PLT DrScheme: Programming Environment Manual

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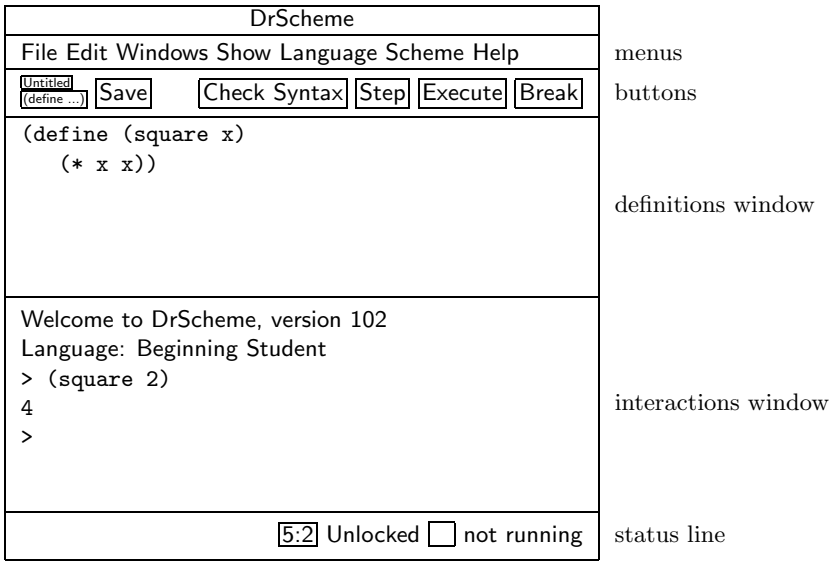
1. About DrScheme

DrScheme is a graphical environment for developing programs using the Scheme programming language. DrScheme runs under Windows 95/98/NT, MacOS, and Unix/X.

2. Using DrScheme

2.1 Interface Essentials

The DrScheme window has three parts: a row of buttons at the top, two editing panels in the middle, and a status line at the bottom.



The top editing panel, called the **definitions window**, is for defining Scheme programs. The above figure shows a program that defines the function `square`.

The bottom panel, called the **interactions window**, is for evaluating Scheme expressions interactively. The Language line in the interactions window indicates which primitives are available in the definitions and interactions windows. In the above figure, the language is Beginning Student, which is the default language.

Clicking the Execute button evaluates the program in the definitions window, making the program's definitions available in the interactions window. Given the definition of `square` as in the figure above, typing `(square 2)` in the interactions window produces the result `4`.

The status line at the bottom of DrScheme's window provides information about the current line and position of the editing caret, whether the current file can be modified, and whether DrScheme is currently evaluating any expression. The recycling icon flashes while DrScheme is "recycling" internal resources, such as memory.

2.1.1 Buttons

The left end of the row of buttons in DrScheme contains a miniature button with the current file's name. Clicking the button shows the file's full pathname.

Below the filename button is a (define ...) button for a popup menu of names defined in the definitions window. Selecting an item from the menu moves the blinking caret to the corresponding definition.

The Save button appears whenever the definitions window is modified. Clicking the button saves the contents of the definitions window to a file. The current name of the file appears to the left of the Save button, but a file-selection dialog appears if the file has never been saved before.

The Step button starts The Foot, which shows the evaluation of a program as a series of small steps. Each evaluation step replaces an expression in the program with an equivalent one using the evaluation rules of DrScheme. For example, a step might replace `(+ 1 2)` with `3`. These are the same rules used by DrScheme to evaluate a program. Clicking Step opens a new window that contains the program from the definitions window, plus three new buttons: Next, Previous, and Home. Clicking Next performs a single evaluation step, clicking Previous retraces a single step, and clicking Home returns to the initial program. The Foot works only for programs using the Beginning Student language level.

The Check Syntax button checks the syntax of the program in the definitions window and colorizes keywords and primitive function names. It also enables pop-up arrows that show the relationship between variable declarations and their uses when the mouse cursor is moved over a variable. Modifying the program turns off the arrows until Check Syntax is clicked again.

The Execute button evaluates the program in the definitions window and resets the interactions window.

The Break button interrupts an evaluation, or beeps if DrScheme is not evaluating anything. For example, after clicking Execute or entering an expression into the interactions window, click Break to cancel the evaluation. Click the Break button once to try to interrupt the evaluation gracefully; click the button twice to killing the evaluation immediately.

An Analyze button appears if you have installed the MrSpidey static debugger. Clicking the button starts the debugger on the program. See *PLT MrSpidey: Static Debugger Manual* for more information.

2.1.2 The Editor

DrScheme's editor provides special support for managing parentheses in a program. When the blinking caret is next to a parenthesis, DrScheme shades the region between the parenthesis and its matching parenthesis. This feature is especially helpful when for balancing parentheses to complete an expression. Furthermore, if you type a closing parenthesis ")" that should match an opening square bracket "[", the editor automatically converts the ")" into a "]". DrScheme beeps whenever a closing parenthesis does not match an opening parenthesis.

DrScheme also flashes quotation mark matches, just like parentheses. Beware, however, that DrScheme cannot distinguish between closing an opening quotation marks. Thus, when you type an opening quotation mark, DrScheme may flash a match to the previous closing quotation mark.

Although whitespace is not significant in Scheme, DrScheme encourages a particular format for Scheme code. When you type Enter or Return, the editor inserts a new line and automatically indents it. To make DrScheme re-indent an existing line, move the flashing caret to the line and hit the Tab key. (The caret can be anywhere in the line.) You can re-indent an entire region by selecting the region and typing Tab.

2.1.3 The Interactions Window

The interactions window lets you type an expression after the > prompt for immediate evaluation. You cannot modify any text before the last > prompt. To enter an expression, the flashing caret must appear after the last prompt, and also after the space following the prompt.

When you type a complete expression and hit Enter or Return, DrScheme evaluates the expression and prints the result. After printing the result, DrScheme creates a new prompt for another expression. Some expressions return a special "void" value; DrScheme never prints void, but instead produces a new prompt immediately.

If the expression following the current prompt is incomplete, then DrScheme will not try to evaluate it. In that case, hitting Enter or Return produces a new, auto-indented line.

To copy the previous expression to the current prompt, type ESC-p (i.e., type Escape and then type p). Type ESC-p multiple times to cycle back through old expressions. Type ESC-n to cycle forward through old expressions. Also, if you move the flashing caret after an old expression and hit Enter or Return, DrScheme copies the expression to the current prompt.

Clicking the Execute button evaluates the program in the definitions window and makes the program's definitions available in the interactions window. Clicking Execute also resets the interactions window, erasing all old interactions and removing old definitions from the interaction environment. Although Execute erases old > prompts, ESC-p and ESC-n can still retrieve old expressions.

2.1.4 Errors

Whenever DrScheme encounters an error while evaluating an expression, it prints an error message in the interactions window and highlights the expression that triggered the error. The highlighted expression might be in the definitions window, or it might be after an old prompt in the interactions window.

For certain kinds of errors, DrScheme turns a portion of the error message into a hyperlink. Click the hyperlink to get help regarding a function or keyword related to the error.

2.1.5 Languages

DrScheme supports four languages:

- **Beginning Student** is a small version of Scheme that is tailored for beginning computer science students.
- **Intermediate Student** extends Beginning Student with programmer-defined datatypes and lexically-scoped bindings.
- **Advanced Student** extends Intermediate Student with mutable state.
- **Full Scheme** refers to two main options: Graphical (MrEd) and Textual (MzScheme). Each comes with and without debugging support.

  MzScheme is a practical dialect of Scheme, essentially a superset of R^5RS Scheme (except for macros). In addition to the the base Scheme language, MzScheme provides exceptions, threads, objects, components, regular expressions, TCP support, filesystem utilities, and process control operations. See also *PLT MzScheme: Language Manual*.

  MrEd extends MzScheme with a graphical toolbox for creating GUI applications (with special support for editor applications, hence the Ed in MrEd). See also *PLT MrEd: Graphical Toolbox Manual*.

  Debugging support refers to source highlighting when an error occurs. The non-debugging options are faster and support exactly those languages that you can run outside of DrScheme (as stand-alone applications or scripts, for example).

Programs written in standard Scheme generally require the Full Scheme language. This language level offers options to access graphics libraries, and to provide source location information for syntax and run-time errors (with a small performance cost).

DrScheme always shows the current evaluation language in the top of the interactions window. To choose a different language, select the Language|Choose Language... menu item. After changing the language, click Execute to reset the language in the interactions window.

The table in Figure 2.1 summarizes the syntactic forms and procedures built into each language. `Text` indicates Full Scheme/Textual, and `Graph` indicates Full Scheme/Graphical. Most lines in the table specify the syntactic forms and procedures that each language provides. Lines in the next-to-last section specify deviations from the standard Scheme language:

- **Case-sensitive identifiers and symbols** — In a case-sensitive language, the variable names `x` and `X` are distinct, and the symbols `'x` and `'X` are also distinct. In a case-insensitive language, `x` and `X` are equivalent and `'x` and `'X` represent the same value.
- **Procedures must take at least 1 argument** — In the Beginning Student and Advanced Student languages, defined procedures must consume at least one argument. Since the languages have no side-effects, zero-argument functions are not useful, and rejecting such function definitions helps detect confusing syntactic mistakes.
- **Identifier required at function call position** — In the Beginning Student and Advanced Student languages, procedure calls must be of the form (*identifier* `...`). This restriction helps detect confusing misuses of parentheses, such as `(1)` or `((+ 3 4))`, which is a common mistake among beginners who are used to the optional parentheses of algebra.
- **Top-level required at function call position** — In the Beginning Student language, procedure calls must be of the form (*top-level-identifier* `...`). This restriction helps detect confusing misuses of parentheses, such as (*x*) where *x* is a function argument. DrScheme can detect such mistakes syntactically because Beginning Student does not support higher-order procedures.
- `lambda` **allowed only in definitions** — In the Beginning Student language, `lambda` (or `case-lambda`) may appear only in a definition and only as the value of the defined variable. This restriction is required by the evaluation rules used by the stepper tool.
- `quote` **works only on symbols** — In the Beginning Student and Advanced Student languages, `quote` and `'` can specify only symbols. This restriction avoids the need to explain to beginners why `1` and `'1` are equivalent in standard Scheme.
- **Unmatched** `cond/case` **is an error** — In the Beginning Student, Intermediate Student, and Advanced Student languages, falling through a `cond` or `case` expression without matching a clause signals a run-time error. This convention helps detect syntactic and logical errors in programs.
- **Conditional values must be** `#t` **or** `#f` — In the Beginning Student and Advanced Student languages, an expression whose value is treated as a Boolean must return `#t` or `#f`. This restriction, which applies to `if`, `cond`, `and`, `or`, `nand`, and `nor` expressions, helps detect errors where a Boolean function application is omitted.
- `=`, `<=`, `<`, `>`, `>=`, `+`, `*`, **and** `/` **take at least two arguments** — In the Beginning Student, Intermediate Student, and Advanced Student languages, mathematical operators that are infix in algebra notation require at least two arguments in DrScheme. This restriction helps detect missing arguments to an operator.
- `and`, `or`, `nand`, **and** `nor` **require at least 2 expressions** — In the Beginning Student, Intermediate Student, and Advanced Student languages, the Boolean combination forms require at least two sub-expressions. This restriction helps detect missing or ill-formed sub-expressions in a Boolean expression.
- `set!` **disallowed on arguments** — In the Advanced Student language, `set!` cannot be used to mutate variables bound by `lambda`. This restriction ensures that the substitution model of function application is consistent with Drscheme's evaluation.

	Begin	Inter	Adv	Text	Graph
`define`[1], `define-struct`	√	√	√	√	√
`lambda`[2]	√	√	√	√	√
`cond`, `if`, `and`, `or`	√	√	√	√	√
`nand`, `nor`	√	√	√	†[1]	†[1]
`quote`'d symbols	√	√	√	√	√
MrSpidey annotations	√	√	√	†[2]	†[2]
`quote`'d lists, `quasiquote`, `unquote`		√	√	√	√
`let`[1], `let*`[1], `letrec`[1]		√	√	√	√
`let-struct`		√	√	√	√
`local`		√	√	†[1]	†[1]
`set!`[1], `fluid-let`			√	√	√
`begin`, `begin0`			√	√	√
implicit `begin`				√	√
`when`, `unless`, `if` without else			√	√	√
Named `let`, `delay`, `do`, `case`			√	√	√
`recur`, `rec`, `evcase`			√	†[1]	†[1]
Turtles, `split`, `split*`, `tprompt`			√		†[3]
`require-library`	√	√	√	√	√
`define-macro`, `begin-elaboration-time`	√	√	√	√	√
`time`		√	√	√	√
`let/cc`, `let/ec`, `parameterize`, `with-handlers`			√	√	√
Other MzScheme syntax				√	√
Scheme and MzScheme procedures	√	√	√	√	√
MzLib core library procedures	√	√	√	†[4]	†[4]
MrEd GUI classes					√
Case-sensitive identifiers and symbols	√	√	√		
Procedures must take at least 1 argument	√	√			
Identifier required at function-call position	√	√			
Top-level required at function-call position	√				
`lambda` allowed only in definitions	√				
`quote` works only on symbols	√				
Unmatched `cond`/`case` is an error	√	√	√		
Conditional values must be `#t` or `#f`	√	√			
`=`, ..., `+`, `*`, and `/` take at least 2 arguments	√	√	√		
`and`, `or`, `nand`, `nor` require at least 2 exprs	√	√	√		
Improper lists disallowed	√	√	√		
`set!` disallowed on arguments			√		
structures omit supertype, mutators	√	√			
Constructor-style output	√	√	√		
`write` output				√	√
Abbreviate `cons` constructor with `list`		√	√		
Show sharing in values			√		
Decimal numbers read as exact	√	√	√		
Print inexact numbers with `#i`	√	√	√		

[1] including `-values` forms
[2] including `case-lambda`

†[1] Use `(require-library "macro.ss")`
†[2] Use `(require-library "spidey.ss")`
†[3] Use `(require-library "turtle.ss" "graphics")`
†[4] Use `(require-library "core.ss")`

Figure 2.1: Languge Definitions

- **Improper lists disallowed** — A **proper list** is either an empty list or a list created by `cons`ing onto a proper list. In the Beginning Student through Advanced Student languages, `cons` constructs only **proper lists**, signaling an error if the second argument is not a proper list. Since beginning students do not need improper lists, this restriction help detect logical errors in recursive functions.

- `define-struct` **omits supertype, mutators** — In Beginning Student and Intermediate Student, the `define-struct` syntactic form does not support the optional supertype expression. This restriction simplifies the syntax to help detect parenthesization mistakes. In addition, `define-struct` does not bind the names of structure mutators, since the languages do not support state in general.

Lines in the last section specify deviations from a traditional Scheme `read-eval-print` interface in the way that DrScheme reads and prints interaction results:

- **Constructor-style output** — See Section 2.1.7.1.

- `write` **output** — Prints interaction results with `write`.

- **Abbreviate** `cons` **constructor with** `list` — Adjusts constructor-style output to print list values with `list` instead of a nested sequence of `cons`es.

- **Show sharing in values** — Prints interaction results using the `shared` syntax, which exposes shared structure within a value. For example, the list created by `(let ([l (list 0)]) (list l l))` prints as

  ```
  (shared ((-1- (list 0))) (list -1- -1-))
  ```

  rather than

  ```
  (list (list 0) (list 0)).
  ```

- **Decimal numbers read as exact** — Unless a number containing a decimal point or exponent includes `#i`, it is parsed as an exact number.

- **Print inexact numbers with** `#i` — Prints inexact numbers with a leading `#i` to emphasize that they represent imprecise results (or even effectively incorrect results, depending on the intended calculation).

The Language|Choose Language... dialog contains a Show Details button that lets you configure certain details of the language specification. (Each option corresponds to one of the lines in the language table, but only a few of the lines in the figure have an option in the dialog.) Whenever the selected options do not match the default language specification, a Custom indicator appears next to the language-selection control at the top of the dialog.

2.1.6 Launchers

DrScheme's Create Launcher menu allows you to create your own separate programs that you can use without starting up all of DrScheme. To use them, first save your program to a file and set the language level and teachpacks. Click execute, just to be sure the program is working as you expect. Then, choose the Create Launcher menu item from the Scheme menu. Choose a place to save the launcher and you will be able to use that as you use any other program on your computer.

These launchers are not stand-alone. That is, you cannot copy the launcher to another computer and use it there. DrScheme must be installed on the computer with the launcher in order for it to work properly.

Input Expression	Constructor output	`write` output
`(cons 1 2)`	`(cons 1 2)`	`(1 . 2)`
`(list 1 2)`	`(list 1 2)`	`(1 2)`
`'(1 2)`	`(list 1 2)`	`(1 2)`
`(vector 1 2 3)`	`(vector 1 2 3)`	`#(1 2 3)`
`(box 1)`	`(box 1)`	`#&1`
`(lambda (x) x)`	`(lambda (a) ...)`	`#<procedure>`
`'sym`	`'sym`	`sym`
`(make-s 1 2)`	`(make-s 1 2)`	`#<structure:s>`
`'()`	`empty`	`()`
`#t`	`true`	`#t`
`#f`	`false`	`#f`
`add1`	`add1`	`#<primitive:add1>`
`(list (void))`	`(list (void))`	`(#<void>)`
`(make-weak-box 1)`	`(make-weak-box 1)`	`#<weak-box>`
`(delay 1)`	`(delay ...)`	`#<promise>`
`(regexp "a")`	`(regexp ...)`	`#<regexp>`

Figure 2.2: Comparison of constructor-style output to `write`

2.1.7 Printed Results

2.1.7.1 Constructor-style Output

DrScheme's **constructor-style output** treats `cons`, `vector`, and similar primitives as value constructors, rather than functions. It also treats `list` as shorthand for multiple `cons`'s ending with the empty list. Constructor-style printing is valuable for beginning computer science students, because output values look the same as input values.

Results printed in DrScheme's interactions window using constructor-style printing look different than results printed in traditional Scheme implementations, which use `write` to print results. The table in Figure 2.2 shows the differences between values printed in constructor style and values printed with `write`.

2.1.7.2 Quasiquote-style Output

Constructor-style output is inconvenient for printing S-expression results that represent programs. For example, the value `'(lambda (x) (lambda (y) (+ x y)))` prints as

```
(list 'lambda (list 'x) (list 'lambda (list 'y) (list '+ 'x 'y)))
```

with constructor-style printing.

DrScheme's **quasiquote-style output** combines the input–output invariance of constructor-style printing with the S-expression readability of `write`. It uses `quasiquote` to print lists, and uses `unquote` to escape back to constructor style printing for non-lists and non-symbols.

With quasiquote-style printing, the above example prints as:

```
`(lambda (x) (lambda (y) (+ x y)))
```

This example:

```
(list 'lambda (list 'x) (box '(lambda (y) (+ x y))))
```

in quasiquote-style printing prints as:

```
`(lambda (x) ,(box `(lambda (y) (+ x y))))
```

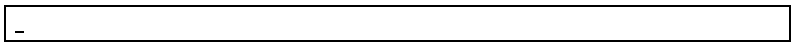
2.1.8 Input and Output

Many Scheme programs avoid explicit input and output operations, obtaining input via direct function calls in the interactions window, and producing output by returning values. Other Scheme programs explicitly print output for the user during evaluation using `write` or `display`, or explicitly request input from the user using `read` or `read-char`.

Explicit input and output appear in the interactions window, but within special boxes that separate explicit I/O from normal expressions and results. For example, evaluating

```
> (read)
```

in the interactions window produces a special box for entering input:



(The underscore indicates the location of the flashing caret.) Type an number into the box and hit Enter, and that number becomes the result of the `(read)` expression. If you type `5`, the overall interaction appears as follows:

```
> (read)
5
5
> _
```

The mouse cursor becomes a watch whenever DrScheme is evaluating expression, but you can still use the mouse to move the selection in an input box.

Output goes to the same box as input. If you execute the program

```
(define v (read))
(display v)
v
```

and provide the input S-expression `(1 2)`, the interactions window ultimately appears as follows:

```
(1 2)
(1 2)
(cons 1 (cons 2 empty)))
> _
```

In this example, `display` produces output immediately beneath the input you typed, but the final result was printed outside the box because it is the result of the program, rather than explicit output. (The above example assumes constructor-style printing. With traditional value printing, the final line outside the box would be `(1 2)`.)

Entering the same program line-by-line in the interactions window produces a different-looking result:

```
> (define v (read))
(1 2)
> (display v)
(1 2)
> v
(cons 1 (cons 2 empty))
> _
```

Although it is the same program as before, entering the program expression-by-expression demonstrates how each prompt creates its own I/O box.

2.1.9 Project Manager

The project manager helps to manage multi-file programs. Instead of the usual definitions window, a project manager has a window with a list of files that comprise the program. To create a new project, choose the New Project menu item from the File menu. This will create a new project window. This window has all of the usual menus, plus a Project menu. The project menu allows you to:

- **Execute the project**: This will load all of the files in the project and put their definitions in to the REPL.
- **Add files to the project**: This adds files to the project. If you add files that are in a collection, the files will be loaded with `require-library`. If you add files that are not in a collection, the files will be loaded with `load`.
- **Choose the language for the project**: This will bring up the language dialog for configuring the project's language. The language settings are saved with the project, instead of using the default language settings. This way, different projects can have different languages.
- **Set the project's collection paths**: Sometimes, you may need a different set of collection paths for the project's execution that you have for the running version of DrScheme (for example, the development team of DrScheme uses the project manager to develop new versions of DrScheme). This allows you to configure them.

2.2 Interface Reference

2.2.1 Menus

2.2.1.1 File

- New creates a new DrScheme window.
- New Project creates a new project window. See section 2.1.9.
- Open... opens a find-file dialog for choosing a file to load into a definitions window.
- Open Project... opens a saved project window. See section 2.1.9.
- Open URL... opens a dialog for choosing a Uniform Resource Locator (URL) to open in a new Help Desk window.
- Revert re-loads the file that is currently in the definitions window. All changes since the file was last saved will be lost.

- Save Definitions saves the program in the definitions window. If the program has never been saved before, a save-file dialog appears.
- Save Definitions As... opens a save-file dialog for choosing a destination file to save the program in the definitions window. Subsequent saves write to the newly-selected file.
- Save Other contains these sub-items
  - Save Definitions As Text... is like Save Definitions As..., but the file is saved in plain-text format (see Section 2.2.4.1). Subsequent saves also write in plain-text format.
  - Save Interactions saves the contents of the interactions window to a file. If the interaction constants have never been saved before, a save-file dialog appears.
  - Save Interactions As... opens a save-file dialog for choosing a destination file to save the contents of the interactions window. Subsequent saves write to the newly-selected file.
  - Save Interactions As Text... is like Save Interactions As..., but the file is saved in plain-text format (see Section 2.2.4.1). Subsequent saves are write in plain-text format.
- Print Definitions... opens a dialog for printing the current program in the definitions window.
- Print Interactions... opens a dialog for printing the contents of the interactions window.
- Bring project to the front brings the project window assocated with this window to the front. See section 2.1.9.
- Close closes this DrScheme window. If this window is the only open DrScheme window, DrScheme quits.
- Quit or Exit exits DrScheme.

2.2.1.2 Edit

All Edit menu items operate on either the definitions or interactions window, depending on the location of the selection or blinking caret. Each window maintains its own Undo and Redo history.

- Undo reverses an editing action. Each window maintains a history of actions, so multiple Undo operations can reverse multiple editing actions.
- Redo reverses an Undo action. Each window maintains a history of Undo actions, so multiple Redo operations can reverse multiple Undo actions.
- Cut copies the selected text to the clipboard and deletes it from the window.
- Copy copies the selected text to the clipboard.
- Paste pastes the current clipboard contents into the window.
- Delete or Clear deletes the selected text.
- Select All highlights the entire text of the buffer.
- Insert Text Box inserts a box into the window. The text box may contain arbitrary text, and it is treated as a value, like a number or symbol.
- Insert Pasteboard Box inserts a graphics box. The box is treated as a value.
- Insert Image... opens a find-file dialog for selecting an image file in GIF, BMP, XBM, or XPM format. The image is treated as a value.
- Wrap Text toggles between wrapped text and unwrapped text in the window.

- Find opens a search dialog or, depending on the preferences, an interactive searching window attached to the frame.
- Find Again finds the next occurrence of the text that was last searched for.
- Replace & Find Again replaces the selection with the replace string (if it matches the find string) and finds the next occurrence of the text that was last searched for.
- Preferences... opens the preferences dialog. See section 2.2.2.

2.2.1.3 Windows

This menu contains an entry for each window in DrScheme. Selecting a menu item brings the corresponding window to the front.

2.2.1.4 Show

Two of the following menu items appear at a time:

- Show Interactions shows interactions window.
- Hide Interactions hides interactions window.
- Show Definitions shows the definitions window.
- Hide Definitions hides the definitions window.

Note: whenever a program is executed, the interactions window is made visible if it is invisible.

2.2.1.5 Language

- Choose Language opens a dialog for selecting the current evaluation language. Click Execute to make the language active in the interactions window. See section 2.1.5 for more information about the languages.
- Add Teachpack... opens a find-file dialog for choosing a teachpack to extend the current language. Click Execute to make the teachpack available in the interactions windows. See Section 3 for information on creating teachpacks.
- Clear All Teachpacks clears all of the current teachpacks. Click Execute to clear the teachpack from the interactions window.

2.2.1.6 Scheme

- Execute resets the interactions window and executes the program in the definitions window.
- Break breaks the current evaluation.
- Kill terminates the current evaluation.
- Create Launcher creates a separate launcher for running your program. See section 2.1.6 for more info.
- Reindent indents the selected text according to the standard Scheme formatting conventions. (Pressing the Tab key has the same effect.)

- Reindent All indents all of the text in either the definitions or interactions window, depending on the location of the selection or blinking caret.
- Comment Out puts ";" characters at each of the the beginning of each selected line of text.
- Uncomment removes all ";" characters at the start of each selected line of text. Uncommenting only removes a ";" if it appears at the start of a line and it only removes the first ";" on each line.

2.2.1.7 Help

- Help Desk Opens the Help Desk. This is the clearing house for all documentation about DrScheme and its language.
- Welcome to DrScheme Opens the dialog that appears the first time DrScheme is run (or when a new version is installed).
- About DrScheme... Shows the credits for DrScheme.

2.2.2 Preferences

The preferences dialog comprises several panels:

- Font

  This panel controls the main font used by DrScheme.

- Indenting

  This panel controls which keywords DrScheme recognizes for indenting, and how each keyword is treated.

- General
  - Highlight between matching parens — If checked, the editor marks the region between matching parenthesis with a gray background (in color) or a stipple pattern (in monochrome) when the flashing caret is next to a parenthesis.
  - Correct parens — If checked, the editor automatically converts a typed ")" to "]" to match "[", or it converts a typed "]" to ")" to match "(".
  - Flash paren match — If checked, typing a closing parenthesis, square bracket, or quotation mark flashes the matching open parenthesis/bracket/quote.
  - Auto-save files — If checked, the editor generates autosave files (see Section 2.2.4.2) for files that have not been saved after five minutes.
  - Map delete to backspace — If checked, the editor treats the Delete key like the Backspace key.
  - Verify exit — If checked, DrScheme consults the user before exiting.
  - Ask before changing save format — If checked, DrScheme consults the user before saving a file in non-text format (see Section 2.2.4.1).
  - Wrap words in editor buffers — If checked, DrScheme editors auto-wrap text lines by default. Changing this preference affects new windows only.
  - Show status-line — If checked, DrScheme shows a status line at the bottom of each window.
  - Count line and column numbers from one — If checked, the status line's line:column counter counts from one. Otherwise, it counts from zero.
  - Display line numbers in buffer; not character offsets — If checked, the status line shows a line:column display for the current selection rather than the character offset into the text.
  - Enable keybindings in menus — If checked, some DrScheme menu items have keybindings. Otherwise, no menu items have key bindings. Changing this preference affects new windows only.
  - Automatically print to postscript file — If checked, printing will automatically save postscript files. If not, printing will use the standard printing mechanisms for your computer.

  - Use separate dialog for searching — If checked, then selecting the Find menu item opens a separate dialog for searching and replacing. Otherwise, selecting Find opens an interactive search-and-replace panel at the bottom of a DrScheme window.

- General II
  - Only warn once when executions and interactions are not synchronized — If checked, DrScheme warns the user on the first interaction after the definitions window, language, or teachpack is changed without a corresponding click on Execute. Otherwise, the warning appears on every interaction.
  - Enable backtrace bug icon in teaching languages — If checked, the teaching languages will display a clickable bug icon when there is stack information to display, along with the error message.

- Check Syntax

  This panel controls the font and color styles used by the Check Syntax colorizations.

2.2.3 Keyboard Shortcuts

Most key presses simply insert a character into the editor ("a", "3", "(", etc.). Other keys and key combinations act as keyboard shortcuts that move the blinking caret, delete a line, copy the selection, etc. Keyboard shortcuts are usually trigger by key combinations using the Control, Meta, or Command key.

C-*key* = This means press the Control key, hold it down and then press *key* and then release them both. For example: C-e (Control-E) moves the blinking caret to the end of the current line.

M-*key* = Same as C-*key*, except with the Meta key. Depending on your keyboard, Meta may be called "Left", "Right" or have a diamond symbol, but it's usually on the bottom row next to the space bar. M-*key* can also be performed as a two-character sequence: first, strike and release the Escape key, then strike *key*. Under Windows and MacOS, Meta is only available through the Escape key.

DEL = The Delete key.

SPACE = The Space bar.

Note: On most keyboards, "<" and ">" are shifted characters. So, to get M->, you actually have to type Meta-Shift->. That is, press and hold down both the Meta and Shift keys, and then strike ">".

Note: Many of the key bindings can also be done with menu items.

Under Windows, some of these keybindings are actually standard menu items. Those keybindings will behave according to the menus, unless the Enable keybindings in menus preference is unchecked.

If you are most familiar with Emacs-style key bindings, you should uncheck the Enable keybindings in menus preference. Many of the keybindings below are inspired by Emacs.

2.2.3.1 Moving Around

- C-f move forward one character
- C-b move backward one character
- M-f move forward one word
- M-b move backward one word
- C-v move forward one page
- M-v move backward one page

- M-< move to beginning of file
- M-> move to end of file
- C-a move to beginning of line (left)
- C-e move to end of line (right)
- C-n move to next line (down)
- C-p move to previous line (up)
- M-C-f move forward one S-expression
- M-C-b move backward one S-expression
- M-C-u move up out of an S-expression
- M-C-d move down into a nested S-expression
- M-C-SPACE select forward S-expression
- M-C-p match parentheses backward
- M-C-left move down into an embedded editor to the left
- M-C-right move down into an embedded editor to the right
- M-C-up move up from an embedded editor

2.2.3.2 Editing Operations

- C-d delete forward one character
- C-h delete backward one character
- M-d delete forward one word
- M-DEL delete backward one word
- C-k delete forward to end of line
- M-C-k delete forward one S-expression
- M-w copy selection to clipboard
- C-w delete selection to clipboard (cut)
- C-y paste from clipboard (yank)
- C-t transpose characters
- M-t transpose words
- C-_ undo
- C-+ redo
- C-x u undo

2.2.3.3 File Operations

- C-x C-s save file
- C-x C-w save file under new name

2.2.3.4 Searching

- C-s search for string forward
- C-r search for string backward

2.2.3.5 Interactions

The interactions window has all of the same keyboard shortcuts as the definitions window plus a few more:

- M-p bring the previously executed expression down to the prompt.
- M-n bring the expression after the current expression in the expression history down to the prompt.

2.2.4 DrScheme Files

2.2.4.1 Program Files

The standard extension for a Scheme program file is **.scm**. The extensions **.ss** and **.sch** are also acceptable.

DrScheme's editor can saves a program file in two different formats:

- **Plain-text format** — All text editors can read this format. DrScheme saves a program in plain-text format by default, unless the program contains images or text boxes. (Plain-text format does not preserve images or text boxes.)

  Plain-text format is platform-specific because different platforms have different newline conventions. However, most tools for moving files across platforms support a "text" transfer mode that adjusts newlines correctly.

- **Multimedia format** — This format is specific to DrScheme, and no other editor recognizes it. DrScheme saves a program in multimedia format by default when the program contains images, text boxes, or formatted text.

  Multimedia format is platform-independent. Use a "binary" transfer mode when moving multimedia-format files across platforms. (Using "text" mode may corrupt the file.)

2.2.4.2 Backup and Autosave Files

When you modify an existing file in DrScheme and save it, DrScheme copies the old version of the file to a special backup file if no backup file exists. The backup file is saved in the same directory as the original file, and the backup file's name is generated from the original file's name:

- Under X and MacOS, a tilde (∼) is added to the end of the file's name.
- Under Windows, the file's extension is replaced with **.bak**.

When a file in an active DrScheme editor is modified but not saved, DrScheme saves the file to a special autosave file after five minutes (in case of a power failure or catastrophic error). If the file is later saved, or if the user exists DrScheme without saving the file, the autosave file is removed. The autosave file is saved in the same directory as the original file, and the autosave file's name is generated from the original file's name:

- Under X and MacOS, a pound sign (#) is added to the start and end of the file's name, then a number is added after the ending pound sign, and then one more pound sign is appended to the name. The number is selected to make the autosave filename unique.
- Under Windows, the file's extension is replaced with a number to make the autosave filename unique.

2.2.4.3 Miscellaneous Files

On start-up, DrScheme reads configuration information from two files: a normal preferences file and a low-level setup file. The names of these files contain "MrEd" because they are part of a preferences system shared by DrScheme and other programs that execute in MrEd.

The name and location of the preferences file depends on the platform and user:

- Under X, preferences are stored in **.mred.prefs** in the user's home directory.
- Under Windows, if the HOMEDRIVE and HOMEPATH environment variables are defined, preferences are stored in **%HOMEDRIVE%\%HOMEPATH%\mred.pre**, otherwise preferences are stored in **mred.pre** in the directory containing the MrEd executable.

  Windows NT: When DrScheme is launched under Windows NT and HOMEDRIVE and HOMEPATH are not set, NT automatically sets the variables to indicate the root directory of the main disk. Therefore, when HOMEDRIVE and HOMEPATH are not set in NT, the preferences file **mred.pre** is saved in the root directory.
- Under MacOS, preferences are stored in **MrEd Preferences** in the system preferences folder.

If that file does not exist, and the file **prefs.ss** in the **defaults** collection (see Library Collections and MzLib, §15 in *PLT MzScheme: Language Manual* for more information about collections) does exist, **prefs.ss** is used for the preferences file. This allows site-specific configuration. To set it up, start up DrScheme and configure the preferences to your liking. Then, exit DrScheme and copy the preferences file into the **defaults** collection and call it **prefs.ss**. Thus, users who do not have any preferences set with default to the preference settings you chose.

The low-level setup file configures font settings that are needed early in the MrEd boot process. (The information in the setup file is duplicated in the normal preferences file, which is loaded later.) The name and location of the low-level setup file depends on the platform and user:

- Under X, preferences are stored in **.mred.resources** in the user's home directory.
- Under Windows, if the HOMEDRIVE and HOMEPATH environment variables are defined, preferences are stored in **%HOMEDRIVE%\%HOMEPATH%\mred.ini**, otherwise preferences are stored in **mred.ini** in the directory containing the MrEd executable.
- Under MacOS, preferences are stored in **mred.fnt** in the system preferences folder.

3. Extending DrScheme

DrScheme supports two forms of extension to the programming environment:

- A **teachpack** extends the set of procedures that are built into a language in DrScheme. For example, a teachpack might extend the Beginning Student language with a procedure for playing sounds.

  Teachpacks are particularly useful in a classroom setting, where an instructor can provide a teachpack that is designed for a specific exercise. To use the teachpack, each student must download the teachpack file and select it through the Language|Set Teachpack To... menu item.

- A **tool** extends the set of utilities within the DrScheme environment. For example, DrScheme's Check Syntax button starts a syntax-checking tool, and the Analyze button starts the MrSpidey tool.

3.1 Teachpacks

Teachpacks are designed to supplement student programs with code that is beyond the teaching languages (Beginning Student, Intermediate Student, Advanced Student). For example, to enable students to play hangman, we supply a teachpack that

- implements the random choosing of a word
- maintains the state variable of how many guesses have gone wrong
- manages the GUI.

All these tasks are beyond students in the third week and/or impose memorization of currently useless knowledge on students.

A single Scheme source file defines a teachpack (although the file may access other files via load and require-library). The last expression in the file must evaluate to a signed unit (see units, §7 in *PLT MzScheme: Language Manual*) that imports the `plt:userspace^` signature.

When a user selects the library into DrScheme, DrScheme adds the names in the unit's export signature to the user's namespace. The unit must import `plt:userspace^`. The `plt:userspace^` signature varies depending on the context that the teachpack is loaded in. In DrScheme, it contains:

- the names in the mred manual,
- the names in mzscheme's core MzLib library, §15 in *PLT MzScheme: Language Manual*,
- the `posn` struct, defined by `(define-struct posn (x y))`, and
- the turtles library.

The last two entries above are the same definitions that appear in the advanced language level. They are linked into the teachpack so the teachpack's code can share state with the user's program, if necessary. To use other libraries, the teachpack author must use a compound unit and link in other libraries.

A teachpack file is always loaded with Graphical Full Scheme without debugging, but in case-sensitive mode (so that a library can export case-sensitive names to the teaching languages).

As an example example, the following signed unit defines a library that adds the binding `four` to the user's namespace:

```
(unit/sig (four)
  (import plt:mz-userspace^)
  (define four 4))
```

For more interesting examples, see the **htdp** directory of the **teachpack** directory in the PLT installation.

3.2 Tools

A separate manual describes the mechanism for defining a tool. See *PLT Tools: DrScheme Extension Manual*.

4. Using DrScheme Jr

DrScheme Jr is a lightweight, text-only programming shell that provides the functionality of DrScheme's interactions window. Under Windows, DrScheme Jr runs within an "MS Dos" shell. Under MacOS, DrScheme Jr uses a text shell that is embedded into MzScheme. Under Unix, DrScheme Jr runs within a terminal window.

DrScheme Jr's `restart` function serves the same purpose as DrScheme's Execute button. Evaluating `(restart)` resets the current interaction and clears all definitions. Evaluating `(restart "file.scm")` resets the current interaction and evaluates the program in **file.scm**.

Set DrScheme Jr's language through a command-line flag when starting DrScheme Jr. For example, to set the language to Beginning Student:

- Under Windows, run `"DrScheme Jr" -l "Beginning Student" --save` in a command shell in the plt directory.
- Under MacOS, double-click on DrScheme Jr while holding down the Command key. A dialog appears with a text box; type `-l "Beginning Student" --save` into the text box and click OK.
- Under Unix, run `plt/bin/drscheme-jr -l "Beginning Student" --save` in a terminal.

The `--save` flag (note that there are two dashes) saves the language selection to a configuration file so that DrScheme Jr starts with the same language next time. (Run DrScheme Jr with the `--help` flag to determine the name of the configuration file.)

5. Frequently Asked Questions

5.1 Supported Operating Systems and Installation

Where can I get DrScheme and/or documentation?

DrScheme is available for download at

`http://www.cs.rice.edu/CS/PLT/packages/drscheme/`

Some documentation is provided with DrScheme, accessible through Help Desk. Other documentation is provided online in HTML format and is also available for download in Adobe PDF format at

`http://www.cs.rice.edu/CS/PLT/packages/doc/`

How much does DrScheme cost?

DrScheme is absolutely free for anyone to use. However, there are restrictions on the way that DrScheme can modified and redistributed. Please read the GNU Library General Public License in the distribution for details.

What operating systems are supported for DrScheme?

Windows 95/98/NT/2000, MacOS, and Unix with the X Window System.

How much memory is needed to run DrScheme?

To run DrScheme comfortably, your machine should have at least 20 MB of RAM and at least 32 MB of total memory.

I don't have that much memory. Are there any other PLT options?

DrScheme Jr is a text-only version of DrScheme. It requires less memory and provides the same language(s) as DrScheme (without the graphics library), but it implements only the interactions half of DrScheme's interface.

MrEd is PLT's raw graphical Scheme implementation (used to execute DrScheme). MrEd provides a minimal read-eval-print loop, but MrEd does not provide DrScheme's teaching languages, and error messages in MrEd do not provide a source code location.

MzScheme is PLT's Scheme implementation. The language is the same as MrEd without graphics. MzScheme provides little programming support, so its memory requirements are minimal (a few MB usually suffices).

The standard DrScheme distribution includes all of the above programs. Smaller distributions can be downloaded from

`http://www.cs.rice.edu/CS/PLT/packages/drschemejr/`

and

http://www.cs.rice.edu/CS/PLT/packages/mzscheme/

Does DrScheme run under DOS or Windows 3.1?

No.

Does DrScheme Jr (PLT's text-only Scheme) run under DOS or Windows 3.1?

No.

I don't have a network connection. Can I obtain DrScheme on floppy disks?

Send three SASFDs (self-addressed stamped floppy disks) to

```
DrScheme
Programming Languages Team
Rice University -- MS 132
Houston, TX 77005-1892
USA
```

Please indicate the desired operating system.

How do I install DrScheme?

Obtain a DrScheme distribution from the above address. For Windows, the distribution is an installer program; running this program installs DrScheme. For MacOS, the distributiton is a StuffIt archive; unpacking the archive mostly installs DrScheme, then run **Setup PLT** to complete the installation. For Unix/X, the distribution is a tarred and gzipped file; unpacking the archive and running **./install** installs DrScheme. In all cases, the final download page provides detailed, platform-specific installation instructions.

When I run plt.exe to install under Windows, it says "corrupt installation detected." What went wrong?

The real problem may be that the installer is unable to write the DrScheme files to your hard drive, or the installer may be unable to modify the **Start** menu. In this case, check to make sure there is disk space available, and contact your system maintainer to make sure that you have the appropriate access privileges.

How large is the distribution archive?

An average archive is around 3.0 MB.

How much disk space does DrScheme consume?

Around 17 MB in its normal configuration, not including the optional documentation. Some disk space (about 5MB) can be saved by deleting all files with the suffix **.zo**. DrScheme does not need the **.zo** files, but it starts up more slowly without them (so keep them unless you really need the disk space).

5.2 Using DrScheme

How do I find general help for DrScheme?

Select Help Desk in DrScheme's Help menu.

How do I run MrSpidey, DrScheme's program analyzer?

MrSpidey is distributed separately from the standard DrScheme distribution. Download MrSpidey from
`http://www.cs.rice.edu/CS/PLT/packages/mrspidey/`

What happened to the Analyze button?

Starting with version 51, PLT distributes DrScheme without the MrSpidey analysis tool. See the previous answer for information about obtaining MrSpidey.

How do I customize DrScheme?

The Edit menu contains a Preferences item that opens the preferences dialog.

How do I turn off parenthesis-flashing and the gray background behind expressions?

Use the Edit|Preferences menu item.

What are the key bindings in DrScheme?

Some basic key bindings are listed in the DrScheme manual, which is accessible via the Help button in DrScheme.

Can I change the key bindings in DrScheme?

Technically, yes, but that requires in-depth information about the way that DrScheme is implemented. (The necessary information is part of the MrEd toolbox manual.) DrScheme currently provides no simple way to adjust the keyboard mappings, other than to set the behavior of the Delete key (via the preferences dialog).

What do those yellow-and-black messages mean, and how do I get rid of them?

When text in the definitions window is modified, the current language is changed, or the current library is changed, DrScheme pessimistically assumes that some definition has been changed. In this case, expressions evaluated in the interaction window would use definitions that do not match those currently displayed in the definitions windows. A yellow-and-black message warns you about this potential inconsistency, and suggests that you resolve the inconsistency by clicking the Execute button. To suppress all but the first warning, see the General II panel in the Preferences dialog.

Why can't I type in the interaction window before the the current prompt?

To prevent accidental revisions of the interaction history, DrScheme disallows editing before the current prompt. While old expressions cannot be edited in place, you can copy old expressions to the current prompt by typing Esc-p. Alternatively, place the insertion caret at the end of any old expression in the interactions window and type Enter or Return to copy the expression down to the current prompt.

Is there a DrScheme compiler?

DrScheme is a compiler; each time the user loads a program or enters expression in the interactions window, DrScheme compiles and then executes the program or expression.

PLT's **mzc** transforms Scheme programs into C programs, and then uses a third-party C compiler to produce executable code. Under Windows, either Microsoft Visual C or gcc (a free compiler from Cygnus Solutions) works as the C compiler. Under MacOS, CodeWarrior works. Under Unix, most any compiler works.

For details, see the **mzc** documentation, available from:

`http://www.cs.rice.edu/CS/PLT/packages/doc/`

Can I produce stand-alone executables from Scheme code?

The **mzc** compiler can be used to produce stand-alone executables, but only with significant effort. See the **mzc** documentation for more information.

Can files saved in DrScheme be transferred between platforms?

DrScheme saves files in two formats: *text* and *multimedia*.

The text format is the usual platform-specific text format. Tools for moving files between platforms typically support a "text" transfer mode that adjusts newlines and carriage returns in the test as appropriate.

The multimedia format, used for saving files that contain pictures or formatted text, is platform-indepdendent. Although no other program is able to read DrScheme's special format, a multimedia-format file can be moved between different platforms (in "binary" mode) and DrScheme will read it correctly on the destination platform.

5.3 Memory and Performance

Does DrScheme really require at least 32 MB of memory?

Yes and no. Although DrScheme starts within 12 MB, using graphics, Help Desk, and other tools increases the amount of Memory DrScheme requires. Most users should find DrScheme usable within 24 MB. However, the total amount of memory needed for DrScheme depends on the kinds of programs the user executes, and we recommend 32 MB in general.

Why does analyzing a program with MrSpidey use even more memory?

MrSpidey is a large program, and it needs a large working memory to calculate the flow of values in a program.

Why is DrScheme so slow at parsing large programs (even compared to PLT's own MzScheme)?

Unlike MzScheme, DrScheme maintains source location information as it parses programs. This information is used to highlight program text for syntax and run-time errors. Partly, the source-correlating parser and compiler is slower than a typical Scheme parser and compiler (such as MzScheme's) because it works harder to maintain location information. Partly, it's slower because DrScheme is implemented as a MzScheme program; MzScheme's parser and compiler are considerably simpler, and can therefore be implemented in a low-level language that executes ten times faster than Scheme programs with our current technology. We are working on Scheme compiler technology that will narrow this gap and speed up DrScheme's parser.

Why do programs run more slowly in DrScheme than in other Scheme implementations (including PLT's own MzScheme)?

Programs run more slowly in DrScheme because DrScheme inserts extra checks into a program to provide information about the location of run-time errors. The MzScheme and MrEd languages (as opposed to MzScheme Debug and MrEd Debug) do not annotate programs in this way.

5.4 Troubleshooting

When I run DrScheme, it is very slow and the disk is constantly running. Why?

You do not have enough memory to run DrScheme. If DrScheme works well for a while, and then starts paging (using the disk a lot), then your memory configuration is borderline for DrScheme. If DrScheme usually works well and has only suddenly started this bad behavior, then perhaps you have written a program that consumes an infinite amount of memory.

My Macintosh has 32 MB of memory, but I am having trouble with DrScheme. What can I do?

Make sure you quit all other applications before starting DrScheme. Also, turn off any non-essential extensions. Select About this Macintosh in the Finder's Apple menu and verify that the system itself uses less than 10 MB.

I have successfully downloaded the installer program for Windows, but the installation fails. Why?

If the installer reports a message such as "corrupt installation detected", the real problem may be that the installer is unable to write the DrScheme files to your hard drive, or the installer may be unable to modify the Start menu. In this case, check to make sure there is disk space available, or contact your system maintainer to make sure that you have the appropriate access privileges.

When I run DrScheme under MacOS, it sometimes freezes the whole machine. Why? Are there any potential software conflicts?

You probably do not have enough memory to run DrScheme. There are no known conflicts between DrScheme and other software.

I think I found a bug. What should I do?

First, read this section to make sure your problem does not have a standard answer. If you need to, submit a bug report using the form available from the home page of Help Desk. Alternatively, you may submit a bug report using the Web at

`http://www.cs.rice.edu/CS/PLT/Bugs/`

If you do not have access to a web browser, as a last resort send mail to

`plt-bugs@cs.rice.edu`

How do I send PLT a question?

If you have a question that is not answered in the documentation or this list of "Frequently Asked Questions", send mail to

`scheme@cs.rice.edu`

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