module as *baseSymbol*.

`visible-surrogate?` ((*self* SURROGATE)) *:* BOOLEAN [Function]
Return `true` if *self* is visible from the current module.

`lookup-visible-surrogates-in-module` ((*name* STRING) (*module* MODULE) (*enforceShadowing?* BOOLEAN)) *:* (CONS OF SURROGATE) [Function]
Return the list of surrogates with *name* visible from *module*. More specific surrogates (relative to the module precedence order defined by `visible-modules`) come earlier in the list. If *module* is `null`, start from `*MODULE*` instead. If *enforceShadowing?* is true, do not return any surrogates that are shadowed due to some :SHADOW declaration.

`import-surrogate` ((*surrogate* SURROGATE) (*module* MODULE)) *:* SURROGATE [Function]
Import *surrogate* into *module* and return the imported *surrogate*. Signal an error if a different surrogate with the same name already exists locally in *module*. Any surrogate with the same name visible in *module* by inheritance will be shadowed by the newly imported *surrogate*.

`safe-import-surrogate` ((*surrogate* SURROGATE) (*module* MODULE)) *:* SURROGATE [Function]

Safe version of `import-surrogate` (which see). Only imports *surrogate* if no surrogate with that name is currently interned or visible in *module*. Returns *surrogate* if it was imported or the conflicting surrogate in *module* otherwise.

`lookup-keyword` ((*name* STRING)) *:* KEYWORD [Function]

Return the keyword with *name* if it exists.

`intern-keyword` ((*name* STRING)) *:* KEYWORD [Function]

Return a newly-created or existing keyword with name *name*. Storage note: a COPY of *name* is stored in the keyword

`gensym` ((*prefix* STRING)) *:* SYMBOL [Function]

Return a transient symbol with a name beginning with *prefix* and ending with a globally gensym'd integer.

`local-gensym` ((*prefix* STRING)) *:* SYMBOL [Function]

Not documented.

`symbol-plist` ((*symbol* SYMBOL)) *:* CONS [Function]

Return the property list of *symbol*. The `symbol-plist` of a symbol can be set with `setf`. IMPORTANT: Property list are modified destructively, hence, if you supply it as a whole make sure to always supply a modfiable copy, e.g., by using `bquote`.

`symbol-property` ((*symbol* SYMBOL) (*key* STANDARD-OBJECT)) *:* OBJECT [Function]

Return the property of *symbol* whose key is `eq?` to *key*. Symbol properties can be set with `setf`.

`symbol-value` ((*symbol* SYMBOL)) *:* OBJECT [Function]

Return the value of *symbol*. Note, that this value is not visible to code that references a variable with the same name as *symbol*. The `symbol-value` is simply a special property that can always be accessed in constant time. The `symbol-value` of a symbol can be changed with `setf`.

`symbolize` ((*surrogate* SURROGATE)) *:* SYMBOL [Function]

Convert *surrogate* into a symbol with the same name and module.

6.14 Context and Modules

`get-stella-context` ((*pathName* STRING) (*error?* BOOLEAN)) *:* CONTEXT [Function]

Return the context located at *pathName*, or `null` if no such context exists. If *error?* is `true`, throw an exception if no context is found, otherwise silently return `null`.

`clear-context` ((*self* CONTEXT)) *:* [Function]

Destroy all objects belonging to *self* or any of its subcontexts.

`within-context` ((*contextForm* OBJECT) **&body** *(body* CONS*))* *:* OBJECT [Macro]

Execute *body* within the context resulting from *contextForm*.

`destroy-context` (*self*) : [Method on CONTEXT]
Make the translator happy.

`destroy-context` (*self*) : [Method on STRING]
Destroy the context *self*, and recursively destroy all contexts that inherit *self*.

`change-context` (*context*) : CONTEXT [Method on CONTEXT]
Change the current context to be the context *context*.

`change-context` (*contextName*) : CONTEXT [Method on STRING]
Change the current context to be the context named *contextName*.

`cc` (**&rest** (*name* NAME)) : CONTEXT [N-Command]
Change the current context to the one named *name*. Return the value of the new current context. If no *name* is supplied, return the pre-existing value of the current context. `cc` is a no-op if the context reference cannot be successfully evaluated.

`defmodule` ((*name* NAME) **&rest** (*options* OBJECT)) : [N-Command]
Define (or redefine) a module named *name*. The accepted syntax is:

```
(defmodule <module-name>
   [:documentation <docstring>]
   [:includes {<module-name> | (<module-name>*)}]
   [:uses {<module-name> | (<module-name>*)}]
   [:lisp-package <package-name-string>]
   [:java-package <package-specification-string>]
   [:cpp-namespace <namespace-name-string>]
   [:java-catchall-class
   [:api? {TRUE | FALSE}]
   [:case-sensitive? {TRUE | FALSE}]
   [:shadow (<symbol>*)]
   [:java-catchall-class <class-name-string>]
   [<other-options>*])
```

name can be a string or a symbol.

Modules include objects from other modules via two separate mechanisms: (1) they inherit from their parents specified via the `:includes` option and/or a fully qualified module name, and (2) they inherit from used modules specified via the `:uses` option. The main difference between the two mechanisms is that inheritance from parents is transitive, while uses-links are only followed one level deep. I.e., a module A that uses B will see all objects of B (and any of B's parents) but not see anything from modules used by B. Another difference is that only objects declared as public can be inherited via uses-links (this is not yet enforced). Note that - contrary to Lisp - there are separate name spaces for classes, functions, and variables. For example, a module could inherit the class `CONS` from the `STELLA` module, but shadow the function of the same name.

The above discussion of `:includes` and `:uses` semantics keyed on the inheritance/visibility of symbols. The PowerLoom system makes another very important distinction: If a module `A` is inherited directly or indirectly via `:includes` specification(s) by a submodule `B`, then all definitions and facts asserted in `A` are visible in B. This is not the cases for `:uses`; the `:uses` options does not impact inheritance of propositions at all.

The list of modules specified in the `:includes` option plus (if supplied) the parent in the path used for *name* become the new module's parents. If no `:uses` option was supplied, the new module will use the `STELLA` module by default, otherwise, it will use the set of specified modules.

If `:case-sensitive?` is supplied as TRUE, symbols in the module will be interned case-sensitively, otherwise (the default), they will be converted to uppercase before they get interned. That means that any reference from inside a case-sensitive module to a non-case-sensitive module will have to use uppercase names for symbols in the non-case-sensitive module. The standard system modules are all NOT case sensitive.

Modules can shadow definitions of functions and classes inherited from parents or used modules. Shadowing is done automatically, but generates a warning unless the shadowed type or function name is listed in the `:shadow` option of the module definition .

Examples:

```
(defmodule "PL-KERNEL/PL-USER"
  :uses ("LOGIC" "STELLA")
  :package "PL-USER")

(defmodule PL-USER/GENEALOGY)
```

The remaining options are relevant only for modules that contain STELLA code. Modules used only to contain knowledge base definitions and assertions have no use for them:

The keywords `:lisp-package`, `:java-package`, and `:cpp-package` specify the name of a native package or name space in which symbols of the module should be allocated when they get translated into one of Lisp, Java, or C++. By default, Lisp symbols are allocated in the `STELLA` package, and C++ names are translated without any prefixes. The rules that the STELLA translator uses to attach translated Java objects to classes and packages are somewhat complex. Use :java-package option to specify a list of package names (separated by periods) that prefix the Java object in this module. Use :java-catchall-class to specify the name of the Java class to contain all global & special variables, parameter-less functions and functions defined on arguments that are not classes in the current module. The default value will be the name of the module.

When set to TRUE, the :api? option tells the PowerLoom User Manual generator that all functions defined in this module should be included in the API section. Additionally, the Java translator makes all API functions `synchronized`.

`get-stella-module` ((*pathName* STRING) (*error?* BOOLEAN)) : MODULE [Function]

Return the module located at *pathName*, or `null` if no such module exists. The search looks at ancestors and top-most (cardinal) modules. If *error?* is `true`, throw an exception if no module is found.

`find-or-create-module` ((*pathname* STRING)) : MODULE [Function]

Return a module located at *pathname* if one exists, otherwise create one `clear-module` (**&rest** *(name* NAME*)*) *:* [N-Command]

Destroy all objects belonging to module *name* or any of its children. If no *name* is supplied, the current module will be cleared after confirming with the user. Important modules such as STELLA are protected against accidental clearing.

`destroy-module` ((*self* MODULE)) *:* [Function]

Destroy the module *self*, and recursively destroy all contexts that inherit *self*.

`destroy-context` (*self*) *:* [Method on MODULE]

Destroy the context *self*, and recursively destroy all contexts that inherit *self*.

`visible-modules` ((*from* MODULE)) *:* (CONS OF MODULE) [Function]

Return a list of all modules visible from module *from* (or `*module*` if *from* is NULL. The generated modules are generated from most to least-specific and will start with the module *from*.

`within-module` ((*moduleForm* OBJECT) **&body** *(body* CONS*)*) *:* OBJECT [Macro]

Execute *body* within the module resulting from *moduleForm*. `*module*` is an acceptable *moduleForm*. It will locally rebind `*module*` and `*context*` and shield the outer bindings from changes.

`in-module` ((*name* NAME)) *:* MODULE [N-Command]

Change the current module to the module named *name*.

`change-module` (*module*) *:* MODULE [Method on MODULE]

Change the current module to be the module *module*.

`change-module` (*moduleName*) *:* MODULE [Method on STRING]

Change the current module to be the module named *moduleName*.

`create-world` ((*parentContext* CONTEXT) (*name* STRING)) *:* WORLD [Function]

Create a new world below the world or module *parentContext*. Optionally, specify a name.

`push-world` () *:* WORLD [Command]

Spawn a new world that is a child of the current context, and change the current context to the new world.

`pop-world` () *:* CONTEXT [Command]

Destroy the current world and change the current context to be its parent. Return the current context. Nothing happens if there is no current world.

`destroy-context` (*self*) *:* [Method on WORLD]

Destroy the context *self*, and recursively destroy all contexts that inherit *self*.

`within-world` ((*worldForm* OBJECT) **&body** *(body* CONS*)*) *:* OBJECT [Macro]

Execute *body* within the world resulting from *worldForm*.

6.15 Input and Output

`read-s-expression` ((*stream* INPUT-STREAM)) *:* OBJECT BOOLEAN [Function]

Read one STELLA s-expression from *stream* and return the result. Return `true` as the second value on EOF.

`read-s-expression-from-string` ((*string* STRING)) *:* OBJECT [Function]

Read one STELLA s-expression from *string* and return the result.

`read-line` ((*stream* INPUT-STREAM)) *:* STRING [Function]

Read one line from *stream* and return the result. This differs from `native-read-line` in that it is not platform-dependent. It recognizes any of the three common line ending formats: CR, LF, CR-LF in any combination. It is not as fast as `native-read-line`, however.

`read-character` ((*inputStream* INPUT-STREAM)) *:* CHARACTER BOOLEAN [Function]

Read one character from *inputStream* and return the result. Return `true` as the second value on EOF.

`unread-character` ((*ch* CHARACTER) (*inputStream* INPUT-STREAM)) *:* [Function]

Unread *ch* from *inputStream*. Signal an error if *ch* was not the last character read.

`y-or-n?` ((*message* STRING)) *:* BOOLEAN [Function]

Read a line of input from STANDARD-INPUT and return `true` if the input was `y` or `false` if the input was `n`. Loop until either `y` or `n` was entered. If *message* is non-'null' prompt with it before the input is read. See also special variable `*USER-QUERY-ACTION*`.

`yes-or-no?` ((*message* STRING)) *:* BOOLEAN [Function]

Read a line of input from STANDARD-INPUT and return `true` if the input was `yes` or `false` if the input was `no`. Loop until either `yes` or `no` was entered. If *message* is non-'null' prompt with it before the input is read. See also special variable `*USER-QUERY-ACTION*`.

`flush-output` ((*self* OUTPUT-STREAM)) *:* [Function]

Flush all buffered output of *self*.

6.16 Files

`open-input-file` ((*fileName* STRING) **&rest** (*options* KEYWORD)) *:* FILE-INPUT-STREAM [Function]

Open file *fileName* for input and return the resulting input stream. By default signal an error if the file does not exist. The only legal option so far is `:IF-NOT-EXISTS` (or `:IF-NOT-EXISTS-ACTION`) which specifies what to do in case the file does not exist. If its value is `:ERROR` then an error will be signaled. If it is `:ABORT` or `:PROBE` the opening operation will be aborted and NULL will be returned.

`open-output-file` ((*fileName* STRING) **&rest** *(options* KEYWORD*))* *:* FILE-OUTPUT-STREAM [Function]

Open file *fileName* for output and return the resulting output stream. By default the file will be created or overwritten if it already exists. If `:IF-EXISTS` (or `:IF-EXISTS-ACTION`) is one of the *options* its value specifies what to do in case the file already exists. If the value is `:SUPERSEDE` the pre-existing file will be overwritten. If the value is `:APPEND` the preexisting file will be appended to (if the file did not yet exist the file will simply be created). If the value is `:ERROR` then an error will be signaled. If it is `:ABORT` or `:PROBE` the opening operation will be aborted and NULL will be returned.

If `:IF-NOT-EXISTS` (or `:IF-NOT-EXISTS-ACTION`) is one of the *options* its value specifies what to do in case the file does not already exist. If the value is `:CREATE`, the file will simply be created. If the value is `:CREATE-PATH` the file will be created plus any non-existing directories in the directory path of *fileName* will also be created. If the value is `:ERROR` then an error will be signaled. If it is `:ABORT` or `:PROBE` the opening operation will be aborted and NULL will be returned.

`close-stream` ((*self* STREAM)) *:* [Function]

Close the stream *self*.

`close-all-files` () *:* [Function]

Close all currently open file streams. Use for emergencies or for cleanup.

`with-input-file` ((*binding* CONS) **&body** *(body* CONS*))* *:* OBJECT [Macro]

Sets up an unwind-protected form which opens a file for input and closes it afterwards. The stream for reading is bound to the variable provided in the macro form. Syntax is `(WITH-INPUT-FILE (var filename options*) body+)` where `options` can be any that are legal for `open-input-file` (which see).

`with-output-file` ((*binding* CONS) **&body** *(body* CONS*))* *:* OBJECT [Macro]

Sets up an unwind-protected form which opens a file for output and closes it afterwards. The stream for writing is bound to the variable provided in the macro form. Syntax is `(WITH-OUTPUT-FILE (var filename options*) body+)` where `options` can be any that are legal for `open-output-file` (which see).

`probe-file?` ((*fileName* FILE-NAME)) *:* BOOLEAN [Function]

Return true if file *fileName* exists. Note that this does not necessarily mean that the file can also be read. IMPORTANT Java idiosyncrasy: if file `foo/bar` exists and is not a directory, Java will also say `foo/bar/` exists, which is different behavior than in Lisp and C++. For this reason, make sure to always use `probe-directory?` to test whether a directory exists.

`file-write-date` ((*fileName* FILE-NAME)) *:* CALENDAR-DATE [Function]

Return the time at which file *fileName* was last modified or NULL if that cannot be determined.

`file-length` ((*fileName* FILE-NAME)) *:* LONG-INTEGER [Function]

Return the length of file *fileName* in bytes or NULL if that cannot be determined.

`copy-file` ((*fromFile* FILE-NAME) (*toFile* FILE-NAME)) *:* [Function]

Copy file *fromFile* to file *toFile*, clobbering any data already in *toFile*.

delete-file ((*fileName* FILE-NAME)) : [Function]
Delete the file *fileName*.

rename-file ((*fromFile* FILE-NAME) (*toFile* FILE-NAME)) : [Function]
Rename the file *fromFile* to *toFile*.

make-temporary-file-name ((*prefix* STRING) (*suffix* STRING)) : STRING [Function]
Return a file name of the form `<prefix>NNNNNN<suffix>` which is guaranteed to not refer to any existing file. A null *prefix* defaults to `tmpfile`, a null *suffix* defaults to the empty string. The number portion NNNNNN will correpond to a random number between 0 and 999999. If no qualifying filename can be found after 100 attempts, NULL will be returned. Note that it is possible due to multi-threading or processing that the generated filename becomes used by another thread or OS process. If necessary, this case can be handled by the caller.

directory-file-name ((*directory* FILE-NAME)) : FILE-NAME [Function]
Return *directory* as a file name, i.e., without a terminating directory separator.

directory-parent-directory ((*directory* FILE-NAME) (*level* INTEGER)) : FILE-NAME [Function]
Return the *level*-th parent directory component of *directory* including the final directory separator, or the empty string if *directory* does not have that many parents.

file-name-as-directory ((*file* FILE-NAME)) : FILE-NAME [Function]
Return *file* interpreted as a directory, i.e., with a terminating directory separator. If *file* is the empty string simply return the empty string, i.e., interpret it as the current directory instead of the root directory.

file-name-directory ((*file* FILE-NAME)) : FILE-NAME [Function]
Return the directory component of *file* including the final directory separator or the empty string if *file* does not include a directory. Note that for purposes of this function, a logical host is considered part of the directory portion of *file*

file-name-without-directory ((*file* FILE-NAME)) : FILE-NAME [Function]
Return the file name portion of *file* by removing any directory and logical host components.

file-name-without-extension ((*file* FILE-NAME)) : FILE-NAME [Function]
Remove *file*s extension (or type) if there is any and return the result.

file-extension ((*file* FILE-NAME)) : STRING [Function]
Return *file*s extension (or type) if it has any including the separator character.

file-base-name ((*file* FILE-NAME)) : FILE-NAME [Function]
Remove *file*s directory (including logical host) and extension components and return the result.

absolute-pathname? ((*pathname* STRING)) : BOOLEAN [Function]
Not documented.

`logical-host?` ((*host* STRING)) *:* BOOLEAN [Function]
Not documented.

`logical-pathname?` ((*pathname* STRING)) *:* BOOLEAN [Function]
Not documented.

`translate-logical-pathname` ((*pathname* STRING)) *:* STRING [Function]
Not documented.

`directory-separator` () *:* CHARACTER [Function]
Not documented.

`directory-separator-string` () *:* STRING [Function]
Not documented.

6.17 Dates and Times

`get-current-date-time` () *:* INTEGER INTEGER INTEGER KEYWORD INTEGER INTEGER INTEGER INTEGER [Function]
Returns the current time in UTC as multiple values of year month day day-of-week hour minute second millisecond. Currently millisecond will always be zero (even in Java where it is technically available).

`get-local-time-zone` () *:* FLOAT [Function]
Returns the current time zone offset from UTC as a float, considering the effects of daylight savings time.

`make-current-date-time` () *:* CALENDAR-DATE [Function]
Create a calendar date with current time and date.

`make-date-time` ((*year* INTEGER) (*month* INTEGER) (*day* INTEGER) (*hour* INTEGER) (*minute* INTEGER) (*second* INTEGER) (*millis* INTEGER) (*timezone* FLOAT)) *:* CALENDAR-DATE [Function]
Create a calendar date with the specified components. *year* must be the complete year (i.e., a year of 98 is 98 A.D in the 1st century). *timezone* is a real number in the range -12.0 to +14.0 where UTC is zone 0.0; The number is the number of hours to add to UTC to arrive at local time.

`parse-date-time` ((*date-time-string* STRING) (*start* INTEGER) (*end* INTEGER) (*error-on-mismatch?* BOOLEAN)) *:* DECODED-DATE-TIME [Function]
Tries very hard to make sense out of the argument *date-time-string* and returns a time structure if successful. If not, it returns `null`. If *error-on-mismatch?* is true, parse-date-time will signal an error instead of returning `null`. Default values are 00:00:00 local time on the current date

`decode-calendar-date` (*date* (*timezone* FLOAT)) *:* DECODED-DATE-TIME [Method on CALENDAR-DATE]
Returns a decoded time object for *date* interpreted in *timezone timezone* is the number of hours added to UTC to get local time. It is in the range -12.0 to +14.0 where UTC is zone 0.0

`encode-calendar-date` (*time-structure*) : CALENDAR-DATE [Method on DECODED-DATE-TIME]

Returns a calendar date object for *time-structure*.

`calendar-date-to-string` [???]

Not yet implemented.

`string-to-calendar-date` ((*input* STRING)) : CALENDAR-DATE [Function]

Returns a calendar date object representing the date and time parsed from the *input* string. If no valid parse is found, `null` is returned.

`relative-date-to-string` [???]

Not yet implemented.

`compute-calendar-date` ((*julian-day* INTEGER)) : INTEGER INTEGER INTEGER KEYWORD [Function]

Returns the YEAR, MONTH, DAY, DAY-OF-WEEK on which the given *julian-day* begins at noon.

`compute-day-of-week` ((*yyyy* INTEGER) (*mm* INTEGER) (*dd* INTEGER)) : KEYWORD [Function]

Returns the day of the week for yyyy-mm-dd.

`compute-day-of-week-julian` ((*julian-day* INTEGER)) : KEYWORD [Function]

Returns the day of the week for julian-day

`compute-julian-day` ((*yyyy* INTEGER) (*mm* INTEGER) (*dd* INTEGER)) : INTEGER [Function]

Returns the Julian day that starts at noon on yyyy-mm-dd. *yyyy* is the year. *mm* is the month. *dd* is the day of month. Negative years are B.C. Remember there is no year zero.

`compute-next-moon-phase` ((*n* INTEGER) (*phase* KEYWORD)) : INTEGER FLOAT [Function]

Returns the Julian Day and fraction of day of the Nth occurence since January 1, 1900 of moon PHASE. PHASE is one of :NEW-MOON, :FIRST-QUARTER, :FULL-MOON, :LAST-QUARTER

`decode-time-in-millis` ((*time* INTEGER)) : INTEGER INTEGER INTEGER INTEGER [Function]

Returns multiple values of hours, minutes, seconds, milliseconds for *time* specified in milliseconds.

`julian-day-to-modified-julian-day` ((*julian-day* INTEGER)) : INTEGER [Function]

Returns the modified Julian day during which *julian-day*starts at noon.

`modified-julian-day-to-julian-day` ((*modified-julian-day* INTEGER)) : INTEGER [Function]

Returns the modified Julian day during which `julian-day`starts at noon.

`time-add` ((*t1* DATE-TIME-OBJECT) (*t2* DATE-TIME-OBJECT)) *:* DATE-TIME-OBJECT [Function]

Add *t1* to *t2*. If one of *t1* or *t2* is a calendar date, then the result is a calendar date. If both *t1* and *t2* are relative dates, then the result is a relative date. *t1* and *t2* cannot both be calendar dates.

`time-divide` ((*t1* TIME-DURATION) (*t2* OBJECT)) *:* OBJECT [Function]

Divides the relative date *t1* by *t2*. *t2* must be either a relative date or a wrapped number. If *t2* is a relative date, then the return value will be a wrapped float. If *t2* is a wrapped number, then the reutrn value will be a relative date.

`time-multiply` ((*t1* OBJECT) (*t2* OBJECT)) *:* TIME-DURATION [Function]

Multiplies a relative date by a wrapped number. One of *t1* or *t2* must be a relative date and the other a wrapped number.

`time-subtract` ((*t1* DATE-TIME-OBJECT) (*t2* DATE-TIME-OBJECT)) *:* DATE-TIME-OBJECT [Function]

Subtract *t2* from *t1*. If *t1* is a calendar date, then *t2* can be either a calendar date (in which case the return value is a relative date) or it can be a relative date (in which case the return value is a calendar date). If *t1* is a relative date, then *t2* must also be a relative date and a relative date is returned.

`get-ticktock` () *:* TICKTOCK [Function]

Return the current CPU time. If the current OS/Language combination does not support measuring of CPU time, return real time instead. Use `ticktock-difference` to measure the time difference between values returned by this function. This is an attempt to provide some platform independent support to measure (at least approximately) consumed CPU time.

`ticktock-difference` ((*t1* TICKTOCK) (*t2* TICKTOCK)) *:* FLOAT [Function]

The difference in two TICKTOCK time values in seconds where *t1* is the earlier time. The resolution is implementation dependent but will normally be some fractional value of a second.

`ticktock-resolution` () *:* FLOAT [Function]

The minimum theoretically detectable resolution of the difference in two TICKTOCK time values in seconds. This resolution is implementation dependent. It may also not be realizable in practice, since the timing grain size may be larger than this resolution.

`sleep` ((*seconds* FLOAT)) *:* [Function]

The program will sleep for the indicated number of seconds. Fractional values are allowed, but the results are implementation dependent: Common Lisp uses the fractions natively, Java with a resolution of 0.001, and C++ can only use integral values.

6.18 XML Support

`make-xml-element` ((*name* STRING) (*namespace-name* STRING) (*namespace* STRING)) *:* XML-ELEMENT [Function]

Creates and interns an XML element object *name* using *namespace-name* to refer to *namespace*. If *namespace* is `null`, then the element will be interned in the null namespace. *namespace* must otherwise be a URI.

`make-xml-global-attribute` ((*name* STRING) (*namespace-name* STRING) (*namespace* STRING)) *:* XML-GLOBAL-ATTRIBUTE [Function]

Creates and interns an XML global attribute object with *name* using *namespace-name* to refer to *namespace*. *namespace*must be a URI.

`make-xml-local-attribute` ((*name* STRING) (*element* XML-ELEMENT)) *:* XML-LOCAL-ATTRIBUTE [Function]

Make an XML-LOCAL-ATTRIBUTE named *name* associated with *element*

`get-xml-tag` ((*expression* CONS)) *:* XML-ELEMENT [Function]

Return the XML tag object of an XML *expression*.

`get-xml-attributes` ((*expression* CONS)) *:* CONS [Function]

Return the list of attributes of an XML *expression* (may be empty).

`get-xml-content` ((*expression* CONS)) *:* CONS [Function]

Return the list of content elements of an XML *expression* (may be empty).

`get-xml-cdata-content` ((*form* CONS)) *:* STRING [Function]

Return the CDATA content of a CDATA *form*. Does NOT make sure that *form* actually is a CDATA form, so bad things can happen if it is given wrong input.

`xml-declaration?` ((*item* OBJECT)) *:* BOOLEAN [Function]

Return `true` if *item* is an XML declaration object

`xml-element?` ((*item* OBJECT)) *:* BOOLEAN [Function]

Return `true` if *item* is an XML element object

`xml-attribute?` ((*item* OBJECT)) *:* BOOLEAN [Function]

Return `true` if *item* is an XML attribute object

`xml-cdata?` ((*item* OBJECT)) *:* BOOLEAN [Function]

Return `true` if *item* is an XML CDATA tag object

`xml-cdata-form?` ((*form* OBJECT)) *:* BOOLEAN [Function]

Return `true` if *form* is a CONS headed by a CDATA tag

`xml-element-match?` (*tag* (*name* STRING) (*namespace* STRING)) *:* BOOLEAN [Method on XML-ELEMENT]

Returns `true` if *tag* is an XML element with the name *name* in namespace *namespace*. Note that *namespace* is the full URI, not an abbreviation. Also, *namespace* may be `null`, in which case *tag* must not have a namespace associated with it.

`xml-attribute-match?` (*attribute* (*name* STRING) (*namespace* STRING)) *:* BOOLEAN [Method on XML-ATTRIBUTE]

Return `true` if *attribute* is an XML attribute with name *name* in namespace *namespace*. Note that *namespace* is the full URI, not an abbreviation. Also, *namespace* may be `null`, in which case *attribute* must not have a namespace associated with it.

`xml-attribute-match?` (*attribute* (*name* STRING) (*namespace* STRING)) *:* BOOLEAN [Method on XML-GLOBAL-ATTRIBUTE]

Return `true` if *attribute* is a global XML attribute with name *name* in namespace *namespace*. Note that *namespace* is the full URI, not an abbreviation. Also, *namespace* may be `null`, in which case *attribute* must not have a namespace associated with it.

`xml-attribute-match?` (*attribute* (*name* STRING) (*namespace* STRING)) *:* BOOLEAN [Method on XML-LOCAL-ATTRIBUTE]

Return `true` if *attribute* is a local XML attribute with name *name*. Note that *namespace* must be `null` and that the *attributes*s parent element element is not considered by the match. To take the parent element into account use `xml-local-attribute-match?`.

`xml-local-attribute-match?` ((*attribute* XML-LOCAL-ATTRIBUTE) (*name* STRING) (*element-name* STRING) (*element-namespace* STRING)) *:* BOOLEAN [Function]

Return true if *attribute* is a local attribute with *name* and whose parent element matches *element-name* and *element-namespace*.

`xml-lookup-attribute` ((*attributes* CONS) (*name* STRING) (*namespace* STRING)) *:* STRING [Function]

Find the XML attribute in *attributes* with *name* and *namespace* and return its value. Note that it is assumed that all *attributes* come from the same known tag, hence, the parent elements of any local attributes are not considered by the lookup.

`xml-tag-case` ((*item* OBJECT) **&body** *(clauses* CONS*)*) *:* OBJECT [Macro]

A case form for matching *item* against XML element tags. Each element of *clauses* should be a clause with the form ("tagname" ...) or (("tagname" "namespace-uri") ...) The clause heads can optionally be symbols instead of strings. The key forms the parameters to the method `xml-element-match?`, with a missing namespace argument passed as NULL.

The namespace argument will be evaluated, so one can use bound variables in place of a fixed string. As a special case, if the namespace argument is :ANY, then the test will be done for a match on the tag name alone.

`read-xml-expression` ((*stream* INPUT-STREAM) (*start-tag* OBJECT)) *:* OBJECT BOOLEAN [Function]

Read one balanced XML expression from *stream* and return its s-expression representation (see `xml-token-list-to-s-expression`). If `startTagName` is non-'null', skip all tags until a start tag matching *start-tag* is encountered. XML namespaces are ignored for outside of the start tag. Use s-expression representation to specify *start-tag*, e.g., `(KIF (:version "1.0"))`. The tag can be an XML element object, a symbol, a string or a cons. If the tag is a cons the first element can also be (name namespace) pair.

Return `true` as the second value on EOF.

CHANGE WARNING: It is anticipated that this function will change to a) Properly take XML namespaces into account and b) require XML element objects instead of strings as the second argument. This change will not be backwards-compatible.

`xml-expressions` ((*stream* INPUT-STREAM) (*regionTag* OBJECT)) *:* XML-EXPRESSION-ITERATOR [Function]

Return an XML-expression-iterator (which see) reading from *stream*. *regionTag* can be used to define delimited regions from which expressions should be considered. Use s-expression representation to specify *regionTag*, e.g., `(KIF (:version "1.0"))`. The tag can be an XML element object, a symbol, a string or a cons. If the tag is a cons the first element can also be (name namespace) pair.

`print-xml-expression` ((*stream* OUTPUT-STREAM) (*xml-expression* CONS) (*indent* INTEGER)) *:* [Function]

Prints *xml-expression* on *stream*. Indentation begins with the value of *indent*. If this is the `null` integer, no indentation is performed. Otherwise it should normally be specified as 0 (zero) for top-level calls.

It is assumed that the *xml-expression* is a well-formed CONS-list representation of an XML form. It expects a form like that form returned by `read-XML-expression`.

Also handles a list of xml forms such as that returned by `XML-expressions`. In that case, each of the forms is indented by *indent* spaces.

`reset-xml-hash-tables` () *:* [Function]

Resets Hashtables used for interning XML elements and global attribute objects. This will allow garbage collection of no-longer used objects, but will also mean that newly parsed xml elements and global attributes will not be eq? to already existing ones with the same name.

6.19 Miscellaneous

This is a catch-all section for functions and methods that haven't been categorized yet into any of the previous sections. They are in random order and many of them will never be part of the official STELLA interface. So beware!

`operating-system` () *:* KEYWORD [Function]

Not documented.

`1d-aref` (*self* (*i* INTEGER)) *:* (LIKE (ANY-VALUE SELF)) [Method on DIMENSIONAL-ARRAY-MIXIN]

Return the element of *self* at position `[i]`.

`1d-aref-address` (*self* (*i* INTEGER)) *:* INTEGER [Method on DIMENSIONAL-ARRAY-MIXIN]

Return the 1D address of the element at position `[i]`. This is useful for fast element-wise iteration that doesn't need arithmetic.

`1d-aref-setter` (*self* (*value* (LIKE (ANY-VALUE SELF))) (*i* INTEGER)) *:* (LIKE (ANY-VALUE SELF)) [Method on DIMENSIONAL-ARRAY-MIXIN]

Set the element of *self* at position `[i]` to *value* and return the result.

`2d-aref` (*self* (*i* INTEGER) (*j* INTEGER)) *:* (LIKE (ANY-VALUE SELF)) [Method on 2-DIMENSIONAL-ARRAY-MIXIN]

Return the element of *self* at position `[i, j]`.

`2d-aref-address` (*self* (*i* INTEGER) (*j* INTEGER)) *:* INTEGER [Method on 2-DIMENSIONAL-ARRAY-MIXIN]

Return the 1D address of the element at position `[i, j]`. This is useful for fast element-wise iteration that doesn't need arithmetic.

`2d-aref-setter` (*self* (*value* (LIKE (ANY-VALUE SELF))) (*i* INTEGER) (*j* INTEGER)) *:* (LIKE (ANY-VALUE SELF)) [Method on 2-DIMENSIONAL-ARRAY-MIXIN]

Set the element of *self* at position `[i, j]` to *value* and return the result.

`abs` (*x*) *:* LONG-INTEGER [Method on LONG-INTEGER]

Return the absolute value of *x*.

`activate-demon` ((*demon* DEMON)) *:* [Function]

Install *demon* in the location(s) specified by its internal structure.

`active?` (*self*) *:* BOOLEAN [Method on POLYMORPHIC-RELATION]

True if *self* or a superslot of *self* is marked active.

`add-configuration-property` ((*property* STRING) (*value* OBJECT) (*configuration* CONFIGURATION-TABLE)) *:* OBJECT [Function]

Add *value* to *property* in *configuration* and return it. If a previous value exists add *value* to the end (listify the old value if it is not yet a list). Otherwise, create a new list containing *value*. Use the global system configuration table if *configuration* is NULL.

`add-current-date-substitution` ((*substitution-list* (KEY-VALUE-LIST OF STRING-WRAPPER STRING-WRAPPER))) *:* [Function]

Fill in *substitution-list* with date information for the current date and time. See `add-date-substitution` for details.

`add-date-substitution` ((*date* CALENDAR-DATE) (*substitution-list* (KEY-VALUE-LIST OF STRING-WRAPPER STRING-WRAPPER))) *:* [Function]

Fill in *substitution-list* with template variable substitions for the names YEAR, MONTH, MON, DAY, HOUR, MINUTE, SECOND, TIMEZONE, DAY-OF-WEEK, DOW with their values for *date*. Also, pre-formatted DATE, TIME and ISO8601 variables are set.

TIMEZONE is in the format `"{+|-}hhmm"`. MONTH is the full English month name and MON is the numeric month. DAY-OF-WEEK is an English string and DOW is the first three letters. Minutes and seconds are zero-padded.

These substitutions can be used with `substitute-template-variables-in-string`

`add-hook` ((*hookList* HOOK-LIST) (*hookFunction* SYMBOL)) *:* [Function]

Insert the function named *hookFunction* into *hookList*.

`add-load-path` ((*path* STRING)) *:* (CONS OF STRING-WRAPPER) [Command]

Append the directories listed in the `|`-separated *path* to the end of the STELLA load path. Return the resulting load path.

`add-property-value` ((*property* NAME) (*value* OBJECT)) *:* [Command]
Add *value* to the end of *propertys* (a string or symbol) value list in the configuration table. Coerces the current value to a list or initializes the list if it is as yet undefined. Allows incremental addition of values to list-valued propertys. Note that *property* is evaluated and will need to be quoted if supplied as a symbol. Symbols will also be upcased if this command is run in a non-case-sensitive module.

`add-trace` (**&rest** *(keywords* GENERALIZED-SYMBOL*))* *:* LIST [N-Command]
Enable trace messages identified by any of the listed *keywords*. After calling (`add-trace` <keyword>) code guarded by (`trace-if` <keyword> ...) will be executed when it is encountered.

`advance-past-whitespace` ((*source* STRING) (*start* INTEGER)) *:* INTEGER [Function]
Returns the first index into *source*, starting from *start*, of the first character that is not white space.

`all-classes` ((*module* MODULE) (*local?* BOOLEAN)) *:* (ITERATOR OF CLASS) [Function]
Iterate over all classes visible from *module*. If *local?*, return only classes interned in *module*. If *module* is null, return all classes interned everywhere.

`all-contexts` () *:* (ITERATOR OF CONTEXT) [Function]
Return an iterator that generates all contexts.

`all-defined?` (**&body** *(forms* CONS*))* *:* OBJECT [Macro]
Evaluate each of the forms in *forms*, and return TRUE if none of them are NULL.

`all-functions` ((*module* MODULE) (*local?* BOOLEAN)) *:* (ITERATOR OF FUNCTION) [Function]
Iterate over all functions visible from *module*. If *local?*, return only functions bound to symbols interned in *module*. If *module* is null, return all functions defined everywhere.

`all-included-modules` ((*self* MODULE)) *:* (ITERATOR OF MODULE) [Function]
Generate a sequence of all modules included by *self*, inclusive, starting from the highest ancestor and working down to *self* (which is last).

`all-methods` ((*module* MODULE) (*local?* BOOLEAN)) *:* (ITERATOR OF METHOD-SLOT) [Function]
Iterate over all methods visible from *module*. If *local?*, return only methods interned in *module*. If *module* is null, return all methods interned everywhere.

`all-modules` () *:* (ITERATOR OF MODULE) [Function]
Return an iterator that generates all modules.

`all-public-functions` ((*module* MODULE) (*local?* BOOLEAN)) *:* (ITERATOR OF FUNCTION) [Function]
Iterate over all functions visible from *module*. If *local?*, return only functions bound to symbols interned in *module*. If *module* is null, return all functions defined everywhere.

`all-public-methods` ((*module* MODULE) (*local?* BOOLEAN)) *:* (ITERATOR OF METHOD-SLOT) [Function]

Iterate over all public methods visible from *module*. If *local?*, return only methods interned in *module*. If *module* is null, return all methods interned everywhere.

`all-required-systems` ((*system-name* STRING)) *:* (CONS OF STRING-WRAPPER) [Function]

Returns a CONS of all of the systems required by *system-name*

`all-slots` ((*module* MODULE) (*local?* BOOLEAN)) *:* (ITERATOR OF SLOT) [Function]

Iterate over all slots visible from *module*. If *local?*, return only methods interned in *module*. If *module* is null, return all methods interned everywhere.

`all-subcontexts` ((*context* CONTEXT) (*traversal* KEYWORD)) *:* (ALL-PURPOSE-ITERATOR OF CONTEXT) [Function]

Return an iterator that generates all subcontexts of `self` (not including `self`) in the order specified by *traversal* (one of :preorder, :inorder, :postorder or :topdown).

`all-surrogates` ((*module* MODULE) (*local?* BOOLEAN)) *:* (ITERATOR OF SURROGATE) [Function]

Iterate over all surrogates visible from *module*. If *local?*, return only surrogates interned in *module*. If *module* is null, return all surrogates interned everywhere.

`all-symbols` ((*module* MODULE) (*local?* BOOLEAN)) *:* (ITERATOR OF SYMBOL) [Function]

Iterate over all symbols visible from *module*. If *local?*, return only symbols interned in *module*. If *module* is null, return all symbols interned everywhere.

`all-variables` ((*module* MODULE) (*local?* BOOLEAN)) *:* (ITERATOR OF GLOBAL-VARIABLE) [Function]

Iterate over all variables visible from *module*. If *local?*, return only variables bound to symbols interned in *module*. If *module* is null, return all variables defined everywhere.

`allocate-cross-product-iterator` ((*domains* (CONS OF CONS))) *:* CROSS-PRODUCT-ITERATOR [Function]

Allocate a cross product iterator for a list of *domains*.

`allocate-iterator` (*self*) *:* (LIKE SELF) [Method on ABSTRACT-ITERATOR]

Iterator objects return themselves when asked for an iterator (they occupy the same position as a collection within a `foreach` statement).

`allocate-iterator` (*self*) *:* (ITERATOR OF (LIKE (ANY-VALUE SELF))) [Method on MEMOIZABLE-ITERATOR]

Alias for `clone-memoized-iterator`.

`allocation` (*self*) *:* KEYWORD [Method on STORAGE-SLOT]

Return the most specific :allocation facet, or :instance if all inherited values are NULL.

`append-character` (*self* (*char* CHARACTER)) *:* [Method on BUFFERED-STRING]

Append *char* to the END of the string *self*. Resize the buffer if necessary.

append-string (*self* (*value* STRING)) *:* [Method on BUFFERED-STRING]
Append *value* to the END of the string *self*. Resize the buffer if necessary.

apply ((*code* FUNCTION-CODE) (*arguments* (CONS OF OBJECT))) *:* OBJECT [Function]
Apply *code* to *arguments*, returning a value of type OBJECT. Currently limited to at most 10 *arguments*.

apply-boolean-method ((*code* METHOD-CODE) (*arguments* (CONS OF OBJECT))) *:* BOOLEAN [Function]
Apply *code* to *arguments*, returning a value of type BOOLEAN.

apply-float-method ((*code* METHOD-CODE) (*arguments* (CONS OF OBJECT))) *:* FLOAT [Function]
Apply *code* to *arguments*, returning a value of type FLOAT.

apply-integer-method ((*code* METHOD-CODE) (*arguments* (CONS OF OBJECT))) *:* INTEGER [Function]
Apply *code* to *arguments*, returning a value of type INTEGER.

apply-long-integer-method ((*code* METHOD-CODE) (*arguments* (CONS OF OBJECT))) *:* LONG-INTEGER [Function]
Apply *code* to *arguments*, returning a value of type LONG-INTEGER.

apply-method ((*code* METHOD-CODE) (*arguments* (CONS OF OBJECT))) *:* OBJECT [Function]
Apply *code* to *arguments*, returning a value of type OBJECT.

apply-string-method ((*code* METHOD-CODE) (*arguments* (CONS OF OBJECT))) *:* STRING [Function]
Apply *code* to *arguments*, returning a value of type STRING.

autoload ((*qualifiedName* STRING) (*systemName* STRING) (*cache* SURROGATE) (*error?* BOOLEAN)) *:* FUNCTION-CODE [Function]
Autoload function *qualifiedName* from system *systemName*. If it is already present in the system, simply return its code. If *cache* is defined, return its value if defined, otherwise, set its value to the function found. If the function failed to be defined by loading *systemName* and *error?* is true, raise an error. Otherwise, simply return NULL.

base60-to-float ((*l* (CONS OF NUMBER-WRAPPER))) *:* FLOAT [Function]
Converts (x y z) into a float. The return value is x + y/60 + z/3600. This can be used to convert from Degree-Minute-Second to decimal degrees or from Hour-Minute-Second format to decimal hours.

blank-string? ((*string* STRING)) *:* BOOLEAN [Function]
Return true if *string* is either NULL, empty, or only contains white space characters.

break-program ((*message* STRING)) *:* [Command]
Interrupt the program and print *message*. Continue after confirmation with the user.

`bump-log-indent` () *:* [Command]

Increase the indentation level for subsequent log messages.

`byte-array-read-sequence` ((*buffer* TOKENIZER-BYTE-ARRAY) (*stream* INPUT-STREAM) (*start* INTEGER) (*end* INTEGER)) *:* INTEGER [Function]

Read from *stream* filling *buffer* between *start* and *end* (depending on how many characters are available). Return the actual end pointer to the input read into *buffer*. EOF is indicated by the return value being equal to start.

`byte-array-write-sequence` ((*buffer* TOKENIZER-BYTE-ARRAY) (*stream* NATIVE-OUTPUT-STREAM) (*start* INTEGER) (*end* INTEGER)) *:* [Function]

Write from *buffer* to *stream*, using data in the buffer starting at position *start* stopping just before *end*.

`calendar-date-to-date-string` (*date* (*timezone* FLOAT) (*numeric-month?* BOOLEAN)) *:* STRING [Method on CALENDAR-DATE]

Returns the date part of the string representation of *date* adjusted for *timezone*. Format is YYYY-MMM-DD, where MMM is a three letter English abbreviation of the month if *numeric-month?* is `false` and a two digit numeric value if *numeric-month?* is `true`. The value `false` is recommended.

`calendar-date-to-iso8601-string` (*date* (*timezone* FLOAT) (*include-timezone?* BOOLEAN)) *:* STRING [Method on CALENDAR-DATE]

Returns an ISO-8601 string representation of *date* adjusted for *timezone*. The Format is YYYY-MM-DDThh:mm:ss z:zz. The timezone as an offset hh:mm is included if *include-timezone?* is `true`.

Recommended values for the flag is `true`.

`calendar-date-to-string` (*date* (*timezone* FLOAT) (*numeric-month?* BOOLEAN) (*include-timezone?* BOOLEAN)) *:* STRING [Method on CALENDAR-DATE]

Returns a string representation of *date* adjusted for *timezone*. The Format is YYYY-MMM-DD hh:mm:ss z.z, where MMM is a three letter English abbreviation of the month if *numeric-month?* is `false` and a two digit numeric value if *numeric-month?* is `true`. The timezone as a float offset z.z is included if *include-timezone?* is `true`.

Recommended values for the flags are `false` and `true` respectively.

`calendar-date-to-time-string` (*date* (*timezone* FLOAT) (*include-timezone?* BOOLEAN) (*include-millis?* BOOLEAN) (*pad-hours?* BOOLEAN)) *:* STRING [Method on CALENDAR-DATE]

Returns the time part of the string representation of *date* adjusted for *timezone*. The timezone is included in the string if *include-timezone?* is `true`. The value `true` is recommended. Milliseconds will be included if *include-millis?* is `true`. Hours will be zero-padded to length 2 if *pad-hours?* is `true`.

`call-clear-module` (**&rest** (*name* NAME)) *:* [Command]

Destroy all objects belonging to module *name* or any of its children. If no *name* is supplied, the current module will be cleared after confirming with the user. Important modules such as STELLA are protected against accidental clearing.

`canonical-slot` ((*slot* STORAGE-SLOT)) *:* STORAGE-SLOT [Function]
Computes the slot at the base of a renaming chain for *slot*.

`canonical-slot-name` ((*slot* STORAGE-SLOT)) *:* SYMBOL [Function]
Name of the slot at the base of a renaming chain for *slot*.

`cast` ((*value* OBJECT) (*type* TYPE)) *:* OBJECT [Function]
Perform a run-time type check, and then return *value*.

`ccc` (**&rest** (*name* NAME)) *:* CONTEXT [N-Command]
Change the current context to the one named *name*. Return the value of the new current context. If no *name* is supplied, return the pre-existing value of the current context. `cc` is a no-op if the context reference cannot be successfully evaluated. In CommonLisp, if the new context is case sensitive, then change the readtable case to the value of CL-USER::*STELLA-CASE-SENSITIVE-READ-MODE* [default = :INVERT], otherwise to :UPCASE.

`cl-slot-value` ((*object* OBJECT) (*slotName* STRING) (*dontConvert?* BOOLEAN)) *:* LISP-CODE [Function]
Lookup slot *slotName* on *object* and return the lispified slot value (see `lispify`). If *dontConvert?* is TRUE, the returned slot value will not be lispified. Generate a warning if no such slot exists on *object*. In a call directly from Lisp *slotName* can also be supplied as a Lisp symbol.

`cl-slot-value-setter` ((*object* OBJECT) (*slotName* STRING) (*value* LISP-CODE) (*dontConvert?* BOOLEAN)) *:* LISP-CODE [Function]
Lookup slot *slotName* on *object* and set its value to the stellafied *value* (see `stellafy`). If *dontConvert?* is TRUE, *value* will not be stellafied before it gets assigned. Generate a warning if no such slot exists on *object*, or if *value* has the wrong type. In a call directly from Lisp *slotName* can also be supplied as a Lisp symbol.

`cl-translate-file` ((*file* FILE-NAME) (*relative?* BOOLEAN)) *:* [Function]
Translate a Stella *file* to Common-Lisp. If *relative?*, concatenate root directory to *file*.

`cl-translate-system` ((*system-name* STRING)) *:* [Function]
Translate a Stella system named *system-name* to Common Lisp.

`cleanup-unfinalized-classes` () *:* [Function]
Remove all finalized classes from `*UNFINALIZED-CLASSES*`, and set `*NEWLY-UNFINALIZED-CLASSES?*` to `false`.

`clear` (*self*) *:* [Method on VECTOR-SEQUENCE]
Clear *self* by setting its active length to zero.

`clear` (*self*) *:* [Method on HEAP]
Clear *self* by setting its active length to zero.

`clear` (*self*) *:* [Method on BUFFERED-STRING]
Clear *self* by setting its active length to zero.

`clear-configuration-property` ((*property* STRING) (*configuration* CONFIGURATION-TABLE)) *:* OBJECT [Function]

Remove *property* in *configuration* and return the previous value. Use the global system configuration table if *configuration* is NULL.

`clear-input` ((*self* INPUT-STREAM)) *:* [Function]

Clear all buffered raw and tokenized input of *self*.

`clear-recycle-list` ((*list* RECYCLE-LIST)) *:* [Function]

Reset *list* to its empty state.

`clear-recycle-lists` () *:* [Function]

Reset all currently active recycle lists to their empty state.

`clear-system` ((*name* STRING)) *:* [Function]

Clears out the system definition named *name*. If *name* is `null`, then clear out all system definitions. This function is useful when changes have been made to the system definition, and one wants to have it reloaded from the standard location in the file system.

`clear-trace` () *:* [Command]

Disable all tracing previously enabled with `add-trace`.

`clone-memoized-iterator` ((*self* MEMOIZABLE-ITERATOR)) *:* (ITERATOR OF (LIKE (ANY-VALUE SELF))) [Function]

Clone the memoized iterator *self* so it can be used to iterate over the collection represented by *self*, while allowing to iterate over it multiple times via multiple clones.

`clv` ((*code* OBJECT)) *:* OBJECT [Macro]

Convenience macro to splice Lisp expressions into STELLA expressions without upsetting the translator during interactive sessions. If *code* is a currently bound Lisp variable, this tries to infer the type of the resulting expression from the object *code* is bound to and generates an appropriate cast. `clv` stands for Common-Lisp Value or Verbatim.

`coerce-&rest-to-cons` ((*restVariable* SYMBOL)) *:* OBJECT [Macro]

Coerce the argument list variable *restVariable* into a CONS list containing all its elements (uses argument list iteration to do so). If *restVariable* already is a CONS due to argument listification, this is a no-op.

`coerce-option-value` ((*value* OBJECT) (*type* TYPE)) *:* OBJECT [Function]

Coerce *value* to *type*. Return NULL if not possible.

`coerce-to-boolean` ((*object* OBJECT)) *:* BOOLEAN-WRAPPER [Function]

Return the boolean object represented by *object*. Return NULL if coercion is not possible.

`coerce-to-float` ((*object* OBJECT)) *:* FLOAT [Function]

Coerce `number` to a float value or NULL if not possible.

coerce-to-hash-set ((*self* OBJECT) (*equalTest?* BOOLEAN)) *:* HASH-SET [Function]

Coerce the collection *self* into a HASH-SET. Use an equal test if *equalTest?* is TRUE (*equalTest?* will be ignored if *self* already is a HASH-SET).

coerce-to-string ((*object* OBJECT)) *:* STRING [Function]

Coerce *object* into a string. If no standard coercion is possible, simply stringify *object*.

coerce-to-symbol ((*name* NAME)) *:* GENERALIZED-SYMBOL [Function]

Return the (generalized) symbol represented by *name*. Return `null` if *name* is undefined or does not represent a string.

coerce-value-to-boolean ((*value* OBJECT) (*error?* BOOLEAN)) *:* BOOLEAN-WRAPPER [Function]

Return the boolean object represented by *value*. Return NULL if coercion is not possible or raise an error if *error?* is TRUE.

coerce-value-to-float ((*value* OBJECT) (*error?* BOOLEAN)) *:* FLOAT [Function]

Coerce *value* to a float value if possible, return NULL otherwise or raise an error if *error?* is true.

coerce-value-to-string ((*value* OBJECT) (*error?* BOOLEAN)) *:* STRING [Function]

Coerce *value* into a string if possible, return NULL otherwise or raise an error if *error?* is true.

coerce-value-to-type ((*value* OBJECT) (*type* TYPE) (*error?* BOOLEAN)) *:* OBJECT [Function]

Coerce *value* to *type*. Return NULL if not possible or raise an error if *error?* is TRUE.

collect (**&body** *(body* CONS*)*) *:* OBJECT [Macro]

Use a VRLET to collect values. Input can have one of the following forms:

```
(collect <var> in <expression> [where <test> <var>])
(collect <collect-expression>
         foreach <var> in <expression>
         {as ...}*
         [where <test> <var>]
         [do ...])
```

The second form really accepts an arbitrary `foreach` expression following the `foreach` keyword.

collection-valued? (*self*) *:* BOOLEAN [Method on SLOT]

True if slot values are collections.

command? ((*method* METHOD-SLOT)) *:* BOOLEAN [Function]

Return `true` if *method* is an evaluable command.

compare-strings ((*x* STRING) (*y* STRING) (*collation* KEYWORD)) *:* INTEGER [Function]

Compare *x* and *y* and return -1, 0, or 1, depending on whether *x* is less than, equal, or greater than *y* relative to *collation*. Currently supported values for *collation* are

:ascii-case-sensitive, :ascii-case-insensitive :ascii-case-normalized. The first two correspond to `string-compare` called with the appropriate third argument. :ascii-case-normalized calls the function `string-compare-case-normalized` (which see).

`component?` (*self*) *:* BOOLEAN [Method on STORAGE-SLOT]

True if fillers of this slot are components of the owner slot, and therefore should be deleted if the owner is deleted.

`compose-namestring` [Function]
((*name-components* (CONS OF STRING-WRAPPER)) **&rest** *(options* OBJECT*))*
: STRING

name-components is a cons to be processed into a namestring. `:prefix` and `:suffix` are strings that will NOT be case-converted. `:case` is one of :UPCASE :TitleCase :titleCaseX :downcase :Capitalize default is :TitleCase `:separator` is a string that should separate word elements. It does not separate the prefix or suffix. Default is `""` `:translation-table` should be a STRING-HASH-TABLE hash table that strings into their desired printed representation as a string. In general the argument will be strings, but that is not strictly necessary.

`compose-namestring-full` ((*strings* (CONS OF STRING-WRAPPER)) [Function]
(*prefix* STRING) (*suffix* STRING) (*outputcase* KEYWORD)
(*outputseparator* STRING) (*translationtable* STRING-HASH-TABLE)
(*useacronymheuristics?* BOOLEAN)) *:* STRING

Non-keyword version of `compose-namestring`, which will probably be easier to use when called from non-Lisp languages.

`compute-module-and-bare-name` ((*name* STRING)) *:* MODULE STRING [Function]

Compute the module indicated by the STELLA name *name* and return it. Return the bare symbol name as the second value. *name* does not necessarily have to be qualified in which case the current module is returned. *name* is assumed to be the printed representation of a STELLA symbol, surrogate or keyword.

`compute-system-root-directories` ((*system* SYSTEM-DEFINITION)) *:* [Function]

Compute any root directories for sources, native and Lisp binary directories in case they were not explicitly specified in *system*s definition. Raises an error in case any of those root directories is missing and can't be computed.

`concatenate-file-names` ((*file* FILE-NAME) [Function]
&rest *(otherFiles* FILE-NAME*))* *:* FILE-NAME

Intelligently join *file* and *otherFiles* into a concatenated path where each component is separated by a single separator (similar to Python's os.path.join). Keeps the result a logical pathname as long as possible, but converts to physical as soon as any of *otherFiles* contain a physical directory separator.

`config-file-option-handler` ((*option* CMD-LINE-OPTION) [Function]
(*value* OBJECT)) *:*

Load the configuration file *value*. This will modify currently set system properties defined in *value* with new values but leave all other currently set properties as they are.

`configure-stella` ((*file* FILE-NAME)) : [Command]

Perform STELLA run-time configuration. If supplied, load the configuration file *file* first which should be supplied with a physical pathname.

`consify` (*self*) : CONS [Method on OBJECT]

If `object` is a CONS, return it. Otherwise, return a singleton cons list containing it.

`consify-command-line-arguments` ((*count* INTEGER) (*arguments* (ARRAY () OF STRING))) : (CONS OF STRING-WRAPPER) [Function]

Convert *count* command line *arguments* into a CONS list.

`continuable-error` (**&body** *(body* CONS*)*) : OBJECT [Macro]

Signal error message, placing non-string arguments in quotes.

`copy` (*self*) : (VECTOR-SEQUENCE OF (LIKE (ANY-VALUE SELF))) [Method on VECTOR-SEQUENCE]

Return a copy of the vector sequence *self*.

`copy` (*self*) : (CUSTOM-VECTOR-SEQUENCE OF (LIKE (ANY-VALUE SELF))) [Method on CUSTOM-VECTOR-SEQUENCE]

Return a copy of the vector sequence *self*.

`copy` (*self*) : (HEAP OF (LIKE (ANY-VALUE SELF))) [Method on HEAP]

Return a copy of the heap *self*.

`copy` (*string*) : MUTABLE-STRING [Method on MUTABLE-STRING]

Return a copy of *string*.

`copy-stream-to-stream` ((*in* INPUT-STREAM) (*out* OUTPUT-STREAM)) : [Function]

Copy *in* verbatimely to *out*. Does the right thing for binary data.

`cpp-find-native-slot-value-offset` ((*self* STANDARD-OBJECT) (*slot* STORAGE-SLOT)) : INTEGER [Function]

Dynamically determine the byte offset where the native value for *slot* starts in *self*. This basically performs the function of the C++ macro `offsetof` but does it dynamically. Of course, it relies on a working `read/write-slot-value` mechanism and we currently primarily use this for the Python API. This basically writes value changes of *slot* to determine a byte position where a change occurred and then restores the original value (which can be NULL). This handles all native OBJECT and LITERAL slots but does not handle special slots such as `dynamic-slots` or hardwired slots or other non-standard types.

`cpp-translate-system` ((*systemName* STRING)) : [Function]

Translate the system *systemName* to C++.

`cpptrans` ((*statement* OBJECT)) : [N-Command]

Translate *statement* to C++ and print the result.

`create-derived-list` ((*self* LIST)) : LIST [Function]

Create a new list object with the same type as *self*.

`create-directories` ((*directory* STRING)) *:* [Command]

If *directory* does not yet exist, create it and any of its parents that do not yet exist. If *directory* already does exist, this simply is a no-op.

`create-object` ((*type* TYPE) **&rest** *(initial-value-pairs* OBJECT*))* *:* OBJECT [Function]

Funcallable version of the `new` operator. Return an instance of the class named by *type*. If *initial-value-pairs* is supplied, it has to be a key/value list similar to what's accepted by `new` and the named slots will be initialized with the supplied values. Similar to `new`, all required arguments for *type* must be included. Since all the slot initialization, etc. is handled dynamically at run time, `create-object` is much slower than `new`; therefore, it should only be used if *type* cannot be known at translation time.

`date-to-version-string` ((*date* CALENDAR-DATE) (*granularity* KEYWORD)) *:* STRING [Function]

Transform *date* into a version string according to *granularity* which is at least :days and defaults to :seconds.

`deactivate-demon` ((*demon* DEMON)) *:* [Function]

Detach *demon* from the location(s) specified by its internal structure.

`decoded-date-time-to-iso8601-string` (*date*) *:* STRING [Method on DECODED-DATE-TIME]

Returns an ISO-8601 string representation of *date* The Format is YYYY-MM-DDThh:mm:ss+zz:zz, with the string stopping at when a null value is first encountered. The time zone will only be included (if present) if a time value is given.

`decompose-namestring` ((*namestring* STRING) **&rest** *(options* OBJECT*))* *:* (CONS OF STRING-WRAPPER) [Function]

Keyword options: :break-on-cap one of :YES :NO :CLEVER default is :CLEVER :break-on-number one of :YES :NO :CLEVER default is :CLEVER :break-on-separators string default is `"-_ "`

DECOMPOSE-NAMESTRING returns a cons of STRING-WRAPPERS that are the decomposition of the input STRING. The arguments are used as follows: *namestring* is the input string. :break-on-cap is a keyword controlling whether changes in capitalization is used to indicate word boundaries. If :YES, then all capitalization changes delineate words. If :CLEVER, then unbroken runs of capitalized letters are treated as acronyms and remain grouped. If :NO or NULL, there is no breaking of words based on capitalization. :break-on-number is a flag controlling whether encountering a number indicates a word boundary. If :YES, then each run of numbers is treated as a word separate from surrounding words. If :CLEVER, then an attempt is made to recognize ordinal numbers (ie, 101st) and treat them as separate words. If :NO or NULL, there is no breaking of words when numbers are encountered. :break-on-separators A string of characters which constitute word delimiters in the input word. This is used to determine how to break the name into individual words. Defaults are space, `-` and `_`.

`decompose-namestring-full` ((*namestring* STRING) [Function]
(*break-on-cap* KEYWORD) (*break-on-number* KEYWORD)
(*break-on-separators* STRING)) : (CONS OF STRING-WRAPPER)

Non-keyword version of `decompose-namestring`, which will probably be easier to use when called from non-Lisp languages.

`default-cmd-line-option-handler` ((*option* CMD-LINE-OPTION) [Function]
(*value* OBJECT)) :

Default handler that tries to set a system property based on *option* and *value*.

`default-form` (*self*) : OBJECT [Method on STORAGE-SLOT]

Returns the current value of default expression when the slot has not been assigned a value.

`defdemon` ((*name* STRING-WRAPPER) (*parameterstree* CONS) [Macro]
&body *(optionsandbody* CONS*)*) : OBJECT

Define a demon *name* and attach it to a class or slot.

`define-demon` ((*name* STRING) **&rest** *(options* OBJECT*)*) : DEMON [Function]

Define a class or slot demon. Options are :create, :destroy, :class, :slot, :guard?, :code, :method, :inherit?, and :documentation.

`define-global-variable-object` ((*definition* STRING) [Function]
(*nativeObject* NATIVE-OBJECT-POINTER)) :

Define a STELLA global variable object based on *definition*, and initialize its variable-native-object slot to *nativeObject* (which is primarily needed for C++).

`define-logical-host-property` ((*host* STRING) [Command]
(*property* KEYWORD) (*value* OBJECT)) :

Define *property* with *value* for the logical host *host*. As a side-effect, this also defines *host* as a logical host (both *property* and *value* can be supplied as NULL). If :ROOT-DIRECTORY is specified, all pathnames with *host* are assumed to be relative to that directory (even if they are absolute) and will be rerooted upon translation. :ROOT-DIRECTORY can be a logical or physical pathname. If :LISP-TRANSLATIONS is specified, those will be used verbatimely as the value of `(CL:logical-pathname-translations host)` if we are running in Lisp, which allows us to depend on the native `CL:translate-logical-pathname` for more complex translation operations.

`define-module` ((*name* STRING) (*options* CONS)) : MODULE [Function]

Define or redefine a module named *name* having the options *options*. Return the new module.

`define-stella-class` ((*name* TYPE) (*supers* (LIST OF TYPE)) [Function]
(*slots* (LIST OF SLOT)) (*options* KEYWORD-KEY-VALUE-LIST)) : CLASS

Return a Stella class with name *name*. Caution: If the class already exists, the Stella class object gets redefined, but the native C++ class is not redefined.

`define-stella-global-variable-from-stringified-source` [Function]
((*stringifiedSource* STRING)) :

Define a stella global variable using a parse tree derived from *stringifiedSource*.

`define-stella-method-slot` ((*inputname* SYMBOL) (*returntypes* CONS) (*function?* BOOLEAN) (*inputParameters* CONS) (*options* KEYWORD-KEY-VALUE-LIST)) *:* METHOD-SLOT [Function]

Define a new Stella method object (a slot), and attach it to the class identified by the first parameter in *inputParameters*.

`defined?` (*x*) *:* BOOLEAN [Method on LONG-INTEGER]

Return true if *x* is defined (handled specially by all translators).

`defined?` (*x*) *:* BOOLEAN [Method on ARRAY]

Return true if *x* is defined (handled specially by all translators).

`defmain` ((*varList* CONS) **&body** *(body* CONS*)*) *:* OBJECT [Macro]

Defines a function called MAIN which will have the appropriate signature for the target translation language. The signature will be: C++: public static int main (int v1, char** v2) {<body>} Java: public static void main (String [] v2) {<body>} Lisp: (defun main (&rest args) <body>) The argument *varList* must have two symbols, which will be the names for the INTEGER argument count and an array of STRINGs with the argument values. It can also be empty to indicate that no command line arguments will be handled. The startup function for the containing system will automatically be called before *body* is executed unless the option :STARTUP-SYSTEM? was supplied as FALSE. There can only be one DEFMAIN per module.

`defsystem` ((*name* SYMBOL) **&rest** *(options* OBJECT*)*) *:* SYSTEM-DEFINITION [N-Command]

Define a system of files that collectively define a Stella application. Required options are: :directory – the relative path from the respective source/native/binary root directory to the directory containing the system files. Can be a string or a list of strings (do not include directory separators). :files – a list of files in the system, containing strings and lists of strings; the latter defines exploded paths to files in subdirectories. Optional options are: :data-files – a list of files like the :files keyword, which contain data or other content that should not be processed, but instead copied verbatim to the native directory :required-systems – a list of systems (strings) that should be loaded prior to loading this system. :cardinal-module – the name (a string) of the principal module for this system. :copyright-header – string with a header for inclusion into all translated files produced by Stella. :lisp-only-files – Like the :files keyword, but these are only included :cpp-only-files in the translation for the specific language, namely :java-only-files Common Lisp, C++ or Java

`deleted?` (*self*) *:* BOOLEAN [Method on OBJECT]

Default `deleted?` method which always returns FALSE. Objects that inherit DYNAMIC-SLOTS-MIXIN also inherit the dynamically-allocated slot `deleted-object?` which is read/writable with specializations of this method.

`describe` ((*name* OBJECT) **&rest** *(mode* OBJECT*)*) *:* [N-Command]

Print a description of an object in :verbose, :terse, or :source modes.

describe-object (*self* (*stream* OUTPUT-STREAM) (*mode* KEYWORD)) : [Method on OBJECT]
Prints a description of *self* to stream *stream*. *mode* can be :terse, :verbose, or :source. The :terse mode is often equivalent to the standard print function.

destroy-class (*self*) : [Method on CLASS]
Destroy the Stella class *self*. Unfinalize its subclasses (if it has any).

destroy-class-and-subclasses ((*self* CLASS)) : [Function]
Destroy the Stella class *self* and all its subclasses.

destructure-defmethod-tree ((*method-tree* CONS) (*options-table* KEY-VALUE-LIST)) : OBJECT CONS CONS [Function]
Return three parse trees representing the name, parameters, and code body of the parse tree *method-tree*. Fill *options-table* with a dictionary of method options. Storage note: Options are treated specially because the other return values are subtrees of *method-tree*, while *options-table* is a newly-created cons tree. Note also, the parameter and body trees are destructively removed from *method-tree*.

dictionary ((*collectionType* TYPE) **&rest** (*alternatingkeysandvalues* OBJECT)) : (ABSTRACT-DICTIONARY OF OBJECT OBJECT) [Function]
Return a dictionary of *collectionType* containing `values`, in order. Currently supported *collectionType*s are @HASH-TABLE, @STELLA-HASH-TABLE, @KEY-VALUE-LIST, @KEY-VALUE-MAP and @PROPERTY-LIST.

direct-super-classes (*self*) : (ITERATOR OF CLASS) [Method on CLASS]
Returns an iterator that generates all direct super classes of *self*.

disable-memoization () : [Command]
Enable memoization and use of memoized expression results.

disabled-stella-feature? ((*feature* KEYWORD)) : BOOLEAN [Function]
Return true if the STELLA *feature* is currently disabled.

disjoint-sets? (*self* (*otherList* CONS)) : BOOLEAN [Method on CONS]
Return true if the intersection of *self* and *otherList* is empty. This is always true if at least one of the two sets is the empty set. Uses an `eql?` test and a simple quadratic-time algorithm. Note that this does not check whether *self* and *otherList* actually are sets.

div (*x* (*y* INTEGER)) : INTEGER [Method on INTEGER]
Return the integer quotient from dividing *x* by *y*.

div (*x* (*y* LONG-INTEGER)) : LONG-INTEGER [Method on LONG-INTEGER]
Return the integer quotient from dividing *x* by *y*.

drop-hook ((*hookList* HOOK-LIST) (*hookFunction* SYMBOL)) : [Function]
Remove the function named *hookFunction* from *hookList*.

drop-load-path ((*path* STRING)) : (CONS OF STRING-WRAPPER) [Command]
Remove the directories listed in the `|`-separated *path* from the PowerLoom load path.

`drop-slot-value` ((*self* STANDARD-OBJECT) (*slot* STORAGE-SLOT) (*value* OBJECT)) : [Function]
Clear or remove *value* for the slot *slot* on *self*. CAUTION: Assumes that collection-valued slots are non-null.

`drop-trace` (**&rest** (*keywords* GENERALIZED-SYMBOL)) : LIST [N-Command]
Disable trace messages identified by any of the listed *keywords*. After calling (`drop-trace` <keyword>) code guarded by (`trace-if` <keyword> ...) will not be executed when it is encountered.

`eight-bit-character?` ((*ch* CHARACTER)) : BOOLEAN [Function]
Return TRUE if *ch* is in the upper half of the byte set such as UTF-8 codes, etc.

`either` ((*value1* OBJECT) (*value2* OBJECT)) : OBJECT [Macro]
If *value1* is defined, return that, else return *value2*.

`empty?` (*x*) : BOOLEAN [Method on STRING-WRAPPER]
Return true if *x* is the wrapped empty string `""`

`empty?` (*self*) : BOOLEAN [Method on VECTOR-SEQUENCE]
Return `true` if *self* has length 0.

`empty?` (*self*) : BOOLEAN [Method on HEAP]
Return TRUE if *self* is empty.

`empty?` (*self*) : BOOLEAN [Method on BUFFERED-STRING]
Return `true` if *self* has length 0.

`enable-memoization` () : [Command]
Enable memoization and use of memoized expression results.

`enabled-stella-feature?` ((*feature* KEYWORD)) : BOOLEAN [Function]
Return true if the STELLA *feature* is currently enabled.

`ends-with?` ((*string* STRING) (*suffix* STRING) (*end* INTEGER)) : BOOLEAN [Function]
Return TRUE if the substring of *string* ending at *end* ends with *suffix*. If *end* is NULL it defaults to the length of *string*.

`ensure-directories-exist` ((*fileName* FILE-NAME)) : [Command]
Ensure all physical directories in the directory portion of *fileName* exist.

`ensure-file-does-not-exist` ((*filename* STRING) (*context* STRING)) : [Function]
Ensures that *filename* does not exist. If it does, an exception of type `FILE-ALREADY-EXISTS-EXCEPTION` is thrown with *context* supplying context for the error message.

`ensure-file-exists` ((*filename* STRING) (*context* STRING)) : [Function]
Ensures that *filename* exists. If not, an exception of type `NO-SUCH-FILE-EXCEPTION` is thrown with *context* supplying context for the error message.

`ensure-free-space` (*self* (*size* INTEGER)) : MUTABLE-STRING [Method on BUFFERED-STRING]
Ensure *self* is big enough to accommodate an additional item of *size*.

`eql-except-in-whitespace?` ((*s1* STRING) (*s2* STRING)) : BOOLEAN [Function]
Return `true` if the strings *s1* and *s2* are the same except for the amounts of whitespace separating words. Leading or trailing whitespace is also not considered.

`error` (**&body** *(body* CONS*)*) : OBJECT [Macro]
Signal error message, placing non-string arguments in quotes.

`eval-in-module-option-handler` ((*option* CMD-LINE-OPTION) (*value* OBJECT)) : [Function]
Interpret an –eval-in-module option. *value* is expected to be of the form `(<module-name> <s-expression>)`.

`eval-option-handler` ((*option* CMD-LINE-OPTION) (*value* OBJECT)) : [Function]
Interpret an –eval option by evaluating *value*.

`evaluate` ((*expression* OBJECT)) : OBJECT [Command]
Evaluate the expression *expression* and return the result. Currently, only the evaluation of (possibly nested) commands and global variables is supported. The second return value indicates the actual type of the result (which might have been wrapped), and the third return value indicates whether an error occurred during the evaluation. Expressions are simple to program in Common Lisp, since they are built into the language, and relatively awkward in Java and C++. Users of either of those languages are more likely to want to call `evaluate-string`.

`evaluate-string` ((*expression* STRING)) : OBJECT [Function]
Evaluate the expression represented by *expression* and return the result. This is equivalent to `(evaluate (unstringify expression))`.

`even?` (*x*) : BOOLEAN [Method on INTEGER]
Return true if *x* is an even number.

`even?` (*x*) : BOOLEAN [Method on LONG-INTEGER]
Return true if *x* is an even number.

`exception-context` ((*e* NATIVE-EXCEPTION)) : STRING [Function]
Print the exception context of *e* to a string and return the result.

`exception-message` ((*e* NATIVE-EXCEPTION)) : STRING [Function]
Accesses the error message of the exception *e*.

`extension` (*self*) : CLASS-EXTENSION [Method on CLASS]
Return the nearest class extension that records instances of the class *self*.

`external-id-head?` ((*attribute* OBJECT)) : BOOLEAN [Function]
Checks to see if this *attribute* is the literal marking either a PUBLIC or SYSTEM literal for an XML Elternal ID. (See 4.2.2)

`fast-heap-root` (*self*) : (LIKE (ANY-VALUE SELF)) [Method on HEAP]
Return the root of *self* which is assumed to be non-empty.

`file-name-without-device` ((*file* FILE-NAME)) *:* FILE-NAME [Function]

Return the file name portion of *file* by removing any physical device components. This is just like `logical-pathname-without-host` but only looks for one-character device strings as used in Windows.

`file-to-string` ((*file* STRING)) *:* STRING [Function]

Read the content of *file* and return it as a string.

`fill-in-date-substitution` [Function]
((*substitution-list* (KEY-VALUE-LIST OF STRING-WRAPPER STRING-WRAPPER)))
:

Fill in *substitution-list* with template variable substitions for the names YEAR and DATE which correspond to the current year and date. These substitutions can then be used with `substitute-template-variables-in-string` DEPRECATED. Use `add-date-subsitution` or `add-current-date-substitution` instead.

`finalize-classes` () *:* [Function]

Finalize all currently unfinalized classes.

`finalize-classes-and-slots` () *:* [Function]

Finalize all currently unfinalized classes and slots.

`finalize-slots` () *:* [Function]

Finalize all currently unfinalized slots.

`find-file-in-load-path` ((*file* STRING) [Command]
(*extensions* (CONS OF STRING-WRAPPER))) *:* STRING

Try to find *file* in the current load path and, if found, return its full name. If *file* can't be found literally, try to find it with any of the listed *extensions* added. If *extensions* is NULL it defaults to `*stella-file-extensions*`, therefore, to not default to any extensions the value has to be supplied as NIL.

`find-matching-prefix-length` ((*string1* STRING) (*start1* INTEGER) [Function]
(*end1* INTEGER) (*string2* STRING) (*start2* INTEGER) (*end2* INTEGER)) *:*
INTEGER

Finds the length of the matching prefix strings of *string1* and *string2*, starting at position *start1* and *start2* respectively. The search will end when *end1* or *end2* is reached. If either *end1* or *end2* is null, then they will be set to the length of their respective strings.

`find-mismatch` ((*string1* STRING) (*start1* INTEGER) (*end1* INTEGER) [Function]
(*string2* STRING) (*start2* INTEGER) (*end2* INTEGER)) *:* INTEGER INTEGER

Finds the first position in each of *string1* and *string2* where they mismatch, starting at position *start1* and *start2* respectively. The search will end when *end1* or *end2* is reached. If either *end1* or *end2* is null, then they will be set to the length of their respective strings. If there is no mismatch, then `null` values are returned.

`find-source-from-native-file-name` ((*nativeFileName* STRING)) *:* [Function]
STRING

Try to find a STELLA source file based on the name and system components of *nativeFileName*. This will generally search the current STELLA systems path, since the tree where a native file resides is not necessarily the one where the corresponding source file is also. This will only work for Lisp and C++ files where the basename of translated files corresponds to the source file from which they were derived. The main purpose for this is to support the Emacs Lisp/STELLA interface to find function definitions.

`find-system-definition-file` ((*name* STRING)) *:* FILE-NAME [Function]

Try to find an existing system definition file for a system named *name* in the current STELLA_SYSTEMS_PATH or built-in implicit systems path. Return NULL if no such definition file can be found. See `build-stella-systems-path` on where it looks.

`find-system-root-directory` ((*system* SYSTEM-DEFINITION)) *:* FILE-NAME [Function]

Given a system definition *system* try to determine the root directory of the STELLA installation containing this system based on its definition file.

`find-system-root-directory-from-file` ((*sysDefFile* FILE-NAME)) *:* FILE-NAME [Function]

Given a system definition file *sysDefFile* try to determine the root directory of the STELLA installation containing this system by looking for top-level native directories.

`first-defined` (**&body** *(forms* CONS*)*) *:* OBJECT [Macro]

Return the result of the first form in *forms* whose value is defined or NULL otherwise.

`float-to-base60` ((*x* FLOAT) (*all-integers?* BOOLEAN)) *:* (CONS OF NUMBER-WRAPPER) [Function]

Returns a cons of *x* in a base-60 form. That means the first value will be the integer part of *x*, the next value the iteger value of the fraction part of *x* times 60 and the third value the fraction part of *x* time 3600. If *all-integers?* is `true`, then the last value will be rounded to an integer. This can be used to convert from decimal degree values to Degree-Minute-Second or from decimal hours to Hour-Minute-Second format.

`fmod` ((*x* FLOAT) (*modulus* FLOAT)) *:* FLOAT [Function]

True modulus for floats. Return the result of *x* mod `modulo`. Note: In C++ and Java, `mod` has more overhead than the similar function `rem`. The answers returned by `mod` and `rem` are only different when the signs of *x* and `modulo` are different.

`format-date` ((*date* OBJECT) (*timezone* OBJECT) (*control* STRING)) *:* STRING [Function]

Format *date* just like `format-date-to-stream` (which see), but return the result as a string.

`format-date-to-stream` ((*date* OBJECT) (*timezone* OBJECT) (*control* STRING) (*stream* OUTPUT-STREAM)) *:* [Function]

Perform formatted printing of *date* relative to *timezone* onto *stream*. *date* has to be either a calendar-date or a decoded-date-time object. *timezone* can be null to indicate the local timezone, or a float or supported timezone name. *control* is a format control string whose characters are printed literally, unless they are a %-code such as one of these (inspired by the codes supported by the Unix *date* command): %% a literal

% %a abbreviated weekday name (e.g., Sun) %A full weekday name (e.g., Sunday) %b abbreviated month name (e.g., Jan) %B full month name (e.g., January) %d day of month (e.g., 01) %D date; same as %m/%d/%y %F full date; same as %Y-%m-%d %H hour (00..23) %I hour (01..12) %m month (01..12) %M minute (00..59) %p either AM or PM %r 12-hour clock time (e.g., 11:11:04 PM) %R 24-hour hour and minute; same as %H:%M %S second (00..60) %T time; same as %H:%M:%S %y last two digits of year (00..99) %Y year %z +hhmm numeric time zone (e.g., -0400) %:z +hhmm numeric time zone (e.g., -04:00) %Z alphabetic time zone abbreviation (e.g., EDT) By default, numeric fields are padded with zeroes. The following optional flags may follow `%`: - (hyphen) do not pad the field _ (underscore) pad with spaces 0 (zero) pad with zeros ^ use upper case if possible , use lower case if possible

`format-with-padding` ((*input* STRING) (*length* INTEGER) (*padchar* CHARACTER) (*align* KEYWORD) (*truncate?* BOOLEAN)) *:* STRING [Function]

Formats *input* to be (at least) *length* long, using *padchar* to fill if necessary. *align* must be one of :LEFT, :RIGHT, :CENTER and will control how *input* will be justified in the resulting string. If *truncate?* is true, then then an overlength string will be truncated, using the opposite of *align* to pick the truncation direction.

`free` (*self*) *:* [Method on OBJECT]

Default method. Deallocate storage for *self*.

`free` (*self*) *:* [Method on ACTIVE-OBJECT]

Remove all pointers between *self* and other objects, and then deallocate the storage for self.

`free-hash-table-values` (*self*) *:* [Method on ABSTRACT-HASH-TABLE]

Call free on each value in the hash table *self*.

`free-space` (*self*) *:* INTEGER [Method on BUFFERED-STRING]

Return the amount of free space in *self*.

`frem` ((*x* FLOAT) (*y* FLOAT)) *:* FLOAT [Function]

Return the floating point remainder from dividing *x* by *y*. The sign of the result is always the same as the sign of *x*. This has slightly different behavior than the `mod` function, and has less overhead in C++ and Java, which don't have direct support for a true modulus function.

`gc-protect-object` ((*object* NATIVE-OBJECT-POINTER)) *:* NATIVE-OBJECT-POINTER [Function]

Protect *object* from garbage collection. Returns a handle that can later be passed to `gc-release-object` to release *object* from garbage collection protection.

`gc-release-object` ((*handle* NATIVE-OBJECT-POINTER)) *:* NATIVE-OBJECT-POINTER [Function]

Release the object pointed to by *handle* from garbage collection protection and return the protected object. This frees *handle* but does not necessarily mean that the object will be garbage collected, it just can be again, once all references to it disappear.

generate-random-uuid () *:* STRING [Function]

Generates a random UUID (Type 4), according to the guidelines of IETF RFC 4122 (see http://www.ietf.org/rfc/rfc4122.txt)

Take 16 random bytes (octets), put them all behind each other, for the description the numbering starts with byte 1 (most significant, first) to byte 16 (least significant, last). Then put in the version and variant. To put in the version, take the 7th byte and perform an and operation using 0x0f, followed by an or operation with 0x40. To put in the variant, take the 9th byte and perform an and operation using 0x3f, followed by an or operation with 0x80. To make the string representation, take the hexadecimal presentation of bytes 1-4 (without 0x in front of it) let them follow by a -, then take bytes 5 and 6, - bytes 7 and 8, - bytes 9 and 10, - then followed by bytes 11-16.

generate-uuid ((*uuid-type* KEYWORD)) *:* STRING [Function]

Generates a UUID of the specified type. Legal types are a subset of the IETF RFC 4122 (see http://www.ietf.org/rfc/rfc4122.txt) UUID types. Currently supported are: :TYPE-4 :RANDOM A type-4 (random) UUID. These are synonyms.

get-calendar-date (*date* (*timezone* FLOAT)) *:* INTEGER INTEGER INTEGER KEYWORD [Method on CALENDAR-DATE]

Returns multiple values of year, month, day and day of week for *date* in *timezone*. *timezone* is the number of hours added to UTC to get local time. It is in the range -12.0 to +14.0 where UTC is zone 0.0

get-generic-slot-accessor ((*slot* STORAGE-SLOT) (*class* CLASS) (*warn?* BOOLEAN)) *:* FUNCTION-CODE [Function]

Return the accessor code to read *slot* on an object of type *class*, or NULL if no such accessor exists. In that case, print a warning if *warn?* is TRUE. NOTE: the accessor expects `canonical-slot-name`s (which see).

get-global-variable-native-object ((*variable* GLOBAL-VARIABLE)) *:* NATIVE-OBJECT-POINTER [Function]

Return the native object of *variable* which can be used to access its runtime value. In Lisp this is the Lisp symbol which holds the variable value, in C++ this is the address of the variable, and in Java this is the declared Field object. For C++ native object addresses are initialized at startup time, for Lisp and Java native objects will be accessed upon first call and then cached in the slot.

get-language-subdirectory-from-file-type ((*type* KEYWORD)) *:* STRING [Function]

Compute a language-specific native subdirectory that should be used for files of *type*. If *type* does not naturally suggest which native language it is associated with, key in on the current translation output language. Returns the empty string for unhandled types.

get-load-path () *:* (CONS OF STRING-WRAPPER) [Command]

Return the current STELLA load path.

`get-local-standard-time-zone` () *:* FLOAT [Function]

Returns the standard time zone offset from UTC as a float, without considering the effects of daylight savings time.

`get-local-time-zone-for-date` ((*year* INTEGER) (*month* INTEGER) (*day* INTEGER) (*hour* INTEGER) (*minute* INTEGER) (*second* INTEGER)) *:* FLOAT [Function]

Returns the time zone offset from UTC (as a float) that is applicable to the given date. Assumes that the date is one that is valid for the underlying programming language. If not, then returns 0.0

`get-log-stream` ((*module* STRING)) *:* OUTPUT-STREAM [Function]

Return a valid log stream for *module*.

`get-logical-host-property` ((*host* OBJECT) (*property* OBJECT)) *:* OBJECT [Command]

Lookup the value of *property* for the logical host *host*.

`get-native-source-subdirectory-from-file-type` ((*type* KEYWORD)) *:* STRING [Function]

Compute a native source subdirectory that should be used for files of *type*. If *type* does not naturally suggest which native language it is associated with, key in on the current translation output language. Returns the empty string for unhandled types.

`get-property` ((*property* NAME) **&rest** (*defaultValue* OBJECT)) *:* OBJECT [Command]

Lookup *property* (a string or symbol) in the configuration table and return its value. If it is undefined, return the optional *defaultValue*. Note that *property* is evaluated and will need to be quoted if supplied as a symbol. Symbols will also be upcased if this command is run in a non-case- sensitive module.

`get-quoted-tree` ((*tree-name* STRING) (*modulename* STRING)) *:* CONS [Function]

Return the quoted tree with name *tree-name*.

`get-root-directory-from-file-extension` ((*file* FILE-NAME)) *:* FILE-NAME [Function]

Given a *file*, determine which STELLA installation root directory tree it naturally belongs to based on its extension (i.e., source, native or binary).

`get-root-directory-from-file-type` ((*type* KEYWORD)) *:* STRING [Function]

Given a normalized file *type*, determine which STELLA installation root directory tree it naturally belongs to (i.e., source, native or binary).

`get-slot` ((*self* STANDARD-OBJECT) (*slot-name* SYMBOL)) *:* SLOT [Function]

Return the slot named *slot-name* on the class representing the type of *self*.

`get-stella-class` (*class-name* (*error?* BOOLEAN)) *:* CLASS [Method on SURROGATE]

Return a class with name *class-name*. If none exists, break if *error?*, else return `null`.

`get-stella-class` (*class-name* (*error?* BOOLEAN)) *:* CLASS [Method on SYMBOL]
Return a class with name *class-name*. If non exists, break if *error?*, else return `null`.

`get-stella-class` (*class-name* (*error?* BOOLEAN)) *:* CLASS [Method on STRING]
Return a class with name *class-name*. If none exists, break if *error?*, else return `null`.

`get-system-definition` ((*name* STRING) (*error?* BOOLEAN)) *:* SYSTEM-DEFINITION [Function]
Return a system named *name*. If no such system is currently defined, look for a system definition file for *name* in standard locations and try to load it. If no matching system could be found or loaded and *error?* is true, raise an error, otherwise, simply return NULL.

`get-system-last-modified-date` ((*system* SYSTEM-DEFINITION)) *:* CALENDAR-DATE [Function]
Compute a last-modified date for *system* based on its most recently modified source file.

`get-system-subdirectory-from-file-type` ((*type* KEYWORD)) *:* STRING [Function]
Compute a native system subdirectory that should be used for files of *type*. If *type* does not naturally suggest which native language it is associated with, key in on the current translation output language. Returns the empty string for unhandled types.

`get-system-version-string` ((*system* SYSTEM-DEFINITION)) *:* STRING [Function]
Compute a version string for *system* which is either based on an explicit :version annotation on *system*s definition, the readable value of an existing `*<system>-version[-string]*`, variable or on its most recent modification date of any of its source files.

`get-temp-directory` () *:* STRING [Function]
Return a suitable directory for temporary files. Uses the value of `stella.tempDirectory` if defined; otherwise, it will use a suitable OS-specific default. The returned directory will end in a separator for immediate concatenation with a physical filename.

`get-time` (*date* (*timezone* FLOAT)) *:* INTEGER INTEGER INTEGER INTEGER [Method on CALENDAR-DATE]
Returns multiple values of hours, minutes, seconds, milliseconds for the calendar date *date* in *timezone*. *timezone* is the number of hours added to UTC to get local time. It is in the range -12.0 to +14.0 where UTC is zone 0.0

`get-token-float` () *:* OBJECT [Macro]
User-level macro to access the most recently parsed token as a float. This assumes correct signed float syntax and only checks for overflows. The main benefit for this is that it doesn't generate strings and wrappers. Float parsing and conversion is generally hairy and we are probably not covering all special cases here; but we are fast :-)

`get-token-integer` () *:* OBJECT [Macro]
User-level macro to access the most recently parsed token as an integer. This assumes correct signed integer syntax and only checks for overflows.

`get-token-long-integer` () *:* OBJECT [Macro]
User-level macro to access the most recently parsed token as a long integer. This assumes correct signed long-integer syntax and only checks for overflows.

`get-xml-base-attribute-value` ((*expression* CONS)) *:* STRING [Function]
Return the last base url attribute in the attribute list of this element if it exists. Otherwise NULL.

`getenv` ((*varname* STRING) **&rest** *(deflt* STRING*))* *:* STRING [Command]
Return the value of the OS environment variable *varname*. If it is not defined or if its value is the empty string and a *deflt* is provided, return the default value instead.

`global-variable-type-spec` ((*global* GLOBAL-VARIABLE)) *:* TYPE-SPEC [Function]
Return the type spec for the global variable *global*.

`hash-string` ((*string* STRING) (*seedCode* INTEGER)) *:* INTEGER [Function]
Generate a hash-code for *string* and return it. Two strings that are equal but not eq will generate the same code. The hash-code is based on *seedCode* which usually will be 0. However, *seedCode* can also be used to supply the result of a previous hash operation to achieve hashing on sequences of strings without actually having to concatenate them.

`heap-root` (*self*) *:* (LIKE (ANY-VALUE SELF)) [Method on HEAP]
Return the root of *self* (NULL if *self* is empty). The root contains the minimum element of a min-heap with `<` predicate.

`heapify` (*self*) *:* [Method on HEAP]
Restore the heap property of *self* according to its `predicate`. Normally, this is not needed, since insert operations preserve the heap property. However, this can be useful after bulk insertion of values or if `predicate` has been changed.

`help-advance-past-whitespace` ((*source* STRING) (*start* INTEGER) (*end* INTEGER)) *:* INTEGER [Function]
Helper for `advance-past-whitespace` that requires *end* to be properly set.

`help-find-matching-prefix-length` ((*string1* STRING) (*start1* INTEGER) (*end1* INTEGER) (*string2* STRING) (*start2* INTEGER) (*end2* INTEGER)) *:* INTEGER [Function]
Helping function for `find-matching-prefix` that requires *end1* and *end2* to be properly set up.

`help-get-stella-module` ((*pathName* STRING) (*error?* BOOLEAN)) *:* MODULE [Function]
Return the module located at *pathName*, or `null` if no such module exists. The search looks at ancestors and top-most (cardinal) modules. If *error?* is `true`, throw an exception if no module is found.

`help-option-handler` ((*option* CMD-LINE-OPTION) (*value* OBJECT)) *:* [Function]
Print documentation about all currently registered option handlers.

`help-print-outline` (*top* (*stream* OUTPUT-STREAM) (*current-depth* INTEGER) (*depth* INTEGER) (*named?* BOOLEAN)) : [Method on CLASS]
Helper method for `print-outline`

`help-print-outline` (*top* (*stream* OUTPUT-STREAM) (*current-depth* INTEGER) (*depth* INTEGER) (*named?* BOOLEAN)) : [Method on OBJECT]
Helper method for `print-outline`

`help-print-outline` (*top* (*stream* OUTPUT-STREAM) (*current-depth* INTEGER) (*depth* INTEGER) (*named?* BOOLEAN)) : [Method on SLOT]
Helper method for `print-outline`

`help-print-outline` (*top* (*stream* OUTPUT-STREAM) (*current-depth* INTEGER) (*depth* INTEGER) (*named?* BOOLEAN)) : [Method on MODULE]
Helper method for `print-outline`

`help-print-outline` (*top* (*stream* OUTPUT-STREAM) (*current-depth* INTEGER) (*depth* INTEGER) (*named?* BOOLEAN)) : [Method on CONTEXT]
Helper method for `print-outline`

`hex-character-value` ((*c* CHARACTER)) : INTEGER [Function]
Convert the base-16 hex character *c* into a base-10 number.

`home-module` (*self*) : MODULE [Method on OBJECT]
Return the home module of *self*.

`if-output-language` ((*language* KEYWORD) (*thenForm* OBJECT) (*elseForm* OBJECT)) : OBJECT [Macro]
Expand to *thenForm* if the current translator output language equals *language*. Otherwise, expand to *elseForm*. This can be used to conditionally translate Stella code.

`if-stella-feature` ((*feature* KEYWORD) (*thenForm* OBJECT) (*elseForm* OBJECT)) : OBJECT [Macro]
Expand to *thenForm* if *feature* is a currently enabled STELLA environment feature. Otherwise, expand to *elseForm*. This can be used to conditionally translate Stella code.

`ignore` (**&body** *(variables* CONS*)*) : OBJECT [Macro]
Ignore unused *variables* with NoOp `setq` statements.

`incrementally-translate` ((*tree* OBJECT)) : OBJECT [Function]
Translate a single Stella expression *tree* and return the result. For C++ and Java print the translation to standard output and return NIL instead.

`indent-outline` ((*current-depth* INTEGER) (*stream* OUTPUT-STREAM)) : [Function]
Helper function that indents outline printings for level *current-depth* on *stream* using the value of the global variable `*OUTLINE-INDENT-STRING*`

`inform` (**&body** *(body* CONS*)*) : OBJECT [Macro]
Print informative message, placing non-string arguments in quotes, and terminating with a newline.

`initial-value` (*self*) *:* OBJECT [Method on CLASS]
Return an initial value for the class *self*.

`initial-value` (*self*) *:* OBJECT [Method on STORAGE-SLOT]
Return an initial value for *self*, or `null`. The initial value can be defined by the slot itself, inherited from an equivalent slot, or inherit from the :initial-value option for the class representing the type of *self*.

`initialize-array` (*self* [Method on DIMENSIONAL-ARRAY-MIXIN]
(*initialValue* (LIKE (ANY-VALUE SELF)))) *:*
Initialize the elements of *self* with *initialValue*.

`initialize-hash-table` (*self*) *:* [Method on STELLA-HASH-TABLE]
Initialize the STELLA hash table *self*. This is a no-op and primarily exists to shadow the standard initializer inherited from ABSTRACT-HASH-TABLE. STELLA hash tables are initialized at the first insertion operation.

`initially` (*self*) *:* OBJECT [Method on STORAGE-SLOT]
Defines the value of a slot before it has been assigned a value.

`insert` (*self* [Method on CUSTOM-VECTOR-SEQUENCE]
(*value* (LIKE (ANY-VALUE SELF)))) *:*
Append *value* to the END of the sequence *self*. Resize the array if necessary.

`insert` (*self* (*value* (LIKE (ANY-VALUE SELF)))) *:* [Method on HEAP]
Insert *value* into *self* and restore the heap property. Signal an error if there is no more room in *self*. Maintains *self* as a Min-heap if *self*s `predicate` has `<` semantics; otherwise as a Max-heap.

`insert-if-better` (*self* (*value* (LIKE (ANY-VALUE SELF)))) *:* [Method on HEAP]
Insert *value* into *self* and restore the heap property. If *self* has available room, simply insert *value*. If the heap is full, only insert *value* if it is better than the current root (i.e., if *value* is greater than the minimum of *self* for the case of a min-heap where *self*s `predicate` has `<` semantics). In that case, replace the root of *self* and restore the heap property. This is useful to build and maintain a heap with some top-N elements (relative to `predicate`) where the root (or minimum) of *self* is the currently weakest element at the end of the list.

`int-to-string` ((*i* INTEGER)) *:* STRING [Function]
Convert *i* to its string representation and return the result. This is a convenience function that expects regular integers as opposed to longs which is useful in contexts where we do automatic unwrapping based on the target.

`integer-length` ((*x* LONG-INTEGER)) *:* INTEGER [Function]
Return the 1-based position of the left-most bit in *x*. If *x* is negative, we only count the value bits, not the sign.

`integer-length10` ((*x* LONG-INTEGER)) *:* INTEGER [Function]
Return the 1-based position of the left-most non-zero digit in the base-10 representation of *x*. If *x* is negative, we only consider its absolute value, not the sign. This effectively computes the minimum number of base-10 digits to represent *x*, with the exception of x=0.

integer-to-hex-string ((*i* LONG-INTEGER)) *:* STRING [Function]

Convert *i* to a string representation in hexadecimal notation and return the result.

integer-to-string-in-base ((*i* LONG-INTEGER) (*base* INTEGER)) *:* STRING [Function]

Convert *i* to a string representation in *base* and return the result. *base* must be positive and not more than 36.

Note that in the C++ version, only 8, 10 and 16 will work as *base* arguments, since that is all the underlying implementation supports. Other argument values will be treated as `10`.

integer-valued? ((*x* FLOAT)) *:* BOOLEAN [Function]

Returns `true` if *x* is the floating point representation of an integer.

intern-stella-name ((*name* STRING)) *:* GENERALIZED-SYMBOL [Function]

Parse *name* which is assumed to be the printed representation of a STELLA symbol, surrogate or keyword, intern it into the current or specified module and return the result. This is identical to calling `unstringify` on *name* but 10-15 times faster.

interpret-command-line-arguments ((*count* INTEGER) (*arguments* (ARRAY () OF STRING))) *:* [Function]

Old name for `process-command-line-arguments` (which see).

isa? ((*object* OBJECT) (*type* TYPE)) *:* BOOLEAN [Function]

Return `true` iff *object* is an instance of the class named *type*.

java-translate-system ((*systemName* STRING)) *:* [Function]

Translate the system *systemName* to Java.

jptrans ((*statement* OBJECT)) *:* [N-Command]

Translate *statement* to C++ and print the result.

keyword-name? ((*name* STRING)) *:* BOOLEAN [Function]

Return TRUE if name is prefixed by `:`.

kvlist-to-plist ((*self* KEY-VALUE-LIST)) *:* (PROPERTY-LIST OF (LIKE (ANY-KEY SELF)) (LIKE (ANY-VALUE SELF))) [Function]

Convert *self* into a property list with identical and identically ordered keys and values.

last (*self*) *:* (LIKE (ANY-VALUE SELF)) [Method on VECTOR-SEQUENCE]

Return the last item in the vector *self*.

last (*self*) *:* (LIKE (ANY-VALUE SELF)) [Method on HEAP]

Return the last item in the heap *self* which will be the largest or best item if *self* is a sorted min-heap with a `<` predicate.

last (*self*) *:* CHARACTER [Method on BUFFERED-STRING]

Return the last character in *self*.

length (*self*) *:* INTEGER [Method on CONS-ITERATOR]

Iterate over *self*, and count how many items there are.

length (*self*) : INTEGER [Method on HEAP]

Return the length of the currently filled portion of *self*.

length (*self*) : INTEGER [Method on DIMENSIONAL-ARRAY-MIXIN]

Return the total number of elements in *self*.

length (*self*) : INTEGER [Method on 2-DIMENSIONAL-ARRAY-MIXIN]

Return the total number of elements in *self*.

length-setter (*self* (*newLength* INTEGER)) : INTEGER [Method on BUFFERED-STRING]

Reset the length of *self* to *newLength*. Fill in NULL characters if *newLength* is greater than the current length. This is the safe way to reset the fill pointer.

lispify ((*thing* UNKNOWN)) : LISP-CODE [Function]

Convert a Stella *thing* as much as possible into a Common-Lisp analogue. The currently supported *thing* types are CONS, LIST, KEY-VALUE-LIST, ITERATOR, SYMBOL, KEYWORD, and all wrapped and unwrapped literal types. BOOLEANs are translated into Lisp's CL:T and CL:NIL logic. Unsupported types are left unchanged.

lispify-boolean ((*thing* UNKNOWN)) : LISP-CODE [Function]

Lispify *thing* which is assumed to be a (possibly wrapped) Stella boolean.

list-directory-files ((*directory* STRING)) : (CONS OF STRING-WRAPPER) [Command]

Return all the files and sub-directories in *directory* sorted by name. Each returned file is a bare file name without a *directory* component. If a file is a directory, it will look just like a plain file. This means consumers might have to explicitly test whether a file is a directory depending on what they do. Excludes . and .. directories. Handles logical pathnames but resulting files will always use physical pathname syntax. This is mostly consistent across native languages, but some differences still exist - e.g., Lisp will convert . or .. into absolute pathnames.

list-directory-files-recursively ((*directory* STRING)) : (CONS OF STRING-WRAPPER) [Command]

Just like `list-directory-files` (which see) but also recurses into subdirectories. Files at the top level of *directory* will be bare file names without a *directory* component. Files in subdirectories will be prefixed with the relative subdirectory path starting right below *directory*. The sort order is lexicographic within directories which results in a depth-first presentation order of files.

list-modules ((*kb-only?* BOOLEAN)) : (CONS OF MODULE) [Command]

Returns a cons of all modules defined in PowerLoom. If *kb-only?* is `true`, then any modules which are code only or just namespaces are not returned.

listify (*self*) : (LIST OF (LIKE (ANY-VALUE SELF))) [Method on CONS]

Return a list of elements in *self*.

listify (*self*) : (LIST OF (LIKE (ANY-VALUE SELF))) [Method on LIST]

Return *self*.

`listify` (*self*) *:* (LIST OF (LIKE (ANY-VALUE SELF))) [Method on KEY-VALUE-LIST]
Return a list of key-value pairs in *self*.

`listify` (*self*) *:* (LIST OF (LIKE (ANY-VALUE SELF))) [Method on VECTOR]
Return a list of elements in *self*.

`listify` (*self*) *:* (LIST OF (LIKE (ANY-VALUE SELF))) [Method on ITERATOR]
Return a list of elements generated by *self*.

`load-configuration-file` ((*file* FILE-NAME)) *:* [Command]
CONFIGURATION-TABLE
Read a configuration *file* and return its content as a configuration table. Also enter each property read into the global system configuration table. Assumes Java-style property file syntax. Each property name is represented as a wrapped string and each value as a wrapped string/integer/float or boolean.

`load-file` ((*file* STRING)) *:* [Command]
Read STELLA commands from *file* and evaluate them. The file should begin with an `in-module` declaration that specifies the module within which all remaining commands are to be evaluated The remaining commands are evaluated one-by-one, applying the function `evaluate` to each of them.

`load-file-option-handler` ((*option* CMD-LINE-OPTION) [Function]
(*value* OBJECT)) *:*
Load the file *value* using the STELLA `load-file` command.

`load-path-option-handler` ((*option* CMD-LINE-OPTION) [Function]
(*value* OBJECT)) *:*
Modify the current file load path according to *option* and *value*.

`load-system` ((*systemName* STRING) [Command]
&rest *(language***&options** OBJECT*)*) *:* BOOLEAN
Natively `language`-compile out-of-date translated files of system *systemName* (only supported for Lisp at the moment) and then load them into the running system. Return true if at least one file was compiled. The following keyword/value `options` are recognized:

`:language`: can be used as an alternative to the optional language argument. If not specified, the language of the running implementation is assumed.

`:force-recompilation?` (default false): if true, files will be compiled whether or not their compilations are up-to-date.

`:startup?` (default true): if true, the system startup function will be called once all files have been loaded.

`:recursive?` (default false): if true, perform `load-system` with the provided options on *systemName* as well as all its required systems and so on. Required systems will be processed first. Note that even without this option, any required systems that have not yet been loaded or started up will also be processed, since that is assumed when loading *systemName* and supporting modules from a definition file.

`:root-source-directory`, `:root-native-directory`, `:root-binary-directory`: if specified these directories will be used to override the respective paths provided in system definitions or computed as defaults from a system's home location.

`log-level<=` ((*level* OBJECT) (*module* STRING)) : BOOLEAN [Function]

Return TRUE if *level* is lower than or equal to the current log level of *module*. Return FALSE if any of them are undefined.

`log-message` ((*module* STRING) (*logLevel* OBJECT) (*message* CONS)) : [Function]

Log all elements of *message* to *module*s log stream if *logLevel* is the same or lower than the *module*s log level. Interprets `EOL` or :EOL to print a line terminator.

`log2` ((*n* FLOAT)) : FLOAT [Function]

Return the logarithm (base 2) of *n*.

`logmsg` ((*module* STRING) (*logLevel* OBJECT) **&rest** (*message* OBJECT)) : [Function]

Log all elements of *message* to *module*s log stream if *logLevel* is the same or lower than the *module*s log level. Interprets `EOL` or :EOL to print a line terminator.

`lookup-class` (*name*) : CLASS [Method on SYMBOL]

Return a class with name *name*. Scan all visible surrogates looking for one that has a class defined for it.

`lookup-class` (*name*) : CLASS [Method on STRING]

Return a class with name *name*. Scan all visible surrogates looking for one that has a class defined for it.

`lookup-class-by-qualified-name` ((*qualifiedName* STRING)) : CLASS [Function]

Variant of `string.lookup-class` that can specify a starting module through a *qualifiedName*.

`lookup-class-cpp-type-by-name` ((*qualifiedName* STRING)) : STRING [Function]

Return a namespace-qualified C++ translation of the class type named by *qualifiedName* or NULL if no such STELLA class exists.

`lookup-command` ((*name* SYMBOL)) : METHOD-SLOT [Function]

If *name* names an evaluable command return its associated command object; otherwise, return `null`. Currently, commands are not polymorphic, i.e., they can only be implemented by functions.

`lookup-command-like-function` ((*name* SYMBOL)) : METHOD-SLOT [Function]

Look up a function with *name* that can be evaluated via `apply` just like a command, regardless of whether it was marked as such.

`lookup-configuration-property` ((*property* STRING) (*defaultValue* OBJECT) (*configuration* CONFIGURATION-TABLE)) : OBJECT [Function]

Lookup *property* in *configuration* and return its value. Use the global system configuration table if *configuration* is NULL. Return *defaultValue* if *property* is not defined.

`lookup-configuration-property-values` ((*property* STRING) (*defaultValue* OBJECT) (*configuration* CONFIGURATION-TABLE)) : CONS [Function]

Lookup *property* in *configuration*, assume it is a multi-valued property and return its value(s) as a list. Use the global system configuration table if *configuration* is NULL. Return *defaultValue* if *property* is not defined or NIL is no default value is specified.

`lookup-demon` ((*name* STRING)) *:* DEMON [Function]
Return the demon named *name*.

`lookup-function` ((*functionSymbol* SYMBOL)) *:* FUNCTION [Function]
Return the function defined for *functionSymbol*, if it exists.

`lookup-function-by-name` ((*name* STRING)) *:* FUNCTION [Function]
Return a function with name *name* visible from the current module. Scan all visible symbols looking for one that has a function defined for it.

`lookup-function-by-qualified-name` ((*qualifiedName* STRING)) *:* METHOD-SLOT [Function]
Variant of `lookup-function-by-name` that can specify a starting module through a *qualifiedName*.

`lookup-global-variable` (*self*) *:* GLOBAL-VARIABLE [Method on SURROGATE]
Return a global variable with name *self*.

`lookup-global-variable` (*self*) *:* GLOBAL-VARIABLE [Method on GENERALIZED-SYMBOL]
Return a global variable with name *self*.

`lookup-global-variable` (*self*) *:* GLOBAL-VARIABLE [Method on STRING]
Return a global variable with name *self*.

`lookup-global-variable-by-name` ((*name* STRING)) *:* GLOBAL-VARIABLE [Function]
Return a global variable with *name* visible from the current module. Scan all visible symbols looking for one that has a global variable defined for it. NOTE: this is more robust than STRING.lookup-global-variable which will fail if there is a local symbol with *name* which shadows one higher up that is the name of a global.

`lookup-global-variable-by-qualified-name` ((*qualifiedName* STRING)) *:* GLOBAL-VARIABLE [Function]
Variant of `lookup-global-variable-by-name` that can specify a starting module through a *qualifiedName*.

`lookup-local-slot` ((*class* CLASS) (*slot-name* SYMBOL)) *:* SLOT [Function]
Lookup a local slot with *slot-name* on *class*.

`lookup-logging-parameter` ((*module* STRING) (*parameter* KEYWORD) (*default* OBJECT)) *:* OBJECT [Function]
Lookup logging *parameter* for *module*. Use *default* if no value is defined.

`lookup-macro` ((*name* SYMBOL)) *:* METHOD-SLOT [Function]
If *name* has a macro definition, return the method object holding its expander function.

`lookup-slot` ((*class* CLASS) (*slot-name* SYMBOL)) *:* SLOT [Function]
Return a slot owned by the class *class* with name *slot-name*. Multiply inherited slots are disambiguated by a left-to-right class precedence order for classes with multiple parents (similar to CLOS).

`lookup-slot-and-class-by-qualified-name` [Function]
((*qualifiedname* STRING)) *:* SLOT CLASS

Lookup a slot via dotted notation with a possibly qualified class name. Examples: "cons.first" or "stella/cons.first". This is a variant of `string-to-slot` in describe.ste that actually obeys the class module if it is given. This also returns the specified class as a second value which might differ from the slot's owner class.

`lookup-slot-by-qualified-name` ((*qualifiedname* STRING)) *:* SLOT [Function]

Lookup a slot via dotted notation with a possibly qualified class name. Examples: "cons.first" or "stella/cons.first". This is a variant of `string-to-slot` in describe.ste that actually obeys the class module if it is given.

`lookup-stella-name` ((*name* STRING)) *:* GENERALIZED-SYMBOL [Function]

Parse *name* which is assumed to be the printed representation of a STELLA symbol, surrogate or keyword, and try to look it up according to its type. This is a lookup version of `intern-stella-name` (which see) for cases where we don't necessarily want to create a symbol in case it doesn't exist already.

`lookup-with-default` (*self* [Method on PROPERTY-LIST]
(*key* (LIKE (ANY-KEY SELF))) (*default* (LIKE (ANY-VALUE SELF)))) *:* (LIKE (ANY-VALUE SELF))

Lookup *key* in *self* and return the result. Return *default* if no value was found.

`lookup-with-default` (*self* [Method on KEY-VALUE-LIST]
(*key* (LIKE (ANY-KEY SELF))) (*default* (LIKE (ANY-VALUE SELF)))) *:* (LIKE (ANY-VALUE SELF))

Lookup *key* in *self* and return the result. Return *default* if no value was found.

`lptrans` ((*statement* OBJECT)) *:* [N-Command]

Translate *statement* to Common-Lisp and print the result.

`make-file-name` ((*filePath* STRING) (*type* KEYWORD) [Function]
(*relative?* BOOLEAN)) *:* FILE-NAME

Make an absolute file-name string from *filePath* with directory location and file extension determined by *type* and *relative?*. *type* is the main determiner for whether we are creating a source, native or binary pathname in the respective root directories, and it also controls the new extension of the resulting pathname replacing any one on *filePath*. If *relative?* is TRUE, then the respective root directory prefix is appended, plus any additional relevant language, system and source subdirectories. If *relative?* is FALSE, then the current directory prefix of *filePath* as indicated by its extension is switched to the new root directory indicated by *type*. In this case, only the root and language directories are inserted, but all the remaining source directory components are left the same (thus, this will generally not do the right thing for Java file names). This function takes the dynamic state of currently active systems and modules into account.

`make-matching-name` ((*original* STRING) **&rest** *(options* OBJECT*))* : STRING [Function]

Keyword options: :break-on-cap one of :YES :NO :CLEVER default is :CLEVER :break-on-number one of :YES :NO :CLEVER default is :CLEVER :break-on-separators string default is `"-_ "` :remove-prefix string :remove-suffix string

:case one of :UPCASE :TitleCase :titleCaseX :downcase :Capitalize :preserve default is :TitleCase :separator string default is `""` :add-prefix string :add-suffix string

MAKE-MATCHING-NAME returns a matching name (a string) for the input name (a string). A matching name is constructed by breaking the input into `words` and then applying appropriate transforms. The arguments are used as follows: *original* is the input name. It is a string. :break-on-cap is a keyword controlling whether changes in capitalization is used to indicate word boundaries. If :YES, then all capitalization changes delineate words. If :CLEVER, then unbroken runs of capitalized letters are treated as acronyms and remain grouped. If :NO or NULL, there is no breaking of words based on capitalization. :break-on-number is a flag controlling whether encountering a number indicates a word boundary. If :YES, then each run of numbers is treated as a word separate from surrounding words. If :CLEVER, then an attempt is made to recognize ordinal numbers (ie, 101st) and treat them as separate words. If :NO or NULL, there is no breaking of words when numbers are encountered. :break-on-separators A string of characters which constitute word delimiters in the input word. This is used to determine how to break the name into individual words. Defaults are space, `-` and `_`. :remove-prefix Specifies a prefix or suffix that is stripped from the input :remove-suffix name before any other processing. This allows the removal of any naming convention dictated prefixes or suffixes. :add-prefix Specifies a prefix or suffix that is added to the output name :add-suffix after all other processing. This allows the addition of any naming convention dictated prefixes or suffixes. :case The case of the resulting name. This is applied to the name before adding prefixes or suffixes. The two title case options differ only in how the first word of the name is treated. :TitleCase capitalizes the first letter of the first word and also the first letter of all other words. :TitleCaseX does not capitalizes the first letter of the first word but capitalizes the first letter of all subsequent words. :preserve results in no change in case. :separator This is a string specifying the word separator to use in the returned name. An empty string (the default) means that the resulting words are concatenated without any separation. This normally only makes sense when using one of the title case values for the case keyword.

`make-matching-name-full` ((*originalname* STRING) (*breakoncap* KEYWORD) (*breakonnumber* KEYWORD) (*breakonseparators* STRING) (*removeprefix* STRING) (*removesuffix* STRING) (*addprefix* STRING) (*addsuffix* STRING) (*outputcase* KEYWORD) (*outputseparator* STRING)) *:* STRING [Function]

Non-keyword version of `make-matching-name`, which will probably be easier to use when called from non-Lisp languages.

`make-system` ((*systemName* STRING) **&rest** *(language***&options** OBJECT*)*) *:* BOOLEAN [Command]

Translate all out-of-date files of system *systemName* into `language` (the first optional argument of *language&options*) and then compile and load them (the latter is only possible for Lisp right now). The following keyword/value `options` are recognized:

`:language`: can be used as an alternative to the optional language argument. If not specified, the language of the running implementation is assumed.

`:two-pass?`: if true, all files will be scanned twice, once to load the signatures of objects defined in them, and once to actually translate the definitions. Otherwise, the translator will make one pass in the case that the system is already loaded (and is being remade), and two passes otherwise.

`:development-settings?` (default false): if true translation will favor safe, readable and debuggable code over efficiency (according to the value of `:development-settings` on the system definition). If false, efficiency will be favored instead (according to the value of `:production-settings` on the system definition).

`:production-settings?` (default true): inverse to `:development-settings?`.

`:force-translation?` (default false): if true, files will be translated whether or not their translations are up-to-date.

`:force-recompilation?` (default false): if true, translated files will be recompiled whether or not their compilations are up-to-date (only supported in Lisp right now).

`:load-system?` (default true): if true, compiled files will be loaded into the current STELLA image (only supported in Lisp and Java right now).

`:startup?` (default true): if true, the system startup function will be called once all files have been loaded.

`:recursive?` (default false): if true, perform `make-system` with the provided options on *systemName* as well as all its required systems and so on. Required systems will be processed first. Note that even without this option, any required systems that have not yet been loaded or started up will also be processed, since that is assumed when loading *systemName* and supporting modules from a definition file.

`:root-source-directory`, `:root-native-directory`, `:root-binary-directory`: if specified these directories will be used to override the respective paths provided in system definitions or computed as defaults from a system's home location.

`make-system-definition-file-name` ((*name* STRING)) *:* FILE-NAME [Function]

Make a canonical system definition file name for a system named *name*.

`make-temporary-file` ((*prefix* STRING) (*suffix* STRING)) *:* STRING [Function]

Variant of `make-temporary-file-name` that actually allocates the file to prevent other processes from using that name. This is still not fully thread safe - for that we would need a file lock - but maybe a bit better in avoiding collisions.

`max` (*x* (*y* INTEGER)) *:* INTEGER [Method on INTEGER]

Return the maximum of *x* and *y*. If either is NULL, return the other.

`max` (*x* (*y* LONG-INTEGER)) *:* LONG-INTEGER [Method on LONG-INTEGER]

Return the maximum of *x* and *y*. If either is NULL, return the other.

`max` (*x* (*y* FLOAT)) *:* FLOAT [Method on FLOAT]
: Return the maximum of *x* and *y*. If either is NULL, return the other.

`max` (*x* (*y* NUMBER-WRAPPER)) *:* NUMBER-WRAPPER [Method on NUMBER-WRAPPER]
: Return the maximum of *x* and *y*. If *y* is NULL, return *x*.

`member?` (*self* (*value* OBJECT)) *:* BOOLEAN [Method on CONS-ITERATOR]
: Iterate over values of *self* and return TRUE if one of them is `eql?` to 'value.

`member?` (*self* (*object* OBJECT)) *:* BOOLEAN [Method on COLLECTION]
: Return true iff *object* is a member of the collection *self*.

`member?` (*self* (*value* OBJECT)) *:* BOOLEAN [Method on SEQUENCE]
: Return TRUE if *value* is a member of the sequence *self*.

`memoize` ((*inputArgs* CONS) **&body** *(body* CONS*)) :* OBJECT [Macro]
: Compute the value of an expression and memoize it relative to the values of *inputArgs*. *inputArgs* should characterize the complete set of values upon which the computation of the result depended. Calls to `memoize` should be of the form

(memoize (<arg>+) {:<option> <value>}* <expression>)

and have the status of an expression. The following options are supported:

:timestamps A single or list of keywords specifying the names of timestamps which when bumped should invalidate all entries currently memoized in this table. :name Names the memoization table so it can be shared by other memoization sites. By default, a gensymed name is used. CAUTION: IT IS ASSUMED THAT ALL ENTRIES IN A MEMOZATION TABLE DEPEND ON THE SAME NUMBER OF ARGUMENTS!! :max-values The maximum number of values to be memoized. Only the `:max-values` most recently used values will be kept in the memoization table, older values will be discarded and recomputed if needed. Without a `:max-values` specification, the memoization table will grow indefinitely.

PERFORMANCE NOTES: For most efficient lookup, input arguments that vary the most should be listed first. Also, arguments of type STANDARD-OBJECT (and all its subtypes) can be memoized more efficiently than arguments of type OBJECT or wrapped literals (with the exception of BOOLEANs).

`merge-file-names` ((*baseFile* FILE-NAME) (*defaults* FILE-NAME)) *:* FILE-NAME [Function]
: Parse *baseFile*, supply any missing components from *defaults* if supplied and return the result.

`merge-null-fields` (*self* (*default* DECODED-DATE-TIME)) *:* [Method on DECODED-DATE-TIME]
: Replace any null valued fields in *self* with values from *default*. The day of the week will be set consistently, if possible.

`merge-superior-null-fields` (*self* (*default* DECODED-DATE-TIME)) *:* [Method on DECODED-DATE-TIME]
: Replace only null valued fields in *self* that represent larger time units than the smallest non-null in *self* with values from *default*. The day of the week will be set consistently,

if possible. Example: if *self* just has the month being non-null, then only the year will be filled in from *default*. If the day and minute were non-null, then hour, month and year will be filled.

This can be useful when one doesn't want to extend the precision of the answer.

`min` (*x* (*y* INTEGER)) *:* INTEGER [Method on INTEGER]
Return the minimum of *x* and *y*. If either is NULL, return the other.

`min` (*x* (*y* LONG-INTEGER)) *:* LONG-INTEGER [Method on LONG-INTEGER]
Return the minimum of *x* and *y*. If either is NULL, return the other.

`min` (*x* (*y* FLOAT)) *:* FLOAT [Method on FLOAT]
Return the minimum of *x* and *y*. If either is NULL, return the other.

`min` (*x* (*y* NUMBER-WRAPPER)) *:* NUMBER-WRAPPER [Method on NUMBER-WRAPPER]
Return the minimum of *x* and *y*. If *y* is NULL, return *x*.

`mod` (*x* (*modulus* INTEGER)) *:* INTEGER [Method on INTEGER]
True modulus. Return the result of *x* mod `modulo`. Note: In C++ and Java, `mod` has more overhead than the similar function `rem`. The answers returned by `mod` and `rem` are only different when the signs of *x* and `modulo` are different.

`mod` (*x* (*modulus* LONG-INTEGER)) *:* LONG-INTEGER [Method on LONG-INTEGER]
True modulus. Return the result of *x* mod `modulo`. Note: In C++ and Java, `mod` has more overhead than the similar function `rem`. The answers returned by `mod` and `rem` are only different when the signs of *x* and `modulo` are different.

`multiple-parents?` (*class*) *:* BOOLEAN [Method on CLASS]
Return `true` if *class* has more than one direct superclass.

`multiple-parents?` (*module*) *:* BOOLEAN [Method on MODULE]
Return TRUE if *module* has more than one parent.

`multiple-parents?` (*world*) *:* BOOLEAN [Method on WORLD]
Return FALSE always, since worlds never have more than one parent.

`name-to-string` ((*name* OBJECT)) *:* STRING [Function]
Return the string represented by *name*. Return `null` if *name* is undefined or does not represent a string.

`native-delete-file` ((*fileName* FILE-NAME)) *:* [Function]
Delete the file *fileName*. This does not handle any necessary pathname translations or error conditions.

`native-file-length` ((*fileName* FILE-NAME)) *:* LONG-INTEGER [Function]
Return the length of file *fileName* in bytes or NULL if that cannot be determined. This does not handle any necessary pathname translations or error conditions.

`native-file-write-date` ((*fileName* FILE-NAME)) *:* CALENDAR-DATE [Function]
Return the time at which file *fileName* was last modified or NULL if that cannot be determined. This does not handle any necessary pathname translations or error conditions.

native-probe-directory? ((*fileName* FILE-NAME)) : BOOLEAN [Function]
Return true if file *fileName* exists and is a directory. Note that this does not necessarily mean that the directory can also be read. This does not handle any necessary pathname translations or error conditions.

native-probe-file? ((*fileName* FILE-NAME)) : BOOLEAN [Function]
Return true if file *fileName* exists. Note that this does not necessarily mean that the file can also be read. This does not handle any necessary pathname translations or error conditions.

native-read-line ((*inputStream* INPUT-STREAM)) : STRING [Function]
Read one line from *inputStream* using the native language readline algorithm and return the result. On EOF return `null`

native-rename-file ((*fromFile* FILE-NAME) (*toFile* FILE-NAME)) : [Function]
Rename the file *fromFile* to *toFile*. This does not handle any necessary pathname translations or error conditions.

next? (*self*) : BOOLEAN [Method on MEMOIZABLE-ITERATOR]
Generate the next value of the memoized iterator *self* (or one of its clones) by either using one of the values generated so far or by generating and saving the next value of the `base-iterator`.

no-duplicates? (*self*) : BOOLEAN [Method on COLLECTION]
Return `true` if the collection *self* forbids duplicate values.

non-empty? (*x*) : BOOLEAN [Method on STRING-WRAPPER]
Return true if *x* is not the wrapped empty string `""`

non-empty? (*self*) : BOOLEAN [Method on VECTOR-SEQUENCE]
Return `true` if *self* has length `>` 0.

non-empty? (*self*) : BOOLEAN [Method on BUFFERED-STRING]
Return `true` if *self* has length `>` 0.

non-matching-position ((*source* STRING) (*start* INTEGER) (*match* STRING)) : INTEGER [Function]
Returns the index into *source*, starting from *start*, of the first character that is not included in *match*.

non-matching-position-helper ((*source* STRING) (*start* INTEGER) (*end* INTEGER) (*match* STRING)) : INTEGER [Function]
Helper for `non-matching-position` that requires *end* to not be `null`.

nth (*self* (*position* INTEGER)) : CHARACTER [Method on BUFFERED-STRING]
Return the character in *self* at *position*.

nth (*self* (*position* INTEGER)) : (LIKE (ANY-VALUE SELF)) [Method on NATIVE-VECTOR]
Return the element in *self* at *position*.

nth-setter (*self* (*ch* CHARACTER) (*position* INTEGER)) *:* CHARACTER [Method on BUFFERED-STRING]
Set the character in *self* at *position* to *ch*.

null? (*x*) *:* BOOLEAN [Method on LONG-INTEGER]
Return true if *x* is undefined (handled specially by all translators).

null? (*x*) *:* BOOLEAN [Method on ARRAY]
Return true if *x* is undefined (handled specially by all translators).

number-less-than? ((*x* NUMBER-WRAPPER) (*y* NUMBER-WRAPPER)) *:* BOOLEAN [Function]
Generic number comparison that works with integers, longs and floats.

object-equal? (*x* (*y* OBJECT)) *:* BOOLEAN [Method on VECTOR-SEQUENCE]
Return TRUE iff the sequences *x* and *y* are structurally equivalent. Uses `equal?` to test equality of elements.

odd? (*x*) *:* BOOLEAN [Method on INTEGER]
Return true if *x* is an odd number.

odd? (*x*) *:* BOOLEAN [Method on LONG-INTEGER]
Return true if *x* is an odd number.

only-if ((*test* OBJECT) (*expression* OBJECT)) *:* OBJECT [Macro]
If *test* is TRUE, return the result of evaluating *expression*.

open-network-stream ((*host* STRING) (*port* INTEGER)) *:* INPUT-STREAM OUTPUT-STREAM [Function]
Open a TCP/IP network stream to *host* at *port* and return the result as an input/output stream pair.

ordered? (*self*) *:* BOOLEAN [Method on COLLECTION]
Return `true` if the collection *self* is ordered.

outline-depth-exceeded? ((*current-depth* INTEGER) (*depth-limit* INTEGER)) *:* BOOLEAN [Function]
Helper function that returns `true` if *current-depth* exceeds *depth-limit*. This functions uses the convention that a `null` or negative value of *depth-limit* means the depth is unlimited. In those cases it always returns false.

parameters (*self*) *:* (LIST OF SYMBOL) [Method on CLASS]
Returns the list of parameters names of *self*.

parse-date-time-in-time-zone ((*date-time-string* STRING) (*time-zone* FLOAT) (*start* INTEGER) (*end* INTEGER) (*error-on-mismatch?* BOOLEAN)) *:* DECODED-DATE-TIME [Function]
Tries very hard to make sense out of the argument *date-time-string* and returns a time structure if successful. If not, it returns `null`. If *error-on-mismatch?* is true, parse-date-time will signal an error instead of returning `null`. Default values are 00:00:00 in the given timezone on the current date. If the given *time-zone* value is `null`, then the local time zone for the given date and time will be used as determined by the operating system.

`parse-date-time-relative-to-base` ((*date-time-string* STRING) (*base-date-time* DECODED-DATE-TIME) (*start* INTEGER) (*end* INTEGER) (*error-on-mismatch?* BOOLEAN) (*merge-null-fields?* BOOLEAN)) *:* DECODED-DATE-TIME [Function]

Tries very hard to make sense out of the argument *date-time-string* and returns a time structure if successful. If not, it returns `null`. If *error-on-mismatch?* is true, parse-date-time will signal an error instead of returning `null`. Default values are passed in via *base-date-time*. If the timezone field that is passed in is NULL, then the local time zone for the parsed date/time will be used. If *merge-null-fields?* is `true`, then default values from `base-time-date` will be merged into missing components. If `false`, then they won't be merged in for null components but can still be used as a basis for interpreatation of relative time strings like "now" or "yesterday"

`parse-float` ((*value* STRING)) *:* FLOAT [Function]

Convert a float *value* string into a float. Leading and trailing whitespace is allowed. Raise an error if we have illegal number syntax which makes it preferable over the naive C++ stringToFloat conversion function which just returns 0.

`parse-integer` ((*value* STRING)) *:* INTEGER [Function]

Convert an integer *value* string into an integer. Leading and trailing whitespace is allowed. Raise an error if we have illegal number syntax which makes it preferable over the naive C++ stringToInteger conversion function which just returns 0.

`parse-long-integer` ((*value* STRING)) *:* LONG-INTEGER [Function]

Convert a long integer *value* string into a long integer. Leading and trailing whitespace is allowed. Raise an error if we have illegal number syntax which makes it preferable over the naive C++ stringToInteger conversion function which just returns 0.

`parse-options` ((*options* OBJECT) (*legalOptions***&Types** CONS) (*coercionError?* BOOLEAN) (*allowOtherKeys?* BOOLEAN)) *:* PROPERTY-LIST [Function]

Parse *options*, check their validity according to *legalOptions&Types* and return the result as a PROPERTY-LIST. *legalOptions&Types* has to either be NULL or a flat list of legal <keyword> <coercionType> pairs. A type specifcation of @IDENTITY means don't perform any coercion. If *coercionError?* is TRUE, raise an error if a coercion failed. If *allowOtherKeys?* is TRUE options other than those specified in *legalOptions&Types* are allowed but won't be coerced since we don't know their type. A special implicit :options keyword that does not need to be declared can be used to pass in an already parsed options list from a caller, which will then be analyzed and used instead.

`parse-stella-name` ((*name* STRING) (*enableCaseConversion?* BOOLEAN)) *:* STRING STRING KEYWORD [Function]

Parse the printed representation *name* of a STELLA symbol, surrogate or keyword and return its symbol name, module name and type (which is either :SYMBOL, :SURROGATE or :KEYWORD). *name* can be qualified and must use the exact same syntax and escape characters that would be used if it were to be read by `read-s-expression-from-string` (or `unstringify`). If *enableCaseConversion?* is TRUE, the returned symbol name will be upcased if the current module is case-insensitive; otherwise, it will be returned as is. Raises a read exception if *name* does not represent a symbol. This function is available primarily for efficiency, since it is about 10-15 times faster than `unstringify`.

`pick-hash-table-size-prime` ((*minSize* INTEGER)) *:* INTEGER [Function]
Return a hash table prime of at least *minSize*.

`plist-to-kvlist` ((*self* PROPERTY-LIST)) *:* (KEY-VALUE-LIST OF (LIKE (ANY-KEY SELF)) (LIKE (ANY-VALUE SELF))) [Function]
Convert *self* into a key-value list with identical and identically ordered keys and values.

`plus?` (*x*) *:* BOOLEAN [Method on INTEGER]
Return true if *x* is greater than 0.

`plus?` (*x*) *:* BOOLEAN [Method on LONG-INTEGER]
Return true if *x* is greater than 0.

`pop-load-path` () *:* STRING [Command]
Remove the first element from the STELLA load path and return the removed element.

`primary-type` (*self*) *:* TYPE [Method on OBJECT]
Returns the primary type of *self*. Gets defined automatically for every non-abstract subclass of OBJECT.

`primitive?` (*self*) *:* BOOLEAN [Method on RELATION]
Return `true` if *self* is not a defined relation.

`print` (**&body** *(body* CONS*)*) *:* OBJECT [Macro]
Print arguments to the standard output stream.

`print-configuration-properties` ((*configuration* CONFIGURATION-TABLE) (*stream* OUTPUT-STREAM)) *:* [Function]
Print all properties defined in *configuration* to *stream*.

`print-exception-context` ((*e* NATIVE-EXCEPTION) (*stream* OUTPUT-STREAM)) *:* [Function]
Prints system dependent information about the context of the specified exception *e*. For example, in Java it prints a stack trace. In Lisp, it is vendor dependent.

`print-outline` ((*thing* OBJECT) (*stream* OUTPUT-STREAM) (*depth* INTEGER) (*named?* BOOLEAN)) *:* [Command]
Print an outline of *thing* and its subparts on *stream*. If *depth* is non-negative, only *depth* levels will be printed. If *named?* is `TRUE`, then only named entities will be printed.

This function is intended to be used on things like modules, contexts, concepts, etc. that have hierarchical structure. If *thing* doesn't have a hierarchical structure, it will just be printed.

`print-properties` () *:* [Command]
Print all current configuration property information to standard output.

`print-recycle-lists` () *:* [Function]
Print the current state of all recycle lists.

`print-spaces` (**&body** *(body* CONS*)*) *:* OBJECT [Macro]
(print-spaces [stream] N) prints N spaces onto stream. If no stream form is provided, then STANDARD-OUTPUT will be used.

`print-stella-features` () *:* [Command]
Print the list of enabled and disabled STELLA features.

`print-unbound-surrogates` (**&rest** *(args* OBJECT*)*) *:* [N-Command]
Print all unbound surrogates visible from the module named by the first argument (a symbol or string). Look at all modules if no module name or `null` was supplied. If the second argument is `true`, only consider surrogates interned in the specified module.

`print-undefined-methods` ((*module* MODULE) (*local?* BOOLEAN)) *:* [Function]
Print all declared but not yet defined functions and methods in *module*. If *local?* is true, do not consider any parent modules of *module*. If *module* is NULL, look at all modules in the system. This is handy to pinpoint forward declarations that haven't been followed up by actual definitions.

`print-undefined-super-classes` ((*class* NAME)) *:* [N-Command]
Print all undefined or bad (indirect) super classes of *class*.

`private-class-methods` ((*class* CLASS)) *:* (ITERATOR OF METHOD-SLOT) [Function]
Iterate over all private methods attached to *class*.

`private-class-storage-slots` ((*class* CLASS)) *:* (ITERATOR OF STORAGE-SLOT) [Function]
Iterate over all private storage-slots attached to *class*.

`private?` (*self*) *:* BOOLEAN [Method on RELATION]
Return `true` if *self* is not public.

`probe-directory?` ((*fileName* FILE-NAME)) *:* BOOLEAN [Function]
Return true if file *fileName* exists and is a directory. Note that this does not necessarily mean that the directory can also be read.

`process-command-line-arguments` ((*count* INTEGER) (*arguments* (ARRAY () OF STRING)) (*unhandledOptionAction* KEYWORD)) *:* [Function]
Interpret any command line *arguments* for which handlers have been registered. Leave any remaining unprocessed arguments in `*unprocessed-command-line-arguments*`. If any unprocessed arguments use option syntax (that is they start with a `-`), proceed according to *unhandledOptionAction* which can be one of :ignore, :warn or :error. This ensures that at any point in the option processing, `*unprocessed-command-line-arguments*` accurately reflects the arguments which have been either skipped or not handled yet.

`process-doctype` ((*doctype-declaration* CONS)) *:* XML-DOCTYPE [Function]
Takes an S-Expression representing a doctype and processes into a DOCTYPE object.

`ptrans` ((*statement* OBJECT)) : [N-Command]
Translate *statement* to Common-Lisp and print the result.

`public-class-methods` ((*class* CLASS)) : (ITERATOR OF METHOD-SLOT) [Function]
Iterate over all private methods attached to *class*.

`public-class-storage-slots` ((*class* CLASS)) : (ITERATOR OF STORAGE-SLOT) [Function]
Iterate over all public storage-slots attached to *class*.

`public-slots` (*self*) : (ITERATOR OF SLOT) [Method on CLASS]
Return an iterator over public slots of *self*.

`public-slots` (*self*) : (ITERATOR OF SLOT) [Method on OBJECT]
Return an iterator over public slots of *self*.

`public?` (*self*) : BOOLEAN [Method on SLOT]
True if *self* or one it its ancestors is marked public.

`push-load-path` ((*path* STRING)) : (CONS OF STRING-WRAPPER) [Command]
Add the directories listed in the `|`-separated *path* to the front of the STELLA load path. Return the resulting load path.

`pushf` ((*place* CONS) (*value* OBJECT)) : OBJECT [Macro]
Push *value* onto the cons list *place*.

`put-slot-value` ((*self* STANDARD-OBJECT) (*slot* STORAGE-SLOT) (*value* OBJECT)) : OBJECT [Function]
Set or insert *value* for the slot *slot* on *self*. CAUTION: Assumes that collection-valued slots are non-null.

`qualified-stella-name?` ((*name* STRING)) : BOOLEAN [Function]
Return TRUE if *name* is a symbol or surrogate qualified with a module pathname or a module pathname ending with a `/`. Assumes that *name* is the printed representation of a STELLA symbol (potentially containing escape characters).

`read-global-variable-value` ((*variable* GLOBAL-VARIABLE)) : OBJECT [Function]
Interpreted global *variable* reader which reads and returns its native value which will be wrapped if necessary. This will access the value at the top of the special stack.

`read-line2` ((*stream* INPUT-STREAM)) : STRING KEYWORD [Function]
Read one line from *stream* and return the result and a keyword that indicates the terminator for that line ending: `:CR` `:LF` `:CRLF` or `:EOF`. This is not platform-dependent and differs from `read-line` by returning a second value. It may hang when used on interactive streams such as terminal or network streams with only CR line endings. It should only be used on file or string input streams.

`read-native-variable-value` ((*var* NATIVE-OBJECT-POINTER) (*type* TYPE)) : OBJECT [Function]
Interpreted variable reader which reads a native code variable represented by *var* of type *type* and returns its value which will be wrapped if necessary. If *var* is a special

variable, this will access the current dynamic value at the top of the special stack. This relies upon *type* being completely accurate and bad things will happen if it is not.

`read-slot-value` ((*self* STANDARD-OBJECT) (*slot* STORAGE-SLOT)) : OBJECT [Function]
Read and return a (possibly wrapped) value for the slot *slot* on *self*.

`read-xml-expressions` ((*filename* STRING)) : CONS [Function]
Read all of the top-level XML expressions from *filename* and return them in a list.

`reader` (*self*) : SYMBOL [Method on STORAGE-SLOT]
Name of a method called to read the value of the slot *self*.

`register-cmd-line-option` (**&rest** (*options* OBJECT)) : [Function]
Register a command line option. :key identifies the name of the option which will usually start with a dash such as `-e` or `--eval`. :key2 and :key3 can be used to supply additional options (e.g., long option formats). To supply even more keys, a list can be supplied with the :keys option. If a :property is supplied, this option simply sets or adds to the values of the specified system configuration property. If a :handler name is specified, its function will be used to interpret the values of the option. :documentation can be used to supply a documentation string which will be printed by the `help-option-handler` (usually bound to `-?`). :value-type describes what type an option value should be coerced to before assigning it to the specified configuration :property. :n-arguments describes how many arguments this option takes. This will be 0 for simple switches and can be 1 or greater than one for option handlers that need one or more arguments. :default-value defines the value to use for zero-argument :property options. If :multi-valued? is true, values of multiple occurrences of the option will be added to the specified configuration :property. :error-action can be one of :ignore, :warn or :error to specify what to do in case an error is encountered during option processing.

`register-property-demon` ((*property* STRING) (*demonName* SYMBOL)) : [Function]
Register the function named *demonName* as the demon for *property*. Demons will be run as after demons on every configuration table update. Set the property `stella.test.propertyDemon` to see a test demon in action.

`regular-integer-valued?` ((*x* LONG-INTEGER)) : BOOLEAN [Function]
Return `true` if *x* can be represented by a regular integer.

`relative-unlogicalize-pathname` ((*pathName* STRING)) : STRING [Function]
If *pathName* is a logical pathname translate it, however, remove the :root-directory prefix of the logical host. Otherwise, return *pathName* as is.

`rem` (*x* (*y* INTEGER)) : INTEGER [Method on INTEGER]
Return the remainder from dividing *x* by *y*. The sign of the result is always the same as the sign of *x*. This has slightly different behavior than the `mod` function, and has less overhead in C++ and Java, which don't have direct support for a true modulus function.

`rem` (*x* (*y* LONG-INTEGER)) *:* LONG-INTEGER [Method on LONG-INTEGER]
Return the remainder from dividing *x* by *y*. The sign of the result is always the same as the sign of *x*. This has slightly different behavior than the `mod` function, and has less overhead in C++ and Java, which don't have direct support for a true modulus function.

`remove-configuration-property` ((*property* STRING) (*value* OBJECT) (*configuration* CONFIGURATION-TABLE)) *:* OBJECT [Function]
Remove *value* from *property* in *configuration* and return it. Use the global system configuration table if *configuration* is NULL.

`remove-duplicates` (*self*) *:* (LIKE SELF) [Method on COLLECTION]
Return *self* with duplicates removed. Preserves the original order of the remaining members.

`remove-duplicates-equal` (*self*) *:* (LIKE SELF) [Method on CONS]
`remove-duplicates` (which see) using an `equal?` test. IMPORTANT: since this uses hashing to speed things up, an `equal-hash-code` method needs to be defined for this to work.

`remove-duplicates-equal` (*self*) *:* (LIKE SELF) [Method on LIST]
`remove-duplicates` (which see) using an `equal?` test.

`replace-heap-root` (*self* (*value* (LIKE (ANY-VALUE SELF)))) *:* [Method on HEAP]
Replace the current root of *self* with *value* and restore the heap property. Signal an error if *self* is empty. Maintains *self* as a Min-heap if *self*s `predicate` has `<` semantics; otherwise as a Max-heap.

`required-slots` (*self*) *:* (LIST OF SYMBOL) [Method on CLASS]
Returns a list of names of required slots for *self*.

`required?` (*self*) *:* BOOLEAN [Method on STORAGE-SLOT]
True if a value must be assigned to this slot at creation time.

`reset` (*self*) *:* [Method on CROSS-PRODUCT-ITERATOR]
Reset *self* to its initially allocated state. Note, that this is somewhat expensive, costing almost as much as allocating the iterator.

`reset-stella-features` () *:* [Command]
Reset STELLA features to their default settings.

`resize-buffer` (*self* (*size* INTEGER)) *:* MUTABLE-STRING [Method on BUFFERED-STRING]
Change the size of *self* to *size*. If *size* is smaller than the current size of *self*, it's buffer will be truncated.

`reverse` (*self*) *:* (LIKE SELF) [Method on VECTOR-SEQUENCE]
Reverse the order of elements in the active portion of *self*.

`reverse-interval` ((*lowerbound* INTEGER) (*upperbound* INTEGER)) *:* REVERSE-INTEGER-INTERVAL-ITERATOR [Function]
Create a reverse interval object.

`root-binary-directory` () : FILE-NAME [Function]
: Accessor to determine the currently active binary directory root. If it is defined as an option in the currently active system action, use that. If we have an active system, use its value, otherwise use the STELLA default value.

`root-native-directory` () : FILE-NAME [Function]
: Accessor to determine the currently active native directory root. If it is defined as an option in the currently active system action, use that. If we have an active system, use its value, otherwise use the STELLA default value.

`root-source-directory` () : FILE-NAME [Function]
: Accessor to determine the currently active sources directory root. If it is defined as an option in the currently active system action, use that. If we have an active system, use its value, otherwise use the STELLA default value.

`run-hooks` ((*hooklist* HOOK-LIST) (*argument* OBJECT)) : [Function]
: Run all hook functions in *hooklist*, applying each one to *argument*.

`running-as-lisp?` () : BOOLEAN [Function]
: Return true if the executable code is a Common Lisp application.

`running-in-language` () : KEYWORD [Function]
: Returns the keyword for the language the current implementation is running in.

`running-system-information` () : STRING [Function]
: Returns an information string about the current running system environment.

`safe-compare-strings` ((*x* STRING) (*y* STRING) (*collation* KEYWORD)) : INTEGER [Function]
: Variant of `compare-strings` that also tolerates NULL values. NULL sorts after everything else in any collation.

`safe-equal-hash-code` ((*self* OBJECT)) : INTEGER [Function]
: Return a hash code for *self*. Just like `equal-hash-code` - which see, but also works for NULL. `equal-hash-code` methods that expect to handle NULL components should use this function for recursive calls.

`safe-hash-code` ((*self* OBJECT)) : INTEGER [Function]
: Return a hash code for *self*. Just like `hash-code` - which see, but also works for NULL.

`safe-lookup-slot` ((*class* CLASS) (*slot-name* SYMBOL)) : SLOT [Function]
: Alias for `lookup-slot`. Kept for backwards compatibility.

`safety` ((*level* INTEGER-WRAPPER) (*test* OBJECT) **&body** (*body* CONS)) : OBJECT [Macro]
: Signal warning message, placing non-string arguments in quotes.

`save-configuration-file` ((*table* CONFIGURATION-TABLE) (*file* FILE-NAME) (*title* STRING)) : [Function]
: Save *table* as a configuration file. Uses a Java-style property file syntax.

`save-configuration-value` ((*stream* OUTPUT-STREAM) (*value* OBJECT)) : [Function]

Save *value* to *stream* as a properly formatted configuration value.

`search-cons-tree-with-filter?` ((*tree* OBJECT) (*value* OBJECT) (*filter* CONS)) : BOOLEAN [Function]

Return `true` iff the value *value* is embedded within the cons tree *tree*. Uses an `eql?` test. Does not descend into any cons whose first element matches an element of *filter*.

`search-for-object` ((*self* OBJECT) (*typeref* OBJECT)) : OBJECT [Function]

If *self* is a string or a symbol, search for an object named *self* of type `type`. Otherwise, if *self* is an object, return it.

`seed-random-number-generator` () : [Function]

Seeds the random number generator based on the current time.

`seed-random-number-generator2` () : [Function]

Seeds the random number generator based on the current time and /dev/random if it is available.

`sequence` ((*collectiontype* TYPE) **&rest** (*values* OBJECT)) : (SEQUENCE OF OBJECT) [Function]

Return a sequence containing *values*, in order.

`set-call-log-break-point` ((*count* INTEGER)) : [Command]

Set a call log break point to *count*. Execution will be interrupted right at the entry of the *count*th logged function call.

`set-configuration-property` ((*property* STRING) (*value* OBJECT) (*configuration* CONFIGURATION-TABLE)) : OBJECT [Function]

Set *property* in *configuration* to *value* and return it. Use the global system configuration table if *configuration* is NULL.

`set-current-date` (*values-structure*) : [Method on DECODED-DATE-TIME]

Sets the current date into *values-structure*

`set-current-date-time` (*values-structure*) : [Method on DECODED-DATE-TIME]

Sets the current date and time into *values-structure*

`set-current-time` (*values-structure*) : [Method on DECODED-DATE-TIME]

Sets the current time into *values-structure*

`set-load-path` ((*path* STRING)) : (CONS OF STRING-WRAPPER) [Command]

Set the STELLA load path to the `|`-separated directories listed in *path*. Return the resulting load path.

`set-log-level` ((*module* STRING) (*level* OBJECT)) : [Command]

Set the log-level for *module* to *level*. This is a convenience function for this common operation.

`set-logging-parameters` ((*module* STRING) **&rest** *(params***&values** OBJECT*))* : [Command]

Set logging parameters for *module*. The supported parameters are: :LOG-LEVELS - a cons list of legal levels in ascending log level order; for example, (:NONE :LOW :MEDIUM :HIGH) or (0 1 2 3). :LEVEL - the current log level for *module* :STREAM - the stream or file to log to (defaults to STANDARD-OUTPUT) :PREFIX - the prefix to use to identify the module (defaults to *module*) :MAX-WIDTH - logging output lines will be kept to approximately this width (defaults to 10000, minimum width of about 30 is used to print line header information).

`set-optimization-levels` ((*safety* INTEGER) (*debug* INTEGER) (*speed* INTEGER) (*space* INTEGER)) *:* [Function]

Set optimization levels for the qualities *safety*, *debug*, *speed*, and *space*.

`set-property` ((*property* NAME) (*value* OBJECT)) *:* [Command]

Set *property* (a string or symbol) in the configuration table to *value*. Note that *property* is evaluated and will need to be quoted if supplied as a symbol. Symbols will also be upcased if this command is run in a non-case-sensitive module.

`set-stella-feature` (**&rest** *(features* KEYWORD*))* : [Command]

Enable all listed STELLA *features*.

`set-translator-output-language` ((*new-language* KEYWORD)) *:* KEYWORD [Command]

Set output language to *new-language*. Return previous language.

`setq?` ((*variable* SYMBOL) (*expression* CONS)) *:* OBJECT [Macro]

Assign *variable* the result of evaluating *expression*, and return TRUE if *expression* is not NULL else return FALSE.

`shadowed-symbol?` ((*symbol* GENERALIZED-SYMBOL)) *:* BOOLEAN [Function]

Return `true` if *symbol* is shadowed in its home module.

`shift-right` (*arg* (*count* INTEGER)) *:* INTEGER [Method on INTEGER]

Shift *arg* to the right by *count* positions and 0-extend from the left if *arg* is positive or 1-extend if it is negative. This is an arithmetic shift that preserve the sign of *arg* and is equivalent to dividing *arg* by 2** *count*.

`shift-right` (*arg* (*count* INTEGER)) *:* LONG-INTEGER [Method on LONG-INTEGER]

Shift *arg* to the right by *count* positions and 0-extend from the left if *arg* is positive or 1-extend if it is negative. This is an arithmetic shift that preserve the sign of *arg* and is equivalent to dividing *arg* by 2** *count*.

`signal` ((*type* SYMBOL) **&body** *(body* CONS*))* : OBJECT [Macro]

Signal error message, placing non-string arguments in quotes.

`signal-read-error` (**&body** *(body* CONS*))* : OBJECT [Macro]

Specialized version of `signal` that throws a READ-EXCEPTION.

`sort` (*self* (*predicate* FUNCTION-CODE)) *:* (VECTOR OF (LIKE (ANY-VALUE SELF))) [Method on VECTOR]

Perform a destructive sort of *self* according to *predicate*, and return the result. If *predicate* has a `<` semantics, the result will be in ascending order. If *predicate* is `null`, a suitable `<` predicate is chosen depending on the first element of *self*, and it is assumed that all elements of *self* have the same type (supported element types are GENERALIZED-SYMBOL, STRING, INTEGER, and FLOAT).

`sort` (*self* (*predicate* FUNCTION-CODE)) *:* (HEAP OF (LIKE (ANY-VALUE SELF))) [Method on HEAP]

Sort the heap *self* according to *predicate* (in ascending order if *predicate* has `<` semantics). If *predicate* is NULL simply use *self*s internal predicate (the normal case). If it is different from *self*s internal predicate, heapify *self* first according to the new predicate, store the new predicate in *self* and then sort the heap. Note that a sorted array automatically satisfies the heap property. This is slightly different than a regular heap sort due to the way HEAP's are maintained; however, the complexity is the same.

`sort-objects` (*self* (*slot* STORAGE-SLOT) (*predicate* FUNCTION-CODE)) *:* (CONS OF (LIKE (ANY-VALUE SELF))) [Method on CONS]

Just like `sort` but assumes each element of *self* has a *slot* whose value will be used for comparison. Elements must be descendants of STANDARD OBJECT. Note that while this will work with literal-valued slots, it will cause value wrapping everytime *slot* is read.

`sort-objects` (*self* (*slot* STORAGE-SLOT) (*predicate* FUNCTION-CODE)) *:* (VECTOR OF (LIKE (ANY-VALUE SELF))) [Method on VECTOR]

Just like `sort` but assumes each element of *self* has a *slot* whose value will be used for comparison. Elements must be descendants of STANDARD OBJECT. Note that while this will work with literal-valued slots, it will cause value wrapping everytime *slot* is read.

`sort-tuples` (*self* (*n* INTEGER) (*predicate* FUNCTION-CODE)) *:* (VECTOR OF (LIKE (ANY-VALUE SELF))) [Method on VECTOR]

Just like `sort` but assumes each element of *self* is a tuple (a cons) whose *n*-th element (0-based) will be used for comparison.

`split-string` ((*input* STRING) (*separator* CHARACTER)) *:* (CONS OF STRING-WRAPPER) [Function]

Split *input* into separate strings based on the *separator* character.

`start-function-call-logging` ((*fileName* STRING)) *:* [Command]

Start function call logging to *fileName*.

`starts-with?` ((*string* STRING) (*prefix* STRING) (*start* INTEGER)) *:* BOOLEAN [Function]

Return TRUE if *string* starts with *prefix* starting from *start* (which defaults to 0 if it is supplied as NULL).

stella-collection? ((*self* OBJECT)) *:* BOOLEAN [Function]
Return `true` if *self* is a native collection.

stella-information () *:* STRING [Command]
Returns information about the current Stella implementation. Useful when reporting problems.

stella-integer-to-string-in-base ((*integer* LONG-INTEGER) (*base* INTEGER)) *:* STRING [Function]
STELLA version of `integer-to-string-in-base` which is faster than the C++ version we have but slower than the native Java version.

stella-object? ((*self* OBJECT)) *:* BOOLEAN [Function]
Return true if *self* is a member of the STELLA class `OBJECT`.

stella-version-string () *:* STRING [Function]
Return a string identifying the current version of STELLA.

stellafy ((*thing* LISP-CODE) (*targetType* TYPE)) *:* OBJECT [Function]
Partial inverse to `lispify`. Convert the Lisp object *thing* into a Stella analogue of type *targetType*. Note: See also `stellify`. it is similar, but guesses *targetType* on its own, and makes somewhat different translations.

stellify ((*self* OBJECT)) *:* OBJECT [Function]
Convert a Lisp object into a STELLA object.

stop-function-call-logging () *:* [Command]
Stop function call logging and close the current log file.

stream-position (*self*) *:* LONG-INTEGER [Method on OUTPUT-FILE-STREAM]
Return the current position of the file input cursor in *self*.

stream-position (*self*) *:* LONG-INTEGER [Method on INPUT-FILE-STREAM]
Return the current position of the file input cursor in *self*.

stream-position-setter (*self* (*newpos* LONG-INTEGER)) *:* LONG-INTEGER [Method on OUTPUT-FILE-STREAM]
Set the current position of the file input cursor in *self* to *newpos*.

stream-position-setter (*self* (*newpos* LONG-INTEGER)) *:* LONG-INTEGER [Method on INPUT-FILE-STREAM]
Set the current position of the file input cursor in *self* to *newpos*. If *self* has any tokenizer state associated with it, this will also reset to the start state of the tokenizer table; otherwise, behavior would be unpredictable unless the character class of the new position is exactly the same as the one following the most recent token.

stream-to-string (*from*) *:* STRING [Method on INPUT-STREAM]
Read all of the input from `stream` and return it as a string.

string-compare-case-normalized ((*x* STRING) (*y* STRING)) : INTEGER [Function]

Compare *x* and *y* and return -1, 0, or 1, depending on whether *x* is less than, equal, or greater than *y* relative to the :ascii-case-normalized collation. In this collation `a < A < b` which gives strings that only differ in case a definite order while otherwise behaving identically to :ascii-case-insensitive. This is similar to using a Java Collator for Locale.US with strength set to TERTIARY (which see).

string-search-ignore-case ((*string* STRING) (*substring* STRING) (*start* INTEGER)) : INTEGER [Function]

Return start position of the left-most occurrence of *substring* in *string*, beginning from *start*. Return NULL if it is not a substring. The comparison ignores differences in letter case.

string-to-calendar-date-with-default ((*input-date* STRING) (*default-date* DECODED-DATE-TIME)) : CALENDAR-DATE [Function]

Returns a calendar date object representing the date and time parsed from the *input-date* string. Default values for missing fields and the interpretation of relative references come from *default-date*. If the *default-date* is `null`, the current date will be used. If a null set of defaults is desired, use `*NULL-DECODED-DATE-TIME*`. If no valid parse is found, `null` is returned.

string-to-decoded-date-time ((*input* STRING)) : DECODED-DATE-TIME [Function]

Returns a decoded date-time object representing the date and time parsed from the *input* string. If no valid parse is found, `null` is returned.

string-to-int ((*string* STRING)) : INTEGER [Function]

Convert a *string* representation of an integer into an integer. This is a convenience function that ensures a regular integer return value. If *string* represents a long integer, the behavior is undefined. Use `parse-integer` if the syntax of *string* needs to be checked for errors.

string-to-surrogate ((*self* STRING)) : SURROGATE [Function]

Return a surrogate with the name *self* visible in the current module. Very tricky: The logic is designed to avoid returning an inherited surrogate that has no value. In that case, a new local surrogate is created that shadows the inherited surrogate.

string-to-time-duration ((*duration* STRING)) : TIME-DURATION [Function]

Parses and returns an time-duration object corresponding to *duration*. The syntax for time duration strings is "{plus|minus} N days[; M ms]" where N and M are integer values for days and milliseconds. If no valid parse is found, `null` is returned.

string-trim ((*string* STRING)) : STRING [Function]

Remove any leading and trailing white space from *string* and return a copy of the trimmed substring (which might be empty if we had all white space). If no white space was removed, *string* is returned unmodified and uncopied.

subclass-of? ((*subClass* CLASS) (*superClass* CLASS)) : BOOLEAN [Function]

Return `true` if *subClass* is a subclass of *superClass*.

`subsequence` (*self* (*start* INTEGER) (*end* INTEGER)) : STRING [Method on BUFFERED-STRING]

Return a substring of `string` beginning at position *start* and ending up to but not including position *end*, counting from zero. An *end* value of NULL stands for the rest of the string.

`subsequence` (*string* (*start* INTEGER) (*end* INTEGER)) : STRING [Method on MUTABLE-STRING]

Return a substring of *string* beginning at position *start* and ending up to but not including position *end*, counting from zero. An *end* value of NULL stands for the rest of the string.

`substitute-characters` (*self* (*new-chars* STRING) (*old-chars* STRING)) : STRING [Method on STRING]

Substitute all occurences of of a member of *old-chars* with the corresponding member of *new-chars* in the string *self*. Returns a new string.

`substitute-characters` (*self* (*new-chars* STRING) (*old-chars* STRING)) : MUTABLE-STRING [Method on MUTABLE-STRING]

Substitute all occurences of of a member of *old-chars* with the corresponding member of *new-chars* in the string *self*. IMPORTANT: The return value should be used instead of relying on destructive substitution, since the substitution will not be destructive in all translated languages.

`subtype-of?` ((*sub-type* TYPE) (*super-type* TYPE)) : BOOLEAN [Function]

Return `true` iff the class named *sub-type* is a subclass of the class named *super-type*.

`super-classes` (*self*) : (ITERATOR OF CLASS) [Method on CLASS]

Returns an iterator that generates all proper super classes of *self*.

`surrogate-name?` ((*name* STRING)) : BOOLEAN [Function]

Return TRUE if name is prefixed by `SURROGATE-PREFIX-CHARACTER`.

`surrogatify` (*self*) : SURROGATE [Method on SURROGATE]

Converts *self* into a surrogate.

`surrogatify` (*self*) : SURROGATE [Method on SYMBOL]

Converts *self* into a surrogate (same semantics as `symbol-to-surrogate` which see).

`surrogatify` (*self*) : SURROGATE [Method on STRING]

Converts *self* into a surrogate.

`sweep` (*self*) : [Method on OBJECT]

Default method. Sweep up all *self*-type objects.

`symbol-to-surrogate` ((*self* SYMBOL)) : SURROGATE [Function]

Return a surrogate with the same name as *self*. Very tricky: The logic is designed to avoid returning an inherited surrogate that has no value. In that case, a new local surrogate is created that shadows the inherited surrogate. Unlike `string-to-surrogate`, the search starts first from the home context of *self*, and if that fails, then it restarts in *module*.

`symbol-to-type` ((*self* SYMBOL)) *:* SURROGATE [Function]

Convert *self* into a surrogate with the same name and module.

`system-default-value` (*self*) *:* OBJECT [Method on STORAGE-SLOT]

Return a default value expression, or if *self* has dynamic storage, an initial value expression.

`system-default-value` (*self*) *:* OBJECT [Method on SLOT]

Return a default value expression, or if *self* has dynamic storage, an initial value expression.

`system-loaded-or-started-up?` ((*name* STRING)) *:* BOOLEAN [Function]

Return `true` if system *name* has either been loaded or initialized with its startup function.

`system-loaded?` ((*name* STRING)) *:* BOOLEAN [Function]

Return `true` if system *name* has been loaded.

`terminate-program` () *:* [Command]

Terminate and exit the program with normal exit code.

`test-property-demon` ((*action* KEYWORD) (*property* STRING) (*value* OBJECT) (*table* CONFIGURATION-TABLE)) *:* [Function]

A test demon for the property demon machinery which simply prints arguments.

`the-string` (*self*) *:* STRING [Method on BUFFERED-STRING]

Return a substring of `string` beginning at position `start` and ending up to but not including position `end`, counting from zero. An `end` value of NULL stands for the rest of the string.

`time-duration-to-string` (*date*) *:* STRING [Method on TIME-DURATION]

Returns a string representation of *date*

`time-zone-format60` ((*timezone* FLOAT) (*include-colon?* BOOLEAN)) *:* STRING [Function]

Format `zone` as an hh:mm or hhmm string depending on *include-colon?*

`toggle-output-language` () *:* KEYWORD [Function]

Switch between Common Lisp and C++ as output languages.

`tokenize-string` ((*string* STRING) (*punctuationchars* STRING) (*quotechars* STRING) (*escapechars* STRING)) *:* (CONS OF CONS) [Function]

Simple tokenizer that is somewhere between Java's StringTokenizer and StreamTokenizer in functionality. It doens't specially support number tokens nor comment strings/sequences even though this could be added at the expense of some extra complexity. Returns a list of (<token-string> <token-type>) pairs, where the token type is one of :TEXT, :PUNCTUATION or :QUOTE, i.e., all white space is ignored and escape characters are handled and removed. For example:

```
(tokenize-string "for(i='fo^'o'; i>0; i++)" "()=<>+-;" "'" "^")
=>
```

```
(("for" :TEXT) ("(" :PUNCTUATION) ("i" :TEXT)
 ("=" :PUNCTUATION) ("'" :QUOTE) ("fo'o" :TEXT)
 ("'" :QUOTE) (";" :PUNCTUATION) ("i" :TEXT)
 (">" :PUNCTUATION) ("0" :TEXT) (";" :PUNCTUATION)
 ("i" :TEXT) ("++)" :PUNCTUATION))
```

NOTE: this aggregates multiple punctuation characters that immediately follow each other into a single token which is (generally) useful to pickup multi-character operators such as `++`, >=, etc. It's still easy to pick them apart in a post-processing step if necessary (e.g., for the `++)` case above), so we leave this for now as a feature.

`top-level-stella-system-directory?` ((*directory* FILE-NAME)) *:* BOOLEAN [Function]

Return TRUE if *directory* is a top-level STELLA installation directory containing one or more STELLA systems. We currently determine this solely by looking for the existence of at least one relevant top-level native directory. This is needed to find system root directories and other relevant STELLA installation directories.

`trace-if` ((*keyword* OBJECT) **&body** *(body* CONS*)*) *:* OBJECT [Macro]

If *keyword* is a trace keyword that has been enabled with `add-trace` print all the elements in *body* to standard output. Otherwise, do nothing. *keyword* can also be a list of keywords in which case printing is done if one or more of them are trace enabled.

`translate-system` ((*systemName* STRING) **&rest** *(language***&options** OBJECT*)*) *:* BOOLEAN [Command]

Translate all of the STELLA source files in system *systemName* into `language` (the optional first argument). The following keyword/value `options` are recognized:

`:language`: can be used as an alternative to the optional language argument. If not specified, the language of the running implementation is assumed.

`:two-pass?` (default false): if true, all files will be scanned twice, once to load the signatures of objects defined in them, and once to actually translate the definitions.

`:force-translation?` (default false): if true, files will be translated whether or not their translations are up-to-date.

`:development-settings?` (default false): if true translation will favor safe, readable and debuggable code over efficiency (according to the value of `:development-settings` on the system definition). If false, efficiency will be favored instead (according to the value of `:production-settings` on the system definition).

`:production-settings?` (default true): inverse to `:development-settings?`.

`:recursive?` (default false): if true, perform `translate-system` with the provided options on *systemName* as well as all its required systems and so on. Required systems will be processed first. Note that even without this option, any required systems that have not yet been loaded or started up will also be processed, since that is assumed when loading *systemName* and supporting modules from a definition file.

`:root-source-directory`, `:root-native-directory`, `:root-binary-directory`: if specified these directories will be used to override the respective paths provided in system definitions or computed as defaults from a system's home location.

`translate-to-common-lisp?` () *:* BOOLEAN [Function]
Return `true` if current output language is Common-Lisp.

`translate-to-cpp?` () *:* BOOLEAN [Function]
Return `true` if current output language is C++

`translate-to-java?` () *:* BOOLEAN [Function]
Return `true` if current output language is Java

`truncate` ((*n* NUMBER)) *:* INTEGER [Function]
Truncate *n* toward zero and return the result.

`try-to-evaluate` ((*tree* OBJECT)) *:* OBJECT [Function]
Variant of `evaluate` that only evaluates *tree* if it represents an evaluable expression. If it does not, *tree* is returned unmodified. This can be used to implement commands with mixed argument evaluation strategies.

`two-argument-least-common-superclass` ((*class1* CLASS) (*class2* CLASS)) *:* CLASS [Function]
Return the most specific class that is a superclass of both *class1* and *class2*. If there is more than one, arbitrarily pick one. If there is none, return `null`.

`two-argument-least-common-supertype` ((*type1* TYPE-SPEC) (*type2* TYPE-SPEC)) *:* TYPE-SPEC [Function]
Return the most specific type that is a supertype of both *type1* and *type2*. If there is more than one, arbitrarily pick one. If there is none, return @VOID. If one or both types are parametric, also try to generalize parameter types if necessary.

`type` (*self*) *:* TYPE [Method on SLOT]
The type of a storage slot is its base type.

`type-specifier` (*self*) *:* TYPE-SPEC [Method on SLOT]
If *self* has a complex type return its type specifier, otherwise, return `type` of *self*.

`type-to-symbol` ((*type* TYPE)) *:* SYMBOL [Function]
Convert *type* into a symbol with the same name and module.

`type-to-wrapped-type` (*self*) *:* TYPE [Method on SURROGATE]
Return the wrapped type for the type *self*, or *self* if it is not a bare literal type.

`unbound-surrogates` ((*module* MODULE) (*local?* BOOLEAN)) *:* (ITERATOR OF SURROGATE) [Function]
Iterate over all unbound surrogates visible from *module*. Look at all modules if *module* is `null`. If *local?*, only consider surrogates interned in *module*.

`unbump-log-indent` () *:* [Command]
Decrease the indentation level for subsequent log messages.

`unescape-html-string` ((*input* STRING)) *:* STRING [Function]
Replaces HTML escape sequences such as & with their associated characters.

unescape-url-string ((*input* STRING)) : STRING [Function]

Takes a string and replaces %-format URL escape sequences with their real character equivalent according to RFC 2396.

unprocessed-command-line-arguments () : (CONS OF STRING-WRAPPER) [Command]

Return all command line arguments which have not yet been processed by (or been ignored by) `process-command-line-arguments`. If arguments have not yet been processed, this will return NULL.

unregister-all-cmd-line-options () : [Function]

Unregister all currently registered command line options.

unregister-cmd-line-option ((*key* STRING)) : [Function]

Unregister the command line option identified by *key* under all its keys.

unregister-property-demon ((*property* STRING)) : [Function]

Unregister any demon for *property*.

unset-stella-feature (**&rest** (*features* KEYWORD)) : [Command]

Disable all listed STELLA *features*.

unsigned-shift-right-by-1 (*arg*) : INTEGER [Method on INTEGER]

Shift *arg* to the right by 1 position and 0-extend from the left. This does not preserve the sign of *arg* and shifts the sign-bit just like a regular bit. In Common-Lisp we can't do that directly and need to do some extra masking.

unsigned-shift-right-by-1 (*arg*) : LONG-INTEGER [Method on LONG-INTEGER]

Shift *arg* to the right by 1 position and 0-extend from the left. This does not preserve the sign of *arg* and shifts the sign-bit just like a regular bit. In Common-Lisp we can't do that directly and need to do some extra masking.

unstringify-stella-source ((*source* STRING) (*module* MODULE)) : OBJECT [Function]

Unstringify a STELLA *source* string relative to *module*, or `*MODULE*` if no module is specified. This function allocates transient objects as opposed to `unstringify-in-module` or the regular `unstringify`.

unwrap-boolean ((*wrapper* BOOLEAN-WRAPPER)) : BOOLEAN [Function]

Unwrap *wrapper* and return its values as a regular BOOLEAN. Map NULL onto FALSE.

unwrap-function-code ((*wrapper* FUNCTION-CODE-WRAPPER)) : FUNCTION-CODE [Function]

Unwrap *wrapper* and return the result. Return NULL if *wrapper* is NULL.

unwrap-long-integer ((*wrapper* LONG-INTEGER-WRAPPER)) : LONG-INTEGER [Function]

Unwrap *wrapper* and return the result. Return NULL if *wrapper* is NULL.

`unwrap-method-code` ((*wrapper* METHOD-CODE-WRAPPER)) : METHOD-CODE [Function]

Unwrap *wrapper* and return the result. Return NULL if *wrapper* is NULL.

`value-setter` (*self* (*value* (LIKE (ANY-VALUE SELF)))) : (LIKE (ANY-VALUE SELF)) [Method on ABSTRACT-DICTIONARY-ITERATOR]

Abstract method needed to allow application of this method on abstract iterator classes that do not implement it. By having this here all `next?` methods of dictionary iterators MUST use the `slot-value` paradigm to set the iterator value.

`warn` (**&body** *(body* CONS*)*) : OBJECT [Macro]

Signal warning message, placing non-string arguments in quotes.

`with-network-stream` ((*binding* CONS) **&body** *(body* CONS*)*) : OBJECT [Macro]

Sets up an unwind-protected form which opens a network socket stream to a host and port for input and output and closes it afterwards. Separate variables as provided in the call are bound to the input and output streams. Syntax is (WITH-NETWORK-STREAM (varIn varOut hostname port) body+)

`with-permanent-objects` (**&body** *(body* CONS*)*) : OBJECT [Macro]

Allocate `permanent` (as opposed to `transient`) objects within the scope of this declaration.

`with-system-definition` ((*systemnameexpression* OBJECT) **&body** *(body* CONS*)*) : OBJECT [Macro]

Set *currentSystemDefinition* to the system definition named `system`. Set *currentSystemDefinitionSubdirectory* to match. Execute *body* within that scope.

`with-transient-objects` (**&body** *(body* CONS*)*) : OBJECT [Macro]

Allocate `transient` (as opposed to `permanent`) objects within the scope of this declaration. CAUTION: The default assumption is the allocation of permanent objects. The scope of `with-transient-objects` should be as small as possible, and the user has to make sure that code that wasn't explicitly written to account for transient objects will continue to work correctly.

`wrap-boolean` ((*value* BOOLEAN)) : BOOLEAN-WRAPPER [Function]

Return a literal object whose value is the BOOLEAN *value*.

`wrap-function-code` ((*value* FUNCTION-CODE)) : FUNCTION-CODE-WRAPPER [Function]

Return a literal object whose value is the FUNCTION-CODE *value*.

`wrap-integer-value` ((*value* LONG-INTEGER)) : NUMBER-WRAPPER [Function]

Return a literal object whose value is *value*. Choose a regular integer wrapper unless *value* is too large and needs to be stored in a long wrapper.

`wrap-long-integer` ((*value* LONG-INTEGER)) : LONG-INTEGER-WRAPPER [Function]

Return a literal object whose value is the LONG-INTEGER *value*.

`wrap-method-code` ((*value* METHOD-CODE)) *:* METHOD-CODE-WRAPPER [Function]
Return a literal object whose value is the METHOD-CODE *value*.

`wrapped-type-to-type` ((*self* TYPE)) *:* TYPE [Function]
Return the unwrapped type for the wrapped type *self*, or *self* if it is not a wrapped type.

`wrapper-value-type` ((*self* WRAPPER)) *:* TYPE [Function]
Return the type of the value stored in the wrapper *self*.

`write-global-variable-value` ((*variable* GLOBAL-VARIABLE) (*value* OBJECT)) *:* [Function]
Interpreted global *variable* writer which sets its native value to *value* unwrappig it if necessary. This will change the current value at the top of the special stack.

`write-html-escaping-url-special-characters` ((*stream* NATIVE-OUTPUT-STREAM) (*input* STRING)) *:* [Function]
Writes a string and replaces unallowed URL characters according to RFC 2396 with %-format URL escape sequences.

`write-native-variable-value` ((*var* NATIVE-OBJECT-POINTER) (*type* TYPE) (*value* OBJECT)) *:* [Function]
Interpreted variable writer which sets a native code variable represented by *var* of type *type* to *value* which will be unwrapped if necessary. If *var* is a special variable, this will change the current dynamic value at the top of the special stack. This relies upon *type* being completely accurate and bad things will happen if it is not.

`write-slot-value` ((*self* STANDARD-OBJECT) (*slot* STORAGE-SLOT) (*value* OBJECT)) *:* OBJECT [Function]
Write a (possibly wrapped) *value* for the slot *slot* on *self*.

`writer` (*self*) *:* SYMBOL [Method on STORAGE-SLOT]
Name of a method called to write the value of the slot *self*.

`xml-base-attribute?` ((*item* OBJECT)) *:* BOOLEAN [Function]
Return `true` if *item* is an XML attribute object

`xml-declaration-form?` ((*form* OBJECT)) *:* BOOLEAN [Function]
Return `true` if *form* is a CONS headed by an XML DECLARATION tag

`xml-doctype-form?` ((*form* OBJECT)) *:* BOOLEAN [Function]
Return `true` if *form* is a CONS headed by a DOCTYPE tag

`xml-element-form?` ((*form* OBJECT)) *:* BOOLEAN [Function]
Return `true` if *form* is a CONS headed by an XML ELEMENT tag

`xml-global-attribute?` ((*item* OBJECT)) *:* BOOLEAN [Function]
Return `true` if *item* is an XML attribute object

`xml-local-attribute?` ((*item* OBJECT)) *:* BOOLEAN [Function]
Return `true` if *item* is an XML attribute object

`xml-processing-instruction-form?` ((*form* OBJECT)) : BOOLEAN [Function]
Return `true` if *form* is a CONS headed by an XML PROCESSING INSTRUCTION tag

`xml-processing-instruction?` ((*item* OBJECT)) : BOOLEAN [Function]
Return `true` if *item* is an XML processing instruction object

`xml-token-list-to-s-expression` ((*tokenList* TOKENIZER-TOKEN) (*doctype* XML-DOCTYPE) (*doctype-definition?* BOOLEAN)) : OBJECT [Function]
Convert the XML *tokenList* (using *doctype* for guidance) into a representative s-expression and return the result. The *doctype* argument is currently only used for expansion of entity references. It can be `null`. The flag *doctype-definition?* should be true only when processing the DTD definition of a DOCTYPE tag, since it enables substitution of parameter entity values.

Every XML tag is represented as a cons-list starting with the tag as its header, followed by a possibly empty list of keyword value pairs representing tag attributes, followed by a possibly empty list of content expressions which might themselves be XML expressions. For example, the expression

<a a1=v1 a2='v2'> foo <b a3=v3/> bar

becomes

(<a> (<a1> "v1" <a2> "v2") "foo" (<b> (<a3> "v3")) "bar")

when represented as an s-expression. The tag names are subtypes of XML-OBJECT such as XML-ELEMENT, XML-LOCAL-ATTRIBUTE, XML-GLOBAL-ATTRIBUTE, etc. ?, ! and [prefixed tags are encoded as their own subtypes of XML-OBJECT, namely XML-PROCESSING-INSTRUCTION, XML-DECLARATION, XML-SPECIAL, XML-COMMENT, etc. CDATA is an XML-SPECIAL tag with a name of CDATA.

The name is available using class accessors.

`yield-define-stella-class` ((*class* CLASS)) : CONS [Function]
Return a cons tree that (when evaluated) constructs a Stella class object.

`zero-pad-integer` ((*value* INTEGER) (*size* INTEGER)) : STRING [Function]
Returns a string representing *value* of at least length *size*, padded if necessary with 0 characters.

`zero?` (*x*) : BOOLEAN [Method on INTEGER]
Return true if *x* is 0.

`zero?` (*x*) : BOOLEAN [Method on LONG-INTEGER]
Return true if *x* is 0.

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