Configuring and extending Ion3 with Lua

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Contents

Chapter 1

Introduction

This document is an ”advanced user” manual for Ion, the X11 window manager, and version 3 specifically. It is an attempt attempt at documenting what is in Ion's configuration files, how to configure Ion by simple modifications to these files and how to write more complex extensions in Lua, the lightweight configuration and scripting language used by Ion.

Readers unfamiliar with Lua is advised to first glance at the Lua manual at

http://www.lua.org/docs.html

and perhaps some tutorial pages at the lua-users wiki:

http://lua-users.org/wiki/LuaTutorial

Back in this document, first in chapter 2 some key concepts and relations are explained. These include the module system and Ion's object and class hierarchies. While it might not at first occur that knowing such things would be necessary to *configure* a program, this material is essential because of the object-oriented nature of most of Ion's scripting interface.

The new user, fed up with the default key bindings and eager to just quickly configure Ion to his liking may question the reasons for exposing the ”heavy” internal OO structure in the scripting and configuration interface. I'm not the one to blame him for that. Sure it would be faster to configure Ion to everyone's liking if a simpler binding configuration interface was provided. Such an interface would, however, also be far more limited and make writing extensions more complicated and the advantages from using a real scripting language would be partly lost. One more advantage from a rich scripting and configuration interface is that it allows implementing scripts to read alternate configuration file formats, ones that could be, for example, modified by external configuration tools.

In chapter 3 the very basic Ion configuration know-how is provided. All the different configuration files and their locations are explained and instructions are given to allow the reader to configure bindings and so-called ”winprops”. Chapter 4 explains the notion of drawing engines and graphical styles and how to write new looks for Ion and more advanced aspects of Ion's scripting interface are documented in chapter 5 (a work in progress).

Finally, most of the functions provided by Ion's scripting interface are listed and documented in the Function reference in chapter 6. At the end of the document is an alphabetical listing of all these functions.

Chapter 2

Preliminaries: Key concepts and relations

The purpose of this chapter to explain some of key concepts and relations you need to understand before reading the following chapters. These include modules explained in section 2.1 and the Ion class and object hierarchies, section 2.2.

2.1 Modules

Ion has been designed so that the 'ion' executable only implements some basic services on top of which very different kinds of window managers could be build by loading the appropriate 'modules'. On modern system these modules are simply dynamically loaded *.so* libraries. On more primitive systems, or if you want to squeeze total size of the executable and libraries, the modules can optionally be statically linked to the main binary, but must nevertheless be loaded with the `dopath` function. Modules may also include Lua code.

If no modules are loaded, all client windows appear in full screen mode. To get better window management support, one or more workspace modules should be loaded. Currently Ion provides the following workspace modules

mod_ionws Tiled workspaces of the original Ion kind.
mod_floatws Conventional workspaces with freely floating frames of the PWM flavour.
mod_panews Tiled workspaces with automatic tiling in a template layout based on silly heuristics or winprop (see section 3.5).

Workspace modules alone don't yet make the WM very usable. At the least the *mod_query* and *mod_menu* modules should be loaded for better input capabilities. The full list of additional modules is as follows

mod_query Queries (for starting programs and so on) and message boxes.
mod_menu Support for menus, both pull-down and keyboard-operated in-frame menus.
mod_statusbar Module that implements a statusbar that can be adaptively embedded in each workspace's layout.
mod_dock Module for docking Window Maker dockapps. The dock can both float and be embedded as the statusbar.

mod_sp This module implements a scratchpad frame that can be toggled on/off everywhere. Think of the 'console' in some first-person shooters.

mod_mgmtmode Support module for implementing "management modes" with a XOR-frame similar to move/resize mode around selected region.

mod_sm Session management support module. *Loaded automatically when needed!*

So-called drawing engines are also implemented as a modules, but they are not discussed here; see chapter 4.

The stock configuration for the 'ion3' executable loads all of the modules mentioned above except *mod_dock* and filemod_mgmtmode. The stock configuration for the 'pwm3' executable (which differs from the 'ion3' executable in a few configuration details, such as Xinerama usage) only load *mod_floatws*, *mod_menu* and *mod_query*.

2.2 Class and object hierarchies

While Ion does not not have a truly object-oriented design [1], things that appear on the computer screen are, however, quite naturally expressed as such "objects". Therefore Ion implements a rather primitive OO system for these screen objects and some other things.

It is essential for the module writer to learn this object system, but also people who write their own binding configuration files necessarily come into contact with the class and object hierarchies – you need to know which binding setup routines apply where, and what functions can be used as handlers in which bindings. It is the purpose of this section to attempt to explain these hierarchies. If you do not wish the read the full section, at least read the summary at the end of it, so that you understand the very basic relations.

For simplicity we consider only the essential-for-basic-configuration Ioncore, *mod_ionws* and *mod_query* classes. See Appendix B for the full class hierachy visible to Lua side.

2.2.1 Class hierarchy

One of the most important principles of object-oriented design methodology is inheritance; roughly how classes (objects are instances of classes) extend on others' features. Inheritance gives rise to class hierarchy. In the case of single-inheritance this hierarchy can be expressed as a tree where the class at the root is inherited by all others below it and so on. Figure 2.1 lists out the Ion class hierarchy and below we explain what features of Ion the classes implement.

The core classes:

Obj Is the base of Ion's object system.

1. the author doesn't like such artificial designs

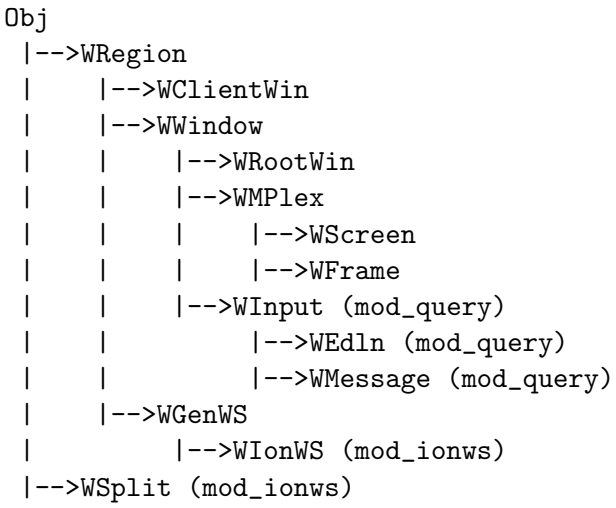

Figure 2.1: Ioncore, *mod_ionws* and *mod_query* class hierarchy.

WRegion is the base class for everything corresponding to something on the screen. Each object of type WRegion has a size and position relative to the parent WRegion. While a big part of Ion operates on these instead of more specialised classes, WRegion is a "virtual" base class in that there are no objects of "pure" type WRegion; all concrete regions are objects of some class that inherits WRegion.

WClientWin is a class for client window objects, the objects that window managers are supposed to manage.

WWindow is the base class for all internal objects having an X window associated to them (WClientWins also have X windows associated to them).

WRootWin is the class for root windows of X screens. Note that an "X screen" or root window is not necessarily a single physical screen as a root window may be split over multiple screens when multi-head extensions such as Xinerama are used. (Actually there can be only one WRootWin when Xinerama is used.)

WMPlex is a base class for all regions that"multiplex" other regions. This means that of the regions managed by the multiplexer, only one can be displayed at a time. Classes that inhereit WMPlex include screens and frames.

WScreen is the class for objects corresponding to physical screens. Screens may share a root window when Xinerama multihead extensions are used as explained above.

WFrame is the class for frames. While most Ion's objects have no graphical presentation, frames basically add to WMPlexes the decorations around client windows (borders, tabs).

WGenWS is a light base class for different types of workspaces.

Classes implemented by the ionws module:

WIonWS is the class for the usual tiled workspaces.

WSplit (or, more specifically, classes that inherit it) encode the WIonWS tree structure.

```
WRootWins
 |-->WScreens
      |-->WIonWSs
      |-->WClientWins in full screen mode
      |-->WFrames
           |-->WClientWins, including transients
           |-->a possible WEdln or WMessage
```

Figure 2.2: Most common parent–child relations

Classes implemented by the query module:

WInput is a virtual base class for the two classes below.

WEdln is the class for the "queries", the text inputs that usually appear at bottoms of frames and sometimes screens. Queries are the functional equivalent of "mini buffers" in many text editors.

WMessage implements the boxes for warning and other messages that Ion may wish to display to the user. These also usually appear at bottoms of frames.

2.2.2 Object hierarchies: WRegion parents and managers

Parent–child relations

Each object of type WRegion has a parent and possibly a manager associated to it. The parent for an object is always a WWindow and for WRegion with an X window (WClientWin, WWindow) the parent WWindow is given by the same relation of the X windows. For other WRegions the relation is not as clear. There is generally very few restrictions other than the above on the parent—child relation but the most common is as described in Figure 2.2.

WRegions have very little control over their children as a parent. The manager WRegion has much more control over its managed WRegions. Managers, for example, handle resize requests, focusing and displaying of the managed regions. Indeed the manager—managed relationship gives a better picture of the logical ordering of objects on the screen. Again, there are generally few limits, but the most common hierarchy is given in Figure 2.3. Note that sometimes the parent and manager are the same object and not all objects may have a manager (e.g. the dock in the dock module at the time of writing this) but all have a parent–a screen if not anything else.

Manager–managed relations

Note that a workspace can manage another workspace. This can be achieved with the `attach_new` function, and allows you to nest workspaces as deep as you want.

```
WRootWins
 |-->WScreens
      |-->full screen WClientWins
      |    |-->transient WClientWins (dialogs)
      |-->WScratchpad
      |-->WIonWSs/WFloatWS/WPaneWS
           |-->WFrames
           |    |-->WClientWins
           |    |    |-->transient WClientWins (dialogs)
           |    |-->possibly a WEdln or WMessage
           |-->WIonWSs/WFloatWS/WPaneWS
```

Figure 2.3: Most common manager–managed relations

2.2.3 Summary

In the standard setup, keeping queries, messages and menus out of consideration:

- The top-level objects that matter are screens and they correspond to physical screens. The class for screens is WScreen.
- Screens contain (multiplex) workspaces and full screen client windows. Only one of them can be viewed at a time. Workspace classes are WIonWS and WFloatWS for the two different types of workspaces (and WGenWS).
- Frames are managed by workspaces. Frames are the objects with decorations such as tabs and borders.
- Frames contain (multiplex) client windows, to each of which corresponds a tab in the frame's decoration. Only one client window (or other object) can be shown at a time in each frame. The class for client windows is WClientWin.

Chapter 3

Basic configuration

This chapter should help your configure Ion to your liking. As the your probably already know, Ion uses Lua as a configuration and extension language. If you're new to it, you might first want to read some Lua documentation as already suggested and pointed to in the Introduction before continuing with this chapter.

Section 3.1 is an overview of the multiple configuration files Ion uses and as a perhaps more understandable introduction to the general layout of the configuration files, a walk-through of the main configuration file *ion.lua* is provided in section 3.2. How keys and mouse action are bound to functions is described in detail in 3.3 and in section 3.5 winprops are explained. For a reference on exported functions, see section 6.

3.1 The configuration files

Ion3, to which document applies, stores its stock configuration files in */usr/local/etc/ion3/* unless you, the OS package maintainer or whoever installed the package on the system has modified the variables `PREFIX` or `ETCDIR` in *system.mk* before compiling Ion. In the first case you probably know where to find the files and in the other case the system administrator or the OS package maintainer should have provided documentation to point to the correct location. If these instructions are no help in locating the correct directory, the command `locate cfg_ion.lua` might help provided `updatedb` has been run recently.

User configuration files go in *~/.ion3/*. Ion always searches the user configuration file directory before the stock configuration file directory for files. Therefore, if you want to change some setting, it is advised against that you modify the stock configuration files in-place as subsequent installs of Ion will restore the stock configuration files. Instead you should always make a copy of the stock file in *~/.ion3/* and modify this file. When searching for a file, if no extension or path component is given, compiled *.lc* files are attempted before *.lua* files.

All the configuration files are named *cfg_*.lua* with the "*" part varying. The configuration file for each module *mod_modname* is *cfg_modname.lua*, with *modname* varying by

the module in question. The following table summarises these and other configuration files:

File	Description
cfg_ion.lua	The main configuration file
cfg_bindings.lua	Most of Ion's bindings are configured here. Bindings that are specific to some module are configured in the module's configuration file. For details, see section 3.3.
cfg_menus.lua	Menu definitions; see section 3.4.
cfg_kludges.lua	Settings to get some applications behave more nicely have been collected here. See section 3.5.
cfg_ionws.lua	Configuration files for different modules.
cfg_floatws.lua	
cfg_panews.lua	
cfg_query.lua	
cfg_menu.lua	
cfg_dock.lua	
cfg_statusbar.lua	
...	

Additionally, there's *look.lua* that configures the drawing engine, but it is covered in chapter 4.

3.2 A walk through *cfg_ion.lua*

As already mentioned *cfg_ion.lua* is Ion's main configuration file. Some basic 'feel' settings are usually configured there and the necessary modules and other configuration files configuring some more specific aspects of Ion are loaded there. In this section we take a walk through the stock *cfg_ion.lua*.

The first thing that is done in that file is set

```
MOD1="Mod1+"
MOD2=""
```

This causes most of Ion's key bindings to use **Mod1** as the modifier key. If `MOD2` is set, it is used as modifier for the keys that don't normally use a modifier. for details on modifiers and key binding setup in general see section 3.3.

Next we do some basic feel configuration:

```
ioncore.set{
    dblclick_delay=250,
    kbresize_delay=1500,
}
```

These two will set the delay between button presses in a double click, and the timeout to quit resize mode in milliseconds.

```
ioncore.set{
    opaque_resize=true,
    warp=true,
}
```

The first of these two settings enables opaque resize mode: in move/resize move frames and other objects mirror you actions immediately. If opaque resize is disabled, a XOR rubber band is shown during the mode instead. This will, unfortunately, cause Ion to also grab the X server and has some side effects.

```
ioncore.set{
    default_ws_type="WIonWS",
}
```

This will set the default workspace type to WIonWS – tiled workspaces.

To actually be able to do something besides display windows in full screen mode, we must next load some modules:

```
dopath("mod_query")
dopath("mod_menu")
dopath("mod_ionws")
dopath("mod_floatws")
dopath("mod_panews")
dopath("mod_statusbar")
--dopath("mod_dock")
--dopath("mod_sp")
```

As already mentioned, each of these modules have their own configuration files. Finally, additional configuration files are loaded:

```
dopath("cfg_kludges")
dopath("cfg_bindings")
dopath("cfg_menus")
```

Bindings and menus are defined in *cfg_bindings.lua* and *cfg_menus.lua*. Details on making such definitions follow in sections 3.3 and 3.4, respectively. some kludges or ”winprops” to make some applications behave better under Ion are colledted in *cfg_kludges.lua*; see section 3.5 for details. In addition to these, this file lists quite a few statements of the form

```
ioncore.defshortening("[^:]+: (.*)(<[0-9]+>)", "$1$2$|$1$<...$2")
```

These are used to configure how Ion attempts to shorten window titles when they do not fit in a Tab. The first argument is a POSIX regular expression that is used to match against the title and the next is a rule to construct a new title of a match occurs. This particular rule is used to shorten e.g. ’Foo: barbaz<3>’ to ’barba. . . <3>’; for details see the function reference entry for `ioncore.defshortening`.

3.3 Keys and rodents

In the stock configuration file setup, most key and mouse bindings are set from the file *cfg_bindings.lua* while module-specific bindings are set from the modules' main configuration files (*cfg_modname.lua*). This, however, does not have to be so as long as the module has been loaded prior to defining any module-specific bindings.

Bindings are defined by calling the function `defbindings` with the "context" of the bindings and the a table of new bindings to make. The context is simply string indicating one of the classes of regions (or modes such as WMoveresMode) introduced in section 2.2, and fully listed in appendix B, although not all define a binding map. For example, the following skeleton would be used to define new bindings for all frames:

```
defbindings("WFrame", {
    -- List of bindings to make goes here.
})
```

There has been some confusion among users about the need to define the "context" for each binding, so let me try to explain this design decision here. The thing is that if there was a just a simple 'bind this key to this action' method without knowledge of the context, some limitations would have to be made on the available actions and writing custom handlers would be more complicated. In addition one may want to bind the same function to different key for different types of objects. Indeed, the workspace and frame tab switching functions are the same both classes being based on WMPlex, and in the stock configuration the switch to n:th workspaces is bound to **Mod1+n** while the switch to n:th tab is bound to the sequence **Mod1+k n**.

The following subsections describe how to construct elements of the binding table. Note that `defbindings` adds the the newly defined bindings to the previous bindings of the context, overriding duplicates. To unbind an event, set the handler parameter to `nil` for each of the functions to be described in the following subsections.

Also note that when multiple objects want to handle a binding, the innermost (when the root window is considered the outermost) active object in the parent–child hierarchy (see Figure 2.2) of objects gets to handle the action.

3.3.1 Binding handlers and special variables

Unlike in Ion2, in Ion3 binding handlers are not normally passed as "anonymous functions", although this is still possible. The preferred method now is to pass the code of the handler as a string. Two special variables are available in this code. These are

Variable	Description
`_` (underscore)	Reference to the object on which the binding was triggered. The object is of the same class as the the context of the `defbindings` call defining the binding.
`_sub`	Usually, the currently active child of the object referred to by `_`, but sometimes (e.g. mouse actions on tabs of frames) something else relevant to the action triggering the binding.

For example, supposing '`_`' is a WFrame, the following handler should move the active window to the right, if possible:

```
"_:inc_index(_sub)"
```

3.3.2 Guards

To suppress error messages, each binding handler may also be accompanied by a "guard" expression that blocks the handler from being called when the guard condition is not met. Currently the following guard expressions are supported:

Guard	Description
`"_sub:non-nil"`	The `_sub` parameter must be set.
`"_sub:SomeClass"`	The `_sub` parameter must be member of class SomeClass.

3.3.3 Defining the bindings

The descriptions of the individual bindings in the binding table argument to `defbindings` should be constructed with the following functions.

Key presses:

- `kpress(keyspec, handler [, guard])`,
- `kpress_wait(keyspec, handler [, guard])` and
- `submap(keyspec, { ... more key bindings ... })`.

Mouse actions:

- `mclick(buttonspec, handler [, guard])`,
- `mdblclick(buttonspec, handler [, guard])`,
- `mpress(buttonspec, handler [, guard])` and
- `mdrag(buttonspec, handler [, guard])`.

The actions that most of these functions correspond to should be clear and as explained in the reference, `kpress_wait` is simply `kpress` with a flag set instructing Ioncore wait for all modifiers to be released before processing any further actions. This is to stop one from accidentally calling e.g. `WRegion.rqclose` multiple times in a row. The `submap` function is used to define submaps or "prefix maps". The second argument to this function is table listing the key press actions (`kpress`) in the submap

The parameters `keyspec` and `buttonspec` are explained below in detail. The parameter `handler` is the handler for the binding, and the optional parameter `guard` its guard. These should normally be strings as explained above.

3.3.4 Examples

For example, to just bind the key **Mod1+1** to switch to the first workspace and **Mod1+Right** to the next workspace, you would make the following call

```
defbindings("WScreen", {
    kpress("Mod1+Right", "_:switch_next()"),
    kpress("Mod1+1", "_:switch_nth(1)"),
})
```

Note that `_:switch_nth(1)` is the same as calling `WMPlex.switch_next(_, 1)` as WScreen inherits WMPlex and this is where the function is actually defined.

Similarly to the above example, to bind the key sequence **Mod1+k n** switch to the next managed object within a frame, and **Mod1+k 1** to the first, you would issue the following call:

```
defbindings("WFrame", {
    submap("Mod1+K", {
        kpress("Right", "_:switch_next()"),
        kpress("1", "_:switch_nth(1)"),
   }),
})
```

3.3.5 Key specifications

As seen above, the functions that create key binding specifications require a `keyspec` argument. This argument should be a string containing the name of a key as listed in the X header file *keysymdef.h*[1] without the `XK_` prefix. Most of the key names are quite intuitive while some are not. For example, the **Enter** key on the main part of the keyboard has the less common name **Return** while the one the numpad is called **KP_Enter**.

The `keyspec` string may optionally have multiple "modifier" names followed by a plus sign (`+`) as a prefix. X defines the following modifiers:

Shift, **Control**, **Mod1** to **Mod5**, **AnyModifier** and **Lock**.

X allows binding all of these modifiers to almost any key and while this list of modifiers does not explicitly list keys such as **Alt** that are common on modern keyboards, such keys are bound to one of the **ModN**. On systems running XFree86 **Alt** is usually **Mod1**. On Suns **Mod1** is the diamond key and **Alt** something else. One of the "flying window" keys on so called Windows-keyboards is probably mapped to **Mod3** if you have such a key. Use the program *xmodmap* to find out what exactly is bound where.

Ion defaults to **AnyModifier** in submaps. This can sometimes lead to unwanted effects when the same key is used with and without explicitly specified modifiers in nested

1. This file can usually be found in the directory */usr/X11R6/include/X11/*.

regions. For this reason, Ion recognises **NoModifier** as a special modifier that can be used to reset this default.

Ion ignores the **Lock** modifier and any **ModN** ($N = 1...5$) bound to **NumLock** or **ScrollLock** by default because such[2] locking keys may otherwise cause confusion.

3.3.6 Button specifications

Button specifications are similar to key definitions but now instead of specifying modifiers and a key, you specify modifiers and one of the button names **Button1** to **Button5**. Additionally the specification may end with an optional area name following an @-sign. Only frames currently support areas, and the supported values in this case are `"border"`, `"tab"`, `"empty_tab"`, `"client"` and `nil` (for the whole frame).

For example, the following code binds dragging a tab with the first button pressed to initiate tab drag&drop handling:

```
defbindings("WFrame", {
    mdrag("Button1@tab", "_:p_tabdrag()"),
})
```

3.3.7 A further note on the default binding configuration

The default binding configuration contains references to the variables `MOD1` and `MOD2` instead of directly using the default values of `"Mod1+"` and `""` (nothing). As explained in section 3.2, the definitions of these variables appear in *cfg_ion.lua*. This way you can easily change the the modifiers used by all bindings in the default configuration without changing the whole binding configuration. Quite a few people prefer to use the Windows keys as modifiers because many applications already use **Alt**. Nevertheless, **Mod1** is the default as a key bound to it is available virtually everywhere.

3.3.8 Client window bindings

As client windows do not have a binding map of their own due to technical reasons, it is necessary to call client window functions by specifying the bindings somewhere else. In the stock configuration file setup this is done among WMPlex bindings, setting the guard to `_sub:WClientWin` and using `_sub` to refer to the client window.

For example, the full screen toggle key is bound like this:

```
defbindings("WMPlex", {
    kpress_wait("Mod1+Return",
                "_:toggle_fullscreen()", "_sub:WClientWin"),
})
```

2. Completely useless keys that should be gotten rid of in the author's opinion.

3.4 Menus

3.4.1 Defining menus

In the stock configuration file setup, menus are defined in the file *cfg_menus.lua* as previously mentioned. The *mod_menu* module must be loaded for one to be able to define menus, and this is done with the function `defmenu` provided by it.

Here's an example of the definition of a rather simple menu with a submenu:

```
defmenu("exitmenu", {
    menuentry("Restart", "ioncore.restart()"),
    menuentry("Exit", "ioncore.shutdown()"),
})

defmenu("mainmenu", {
    menuentry("Lock screen", "ioncore.exec('xlock')"),
    menuentry("Help", "mod_query.query_man(_)"),
    submenu("Exit", "exitmenu"),
})
```

The `menuentry` function is used to create an entry in the menu with a title and an entry handler to be called when the menu entry is activated. The parameters to the handler are similar to those of binding handlers, and usually the same as those of the binding that opened the menu.

The `submenu` function is used to insert a submenu at that point in the menu. (One could as well just pass a table with the menu entries, but it is not encouraged.)

3.4.2 Special menus

The menu module predefines the following special menus. These can be used just like the menus defined as above.

Menu name	Description
`windowlist`	List of all client windows. Activating an entry jumps to that window.
`workspacelist`	List of all workspaces. Activating an entry jumps to that workspaces.
`stylemenu`	List of available *look_*.lua* style files. Activating an entry loads that style and ask to save the selection.
`ctxmenu`	Context menu for given object.

3.4.3 Defining context menus

The "ctxmenu" is a special menu that is assembled from a defined context menu for the object for which the menu was opened for, but also includes the context menus for the manager objects as submenus.

Context menus for a given region class are defined with the `defctxmenu` function. This is other ways similar to `defmenu`, but the first argument instead being the name of the menu, the name of the region class to define context menu for. For example, here's part of the stock WFrame context menu definition:

```
defctxmenu("WFrame", {
    menuentry("Close", "WRegion.rqclose_propagate(_, _sub)"),
    menuentry("Kill",  "WClientWin.kill(_sub)", "_sub:WClientWin"),
})
```

3.4.4 Displaying menus

The following functions may be used to display menus from binding handlers (and elsewhere):

Function	Description
`mod_menu.menu`	Keyboard (or mouse) operated menus that open in the bottom-left corner of a screen or frame.
`mod_menu.bigmenu`	Same as previous, but uses another graphical style.
`mod_menu.pmenu`	Mouse-operated drop-down menus. This function can only be called from a mouse press or drag handler.
`mod_menu.grabmenu`	A special version of `mod_menu.menu` that grabs the keyboard and is scrolled with a given key until all modifiers have been released, after which the selected entry is activated. This function is meant to be used for implementing, for example, Win***s-style **Alt-Tab** handling.[3]

The `grabmenu` function takes the extra key parameter, but aside from that each of these functions takes three arguments, which when called from a binding handler, should be the parameters to the handler, and the name of the menu. For example, the following snippet of of code binds the both ways to open a context menu for a frame:

```
defbindings("WFrame", {
    kpress(MOD1.."M", "mod_menu.menu(_, _sub, 'ctxmenu')"),
    mpress("Button3", "mod_menu.pmenu(_, _sub, 'ctxmenu')"),
})
```

3.5 Winprops

The so-called "winprops" can be used to change how specific windows are handled and to set up some kludges to deal with badly behaving applications. They are defined by calling the function `defwinprop` with a table containing the properties to set and the necessary information to identify a window. The currently supported winprops are listed below, and the subsequent subsections explain the usual method of identifying windows, and how to obtain this information.

3. See the *wcirculate.lua* script in the Ion scripts repository http://iki.fi/tuomov/repos/ion-scripts-3/.

Winprop: `acrobatic` (boolean)
Description: Set this to `true` for Acrobat Reader. It has an annoying habit of trying to manage its dialogs instead of setting them as transients and letting the window manager do its job, causing Ion and acrobat go a window-switching loop when a dialog is opened.

Winprop: `aspect` (table)
Description: The table should contain the entries `w` and `h` that override application-supplied aspect ratio hint.

Winprop: `fullscreen` (boolean)
Description: Should the window be initially in full screen mode?

Winprop: `ignore_cfgrq` (boolean)
Description: Should configure requests on the window be ignored? Only has effect on windows on floatws:s.

Winprop: `ignore_net_active_window` (boolean)
Description: Ignore extended WM hints `_NET_ACTIVE_WINDOW` request.

Winprop: `ignore_resizeinc` (boolean)
Description: Should application supplied size increments be ignored?

Winprop: `jumpto` (boolean)
Description: Should a newly created client window always be made active, even if the allocated frame isn't.

Winprop: `max_size` (table)
Description: The table should contain the entries `w` and `h` that override application-supplied maximum size hint.

Winprop: `min_size` (table)
Description: Similar to `max_size` but for the minimum size hint.

Winprop: `oneshot` (boolean)
Description: Discard this winprop after first use.

Winprop: `switchto` (boolean)
Description: Should a newly mapped client window be switched to within its frame.

Winprop: `target` (string)
Description: The name of an object (workspace, frame) that should manage windows of this type.

Winprop: `transient_mode` (string)
Description: "normal": No change in behaviour. "current": The window should be thought of as a transient for the current active client window (if any) even if it is not marked as a transient by the application. "off": The window should be handled as a normal window even if it is marked as a transient by the application.

Winprop: `transients_at_top` (boolean)
Description: When transients are managed by the client window itself (as it is the case on tiled workspaces), should the transients be placed at the top of the window instead of bottom?

Winprop: `transparent` (boolean)
Description: Should frames be made transparent when this window is selected?

3.5.1 Classes, roles and instances

The identification information in the winprop specification is usually the `class`, `role` , `instance` and `name` of the window. The `name` field is a Lua-style regular expression matched against the window's title and the rest are strings that must exactly much the corresponding window information. It is not necessary to specify all of these fields.

Ion looks for a matching winprop in the order listed by the following table. An 'E' indicates that the field must be set in the winprop and it must match the window's corresponding property exactly or, in case of `name`, the regular expression must match the window title. An asterisk '*' indicates that a winprop where the field is not specified (or is itself an asterisk in case of the first three fields) is tried.

`class`	`role`	`instance`	`name`
E	E	E	E
E	E	E	*
E	E	*	E
E	E	*	*
E	*	E	E
E	*	E	*
E	*	*	E
⋮	⋮	⋮	etc.

If there are multiple winprops with other identification information the same but different `name`, the longest match is chosen.

3.5.2 Finding window identification

The 'Window info' context menu entry (**Mod1+M** or **Button3** on a tab) can be used to list the identification information required to set winprops for a window and all the transient windows managed within it.

Another way to get the identification information is to use `xprop`. Simply run To get class and instance, simply run `xprop WM_CLASS` and click on the particular window of interest. The class is the latter of the strings while the instance is the former. To get the role – few windows have this property – use the command `xprop WM_ROLE`. This method, however, will not work on transients.

So-called ”transient windows” are usually short-lived dialogs (although some programs abuse this property) that have a parent window that they are ”transient for”. On tiled workspaces Ion displays these windows simulatenously with the parent window at the bottom of the same frame. Unfortunately `xprop` is stupid and can't cope with this situation, returning the parent window's properties when the transient is clicked on. For this reason you'll have to do a little extra work to get the properties for that window.[4]

Finally, it should be mentioned that too many authors these days ”forget” to set this vital identification to anything meaningful: everything except name is the same for all of the programs's windows, for example.

3.5.3 Some common examples

Acrobat Reader

The following is absolutely necessary for Acrobat reader:

```
defwinprop{
    class = "AcroRead",
    instance = "documentShell",
    acrobatic = true,
}
```

Fixing a Mozilla Firebird transient

Mozilla Firebird (0.7) incorrectly does not set the `WM_TRANSIENT_FOR` property for the dialog that is used to ask the action to take for a file. It, however, sets the the property point to the main window for the save dialog. This can be annoying and confusing, as the first dialog is not closed before the second is displayed.

We'd like the first dialog to be transient to the main window. The closest we can get to that is to consider it transient to the current window (if there's one). Unfortunately Firebird does not set any meaningful classes, instances or roles for the windows, so we'll have to rely on an ugly title match.

```
defwinprop{
    class = "MozillaFirebird-bin",
    name = "Opening .*",
    transient_mode = "current",
}
```

Forcing newly created windows in named frames

The following winprop should place xterm started with command-line parameter `-name sysmon` and running a system monitoring program in a particular frame:

---

4. There's a patch to `xprop` to fix this, but nothing seems to be happening with respect to including it in XFree86.

```
defwinprop{
    class = "XTerm",
    instance = "sysmon",
    target = "sysmonframe",
}
```

For this example to work, we have to somehow create a frame named `sysmonframe`. One way to do this is to make the following call in the **Mod1+F3** Lua code query:

```
mod_query.query_renameframe(_)
```

Recall that `_` points to the multiplexer (frame or screen) in which the query was opened. Running this code should open a new query prefilled with the current name of the frame. In our example we would change the name to `sysmonframe`, but we could just as well have used the default name formed from the frame's class name and an instance number.

Chapter 4

Graphical styles

This chapter first gives in section 4.1 a general outline of how drawing engines are used, of style specifications and then in section 4.2 describes how to specify styles for the default drawing engine.

4.1 Drawing engines, style specifications and sub-styles

Ion's drawing routines are abstracted into so-called drawing engine modules that can, again depending on the system, be dynamically loaded as needed. The drawing engine modules provide "brushes" that objects can use to draw some high-level primitives such as borders and text boxes (in addition to simple text and rectangle drawing) on their windows and configure e.g. the shape and background of the window. While the drawing engines therefore do not directly implement looks for each possible object (that would hardly be maintainable), different brush styles can be used to give a distinctive look to different objects and engines could interpret some styles as special cases. Style specifications are strings of the form

```
element1-element2-...-elementn
```

An example of such a style specification is `tab-frame`; see the table in subsection 4.1.1 for more styles.

When an object asks for a brush of certain style, the selected drawing engine will attempt to find the closest match to this specification. The styles/brushes defined by the drawing engines may have asterisks (`*`) as some of the elements indicating a match to anything. Exact matches are preferred to asterisk matches and longer matches to shorter. For example, let a brush for style `foo-bar-baz` be queried, then the following brushes are in order of preference:

```
foo-bar-baz
foo-*-baz
foo-bar
*
foo-baz   -- Doesn't match, not selected!
```

Some of the drawing primitives allow extra attributes to be specified, also in the form

`attr1-attr2-...-attrn`

These extra attributes are called *substyles* and allow, for example, the state of the object to be indicated by different colour sets while keeping the interface at an abstract level and the drawing engine completely ignorant of the semantics – only the writer of the drawing engine configuration file has to know them. However the drawing engine can again interpret known substyles as special cases and the default engine indeed does so with frame tab tag and drag states.)

4.1.1 Known styles and substyles

Frames

Style name	Description
`frame`	Style for frames. Substyles: `active`, `inactive`.
`frame-tiled-ionws`	A more specific style for frames on tiled workspaces. Substyles as for `frame`.
`frame-floating-floatws`	A more specific style for frames on floating workspaces. Substyles as for `frame`.

Tabs and menu entries

Style name	Description
`tab`	Style for frames' tabs and menu entries. Substyles: combinations of the form `a-s` where `a` is one of `active`/`inactive` and `s` is one of `selected`/`unselected`
`tab-frame`	A more specific style for frames' tabs. Substyles: combinations of the form `a-s-t-d-u` where `a` and `s` are as above and `t` is one of `tagged`/`not_tagged`, `d` is one of `dragged`/`not_dragged` and `u` is one of `activity`/`no_activity`.
`tab-frame-tiled-ionws`	A more specific tab style for `frame-tiled-ionws` frames.
`tab-frame-floating-floatws`	A more specific style for `frame-floating-floatws` frames.
`tab-menuentry`	A more specific style for entries in WMenus.
`tab-menuentry-bigmenu`	An alternate style for entries in WMenus.

The rest

Style name	Description
`input`	A style for WInputs.
`input-edln`	A more specific style for WEdlns. Substyles: `selection` for selected text and `cursor` for the cursor indicating current editing point.
`input-message`	A more specific style for WMessages.
`input-menu`	A more specific style for WMenus.
`input-menu-bigmenu`	An alternate style for WMenus.
`moveres_display`	The box displaying position/size when moving or resizing frames.
`dock`	The dock.

4.2 Defining styles for the default drawing engine

Drawing engine style files are usually named *look_foo.lua* where *foo* is the name of the style. The file that Ion loads on startup or when `gr.read_config` is called, however, is *look.lua* and should usually be symlinked to or a copy of of some *look_foo.lua*.

4.2.1 The structure of the configuration files

The first thing to do in a stylefile is to choose the drawing engine, possibly loading the module as well. This is done with the following chunk of code.

```
if not gr.select_engine("de") then
    return
end
```

The `gr.select_engine` function sees if the engine given as argument is registered (the default drawing engine is simply called "de"). If the engine could not be found, it tries to load a module of the same name. If the engine still is not registered, `gr.select_engine` returns `false` and in this case we also exit the style setup script. If the engine was found, `gr.select_engine` sees that further requests for brushes are forwarded to that engine and returns `true`.

Before defining new styles it may be a good idea to clear old styles from memory so if the old configuration defines more specific styles than the new, the old styles don't override those specified by the new configuration. That can be done by calling

```
de.reset()
```

After this the new styles can be defined with `de.defstyle` as explained in the next subsection. Finally, after the styles have been defined we must ask objects on the screen to look up new brushes to reflect the changes in configuration. This is done with

```
gr.refresh()
```

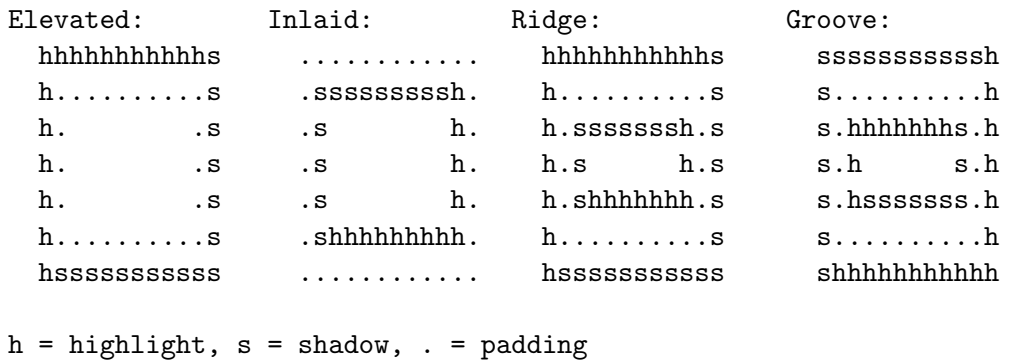

Figure 4.1: Sketch of different border styles and elements

4.2.2 Defining the styles

Styles for the default drawing engine are defined with the function `de.defstyle`. It has two arguments the first being a style specification as explained in previous sections and the second a table whose fields describe the style:

```
de.defstyle("some-style", {
    attribute = value,
    ...
})
```

The supported attributes are described in tables below. The different border elements and styles referred to there are explained in Figure 4.1.

Colours

Each of these fields a string of the form that can be passed to `XAllocNamedColor`. Valid strings are e.g. hexadecimal RGB specifications of the form `#RRGGBB` and colour names as specified in */usr/X11R6/lib/X11/rgb.txt* (exact path varying).

Field	Description
`highlight_colour`	Colour for the ”highlight” part of a border.
`shadow_colour`	Colour for the ”highlight” part of a border.
`foreground_colour`	Colour for the normal drawing operations, e.g. text.
`background_colour`	Window background colour (unless transparency is enabled) and background colour boxes.
`padding_colour`	Colour for the ”padding” part of a border border. Set to `background_colour` if unset.

Borders and widths

All other fields below except `border_style` are non-negative integers indicating a number of pixels.

Field	Description
`border_style`	A string indicating the style of border; one of elevated/inlaid/ridge/groove as seen in the above sketch.
`highlight_pixels`	Width of the highlight part of the border in pixels.
`shadow_pixels`	Width of the shadow part of the border in pixels.
`padding_pixels`	Width of the padding part of the border in pixels.
`spacing`	Space to be left between all kinds of boxes.

Text

Field	Description
`font`	Font to be used in text-drawing operations; standard X font name.
`text_align`	How text is to be aligned in text boxes/tabs; one of the strings left/right/center.

Miscellaneous

Field	Description
`transparent_background`	Should windows' that use this style background be transparent? true/false.
`based_on`	The name of a previously defined style that this style should be based on.

Substyles

As discussed in previous sections, styles may have substyles to e.g. indicate different states of the object being drawn. The "de" engine limits what can be configured in substyles to the set of colours in the first table above, but also specifically interprets for the main style `tab-frame` the substyles `*-*-tagged` and `*-*-*-dragged` by, respectively, drawing a right angle shape at the top right corner of a tab and by shading the tab with a stipple pattern. Also for menus the substyles `*-*-submenu` are handled as a special case.

Substyles are defined with the function `de.substyle` within the table defining the main style. The parameters to this function are similar to those of `de.defstyle`.

```
de.defstyle("some-style", {
   ...
   de.substyle("some-substyle", {
      ...
   }),
   ...
})
```

4.2.3 An example

The following shortened segment from *look_cleanviolet.lua* should help to clarify the matters discussed in the previous subsection.

```
de.defstyle("*", {
    -- Gray background
    highlight_colour = "#eeeeee",
    shadow_colour = "#eeeeee",
    background_colour = "#aaaaaa",
    foreground_colour = "#000000",

    shadow_pixels = 1,
    highlight_pixels = 1,
    padding_pixels = 1,
    spacing = 0,
    border_style = "elevated",

    font = "-*-helvetica-medium-r-normal-*-12-*-*-*-*-*-*-*",
    text_align = "center",
})

de.defstyle("tab-frame", {
    based_on = "*",

    de.substyle("active-selected", {
        -- Violet tab
        highlight_colour = "#aaaacc",
        shadow_colour = "#aaaacc",
        background_colour = "#666699",
        foreground_colour = "#eeeeee",
    }),

    --  More substyles would follow ...
})
```

4.3 Miscellaneous settings

The following style fields are independent of the drawing engine used, but are related to objects' styles and therefore configured in the drawing engine configuration file.

4.3.1 Extra fields for style `frame-tiled`

Field	Description
`bar_inside_border`	Controls whether the tab-bar appears inside or outside of the frame's borders. true/false.

4.3.2 Extra fields for style `frame-floating-floatws`

Field	Description
`floatframe_tab_min_w`	Minimum tab width in pixels, given that this number times number of tabs doesn't exceed frame width.
`floatframe_bar_max_w_q`	Maximum tab-bar width quotient of frame width. A number in the interval $(0, 1]$.

4.3.3 Extra fields for style `dock`

Field	Description
`outline_style`	How borders are drawn: `"none"` – no border, `"all"` – border around whole dock, `"each"` – border around each dockapp.
`tile_size`	A table with entries `width` and `height`, indicating the width and height of tiles in pixels.

Hopefully that's enough to get you started in writing new style configuration files for Ion. When in doubt, study the existing style configuration files.

Chapter 5

Scripting

This chapter documents some additional features of the Ion configuration and scripting interface that can be used for more advanced scripting than the basic configuration exlained in chapter 3.

5.1 Hooks

Hooks are lists of functions to be called when a certain event occurs. There are two types of them; normal and ”alternative” hooks. Normal hooks do not return anything, but alt-hooks should return a boolean indicating whether it handled its assigned task succesfully. In the case that `true` is returned, remaining handlers are not called.

Hook handlers are registered by first finding the hook with `ioncore.get_hook` and then calling `WHook.add` on the (succesfull) result with the handler as parameter. Similarly handlers are unregistered with `WHook.remove`. For example:

```
ioncore.get_hook("ioncore_snapshot_hook"):add(
    function() print("Snapshot hook called.") end
)
```

In this example the hook handler has no parameters, but many hook handlers do. The types of parameters for each hook are listed in the hook reference, section 6.10.

Note that many of the hooks are called in ”protected mode” and can not use any functions that modify Ion’s internal state. TODO: More detailed documentation when this is final.

5.2 Referring to regions

5.2.1 Direct object references

All Ion objects are passed to Lua scriptss as ’userdatas’, and you may safely store such object references for future use. The C-side object may be destroyed while Lua still refers to the object. All exported functions gracefully fail in such a case, but if you need to explicitly test that the C-side object still exists, use `obj_exists`.

As an example, the following short piece of code implements bookmarking:

```
local bookmarks={}

-- Set bookmark bm point to the region reg
function set_bookmark(bm, reg)
    bookmarks[bm]=reg
end

-- Go to bookmark bm
function goto_bookmark(bm)
    if bookmarks[bm] then
        -- We could check that bookmarks[bm] still exists, if we
        -- wanted to avoid an error message.
        bookmarks[bm]:goto()
    end
end
```

5.2.2 Name-based lookups

If you want to a single non-WClientWin region with an exact known name, use `ioncore.lookup_region`. If you want a list of all regions, use `ioncore.region_list`. Both functions accept an optional argument that can be used to specify that the returned region(s) must be of a more specific type. Client windows live in a different namespace and for them you should use the equivalent functions `ioncore.lookup_clientwin` and `ioncore.clientwin_list`.

To get the name of an object, use `WRegion.name`. Please be aware, that the names of client windows reflect their titles and are subject to changes. To change the name of a non-client window region, use `WRegion.set_name`.

5.3 Alternative winprop selection criteria

It is possible to write more complex winprop selection routines than those described in section 3.5. To match a particular winprop using whatever way you want to, just set the `match` field of the winprop to a function that receives the client window as its sole parameter, and that returns `true` if the winprop matches, and `false` otherwise.

The class, instance and role properties can be obtained with `WClientWin.get_ident`, and the title with `WRegion.name`. If you want to match against (almost) arbitrary window properties, have a look at the documentation for the following functions, and their standard Xlib counterparts: `ioncore.x_intern_atom` (XInternAtom), `ioncore.x_get_window_property` (XGetWindowProperty), and `ioncore.x_get_text_property` (XGetTextProperty).

5.4 Layers

In ion3, WMPlex manage two lists of objects. The layer 1 objects are the "normal" objects that appear on screen, and in addition, you can add layer 2 objects, that will either be hidden, or appear on top of the screen. The Scratchpad, for example, is a layer 2 object.

Layer 2 objects can be either passive (ion will never give them the focus) or not (ion will never give the focus to a layer 1 object while a non-passive object is displayed).

You can, for example, attach a WFloatWS on top of a WIonWS with the following lua code:

```
fws = foo:screen_of():attach_new({
    type = "WFloatWS",
    name = "foobar",
    layer = 2,
    passive = false,
    switchto = false,
})
```

While the WFloatWS is empty, it will off course not be visible, but windows opened in this workspace will appear floating on top of the layer 1 workspace.

You can hide this workspace (and all it contains) with

```
fws:screen_of():l2_hide(fws)
```

and show it again with

```
fws:screen_of():l2_show(fws)
```

The script *detach.lua* available in the Ion3 scripts repository[1] can give you some ideas about what it is possible to do with this feature.

5.5 Writing `ion-statusd` monitors

All statusbar meters that do not monitor the internal state of Ion should go in the separate `ion-statusd` program.

Whenever the user requests a meter `%foo` or `%foo_bar` to be inserted in a statusbar, *mod_statusbar* asks `ion-statusd` to load `statusd_foo.lua` on its search path (same as that for Ion-side scripts). This script should then supply all meters with the initial part '`foo`'.

To provide this value, the script should simply call `statusd.inform` with the name of the meter and the value as a string. Additionally the script should provide a 'template' for the meter to facilitate expected width calculation by *mod_statusbar*, and may provide a 'hint' for colour-coding the value. The interpretation of hints depends on the graphical

1. http://iki.fi/tuomov/repos/ion-scripts-3/

style in use, and currently the stock styles support the `normal`, `important` and `critical` hints.

In our example of the 'foo monitor', at script init we might broadcast the template as follows:

```
statusd.inform("foo_template", "000")
```

To inform *mod_statusbar* of the actual value of the meter and indicate that the value is critical if above 100, we might write the following function:

```
local function inform_foo(foo)
    statusd.inform("foo", tostring(foo))
    if foo>100 then
        statusd.inform("foo_hint", "critical")
    else
        statusd.inform("foo_hint", "normal")
    end
end
```

To periodically update the value of the meter, we must use timers. First we must create one:

```
local foo_timer=statusd.create_timer()
```

Then we write a function to be called whenever the timer expires. This function must also restart the timer.

```
local function update_foo()
    local foo= ... measure foo somehow ...
    inform_foo(foo)
    foo_timer:set(settings.update_interval, update_foo)
end
```

Finally, at the end of our script we want to do the initial measurement, and set up timer for further measurements:

```
update_foo()
```

If our scripts supports configurable parameters, the following code (at the beginning of the script) will allow them to be configured in *cfg_statusbar.lua* and passed to the status daemon and our script:

```
local defaults={
    update_interval=10*1000, -- 10 seconds
}

local settings=table.join(statusd.get_config("foo"), defaults)
```

Chapter 6

Function reference

6.1 Functions defined in *ioncore*

Synopsis: `ioncore.TR(s, ...)`
Description: gettext+string.format

Synopsis: `ioncore.bdoc(text)`
Description: Used to enter documentation among bindings so that other programs can read it. Does nothing.

Synopsis: `ioncore.chdir_for(reg, dir)`
Description: Change default working directory for new programs started in `reg`.

Synopsis: `ioncore.compile_cmd(cmd, guard)`
Description: Compile string `cmd` into a bindable function. Within `cmd`, the variable "`_`" (underscore) can be used to refer to the object that was selecting for the bound action and chosen to handle it. The variable "`_sub`" refers to a "currently active" sub-object of `_`, or a sub-object where the action loading to the binding being called actually occured.
The string `guard` maybe set to pose limits on `_sub`. Currently supported guards are `_sub:non-nil` and `_sub:WFoobar`, where WFoobar is a class.

Synopsis: `ioncore.create_ws(scr, ws_type)`
Description: Create new workspace on screen `scr`. If `ws_type` is set, then a workspace of that type is created. Otherwise workspace type is taken from the `default_ws_type` setting returned by `ioncore.get`.

Synopsis: `ioncore.defbindings(context, bindings)`
Description: Define bindings for context `context`. Here `binding` is a table composed of entries created with `ioncore.kpress`, etc.; see section 3.3 for details.

Synopsis: `ioncore.defctxmenu(ctx, ...)`
Description: Define context menu for context `ctx`, `tab` being a table of menu entries.

Synopsis: `ioncore.defmenu(name, tab)`
Description: Define a new menu with `name` being the menu's name and `tab` being a table of menu entries.

Synopsis: `ioncore.defwinprop(list)`
Description: Define a winprop. For more information, see section 3.5.

Synopsis: `ioncore.exec_on(reg, cmd, merr_internal)`
Description: Run `cmd` with the environment variable DISPLAY set to point to the root window of the X screen `reg` is on. If `cmd` is prefixed by a colon (`:`), the following command is executed in an xterm (or other terminal emulator) with the help of the `ion-runinxterm` script. If the command is prefixed by two colons, `ion-runinxterm` will ask you to press enter after the command is finished, even if it returns succesfully.

Synopsis: `table ioncore.read_savefile(string basename)`
Description: Read a savefile.

Synopsis: `string ioncore.get_savefile(string basename)`
Description: Get a file name to save (session) data in. The string `basename` should contain no path or extension components.

Synopsis: `string ioncore.lookup_script(string file, string sp)`
Description: Lookup script `file`. If `try_in_dir` is set, it is tried before the standard search path.

Synopsis: `bool ioncore.write_savefile(string basename, table tab)`
Description: Write `tab` in file with basename `basename` in the session directory.

Synopsis: `ioncore.find_manager(obj, t)`
Description: Find an object with type name `t` managing `obj` or one of its managers.

Synopsis: `ioncore.get_dir_for(reg)`
Description: Get default working directory for new programs started in `reg`.

Synopsis: `ioncore.getbindings(maybe_context)`
Description: Get a table of all bindings.

Synopsis: `ioncore.getctxmenu(name)`
Description: Returns a context menu defined with `ioncore.defctxmenu`.

Synopsis: `ioncore.getmenu(name)`
Description: Returns a menu defined with `ioncore.defmenu`.

Synopsis: `ioncore.getwinprop(cwin)`
Description: Find winprop table for `cwin`.

Synopsis: `string ioncore.aboutmsg()`
Description: Returns an about message (version, author, copyright notice).

Synopsis: `WRegion ioncore.activity_first()`
Description: Return first regio non activity list.

Synopsis: `bool ioncore.activity_goto()`
Description: Go to first region on activity list.

Synopsis: `table ioncore.activity_list()`
Description: Return list of regions with activity/urgency bit set.

Synopsis: `void ioncore.clear_tags()`
Description: Untag all regions.

Synopsis: `table ioncore.clientwin_list()`
Description: Return a list of all client windows.

Synopsis: `WRegion ioncore.current()`
Description: Returns the currently focused region, if any.

Synopsis: `bool ioncore.defshortening(string rx, string rule, bool always)`
Description: Add a rule describing how too long titles should be shortened to fit in tabs. The regular expression `rx` (POSIX, not Lua!) is used to match titles and when `rx` matches, `rule` is attempted to use as a replacement for title. If `always` is set, the rule is used even if no shortening is necessary.
Similarly to sed's 's' command, `rule` may contain characters that are inserted in the resulting string and specials as follows:

Special	Description
$0	Place the original string here.
$1 to $9	Insert n:th capture here (as usual,captures are surrounded by parentheses in the regex).
$|	Alternative shortening separator. The shortening described before the first this kind of separator is tried first and if it fails to make the string short enough, the next is tried, and so on.
$<	Remove characters on the left of this marker to shorten the string.
$>	Remove characters on the right of this marker to shorten the string. Only the first $< or $> within an alternative shortening is used.

Synopsis: `integer ioncore.exec(string cmd)`
Description: Run `cmd` with the environment variable DISPLAY set to point to the X display the WM is running on. No specific screen is set unlike with `WRootWin.exec_on`. The PID of the (shell executing the) new process is returned.

Synopsis: `WScreen ioncore.find_screen_id(integer id)`
Description: Find the screen with numerical id `id`. If Xinerama is not present, `id` corresponds to X screen numbers. Otherwise the ids are some arbitrary ordering of Xinerama rootwins. If `id` is -1, the screen with the highest id is returned.

Synopsis: `table ioncore.get()`
Description: Get ioncore basic settings. For details see `ioncore.set`.

Synopsis: `table ioncore.get_paths(table tab)`
Description: Get important directories (userdir, sessiondir, searchpath).

Synopsis: `WScreen ioncore.goto_next_screen()`
Description: Switch focus to the next screen and return it.
Note that this function is asynchronous; the screen will not actually have received the focus when this function returns.

Synopsis: `WScreen ioncore.goto_nth_screen(integer id)`
Description: Switch focus to the screen with id `id` and return it.
Note that this function is asynchronous; the screen will not actually have received the focus when this function returns.

Synopsis: `WScreen ioncore.goto_prev_screen()`
Description: Switch focus to the previous screen and return it.
Note that this function is asynchronous; the screen will not actually have received the focus when this function returns.

Synopsis: `WRegion ioncore.goto_previous()`
Description: Go to and return to a previously active region (if any).
Note that this function is asynchronous; the region will not actually have received the focus when this function returns.

Synopsis: `bool ioncore.is_i18n()`
Description: Is Ion supporting locale-specifically multibyte-encoded strings?

Synopsis: `bool ioncore.load_module(string modname)`
Description: Attempt to load a C-side module.

Synopsis: `WClientWin ioncore.lookup_clientwin(string name)`
Description: Attempt to find a client window with name `name`.

Synopsis: `WRegion ioncore.lookup_region(string name, string typenam)`
Description: Attempt to find a non-client window region with name `name` and type inheriting `typenam`.

Synopsis: `integer ioncore.popen_bgread(string cmd, function h, function errh)`
Description: Run `cmd` with a read pipe connected to its stdout. When data is received through the pipe, `handler` is called with that data.

Synopsis: `string ioncore.progname()`
Description: Returns the name of program using Ioncore.

Synopsis: `table ioncore.region_list(string typenam)`
Description: Find all non-client window regions inheriting `typenam`.

Synopsis: `void ioncore.request_selection(function fn)`
Description: Request (string) selection. The function `fn` will be called with the selection when and if it is received.

Synopsis: `void ioncore.resign()`
Description: Causes the window manager to simply exit without saving state/session.

Synopsis: `void ioncore.restart()`
Description: Restart, saving session first.

Synopsis: `void ioncore.restart_other(string cmd)`
Description: Attempt to restart another window manager `cmd`.

Synopsis: `void ioncore.set(table tab)`
Description: Set ioncore basic settings. The table `tab` may contain the following fields.

Field	Description
`opaque_resize`	(boolean) Controls whether interactive move and resize operations simply draw a rubberband during the operation (false) or immediately affect the object in question at every step (true).
`warp`	(boolean) Should focusing operations move the pointer to the object to be focused?
`switchto`	(boolean) Should a managing WMPlex switch to a newly mapped client window?
`screen_notify`	(boolean) Should notification tooltips be displayed for hidden workspaces with activity?
`frame_add_last`	(boolean) Add new regions in frames last instead of after current region.
`dblclick_delay`	(integer) Delay between clicks of a double click.
`default_ws_type`	(string) Default workspace type for operations that create a workspace.
`kbresize_delay`	(integer) Delay in milliseconds for ending keyboard resize mode after inactivity.
`kbresize_t_max`	(integer) Controls keyboard resize acceleration. See description below for details.
`kbresize_t_min`	(integer) See below.
`kbresize_step`	(floating point) See below.
`kbresize_maxacc`	(floating point) See below.
`framed_transients`	(boolean) Put transients in nested frames.

When a keyboard resize function is called, and at most `kbresize_t_max` milliseconds has passed from a previous call, acceleration factor is reset to 1.0. Otherwise, if at least `kbresize_t_min` milliseconds have passed from the from previous acceleration update or reset the squere root of the acceleration factor is incremented by `kbresize_step`. The maximum acceleration factor (pixels/call modulo size hints) is given by `kbresize_maxacc`. The default values are (200, 50, 30, 100).

Synopsis: `void ioncore.set_get_winprop_fn(function fn)`
Description: Set function used to look up winprops.

Synopsis: `bool ioncore.set_paths(table tab)`
Description: Set important directories (sessiondir, searchpath).

Synopsis: `void ioncore.set_selection(string p)`
Description: Set primary selection and cutbuffer0 to `p`.

Synopsis: `void ioncore.shutdown()`
Description: End session saving it first.

Synopsis: `void ioncore.snapshot()`
Description: Save session.

Synopsis: `table ioncore.tagged_list()`
Description: Returns a list of tagged regions.

Synopsis: `string ioncore.version()`
Description: Returns Ioncore version string.

Synopsis: `void ioncore.warn(string str)`
Description: Issue a warning. How the message is displayed depends on the current warning handler.

Synopsis: `void ioncore.warn_traced(string str)`
Description: Similar to `ioncore.warn`, but also print Lua stack trace.

Synopsis: `void ioncore.x_change_property(integer win, integer atom, integer atom_type, integer format, string mode, table tab)`
Description: Modify a window property. The `mode` is one of `"replace"`, `"prepend"` or `"append"`, and format is either 8, 16 or 32. Also see `ioncore.x_get_window_property` and the `XChangeProperty`(3) manual page.

Synopsis: `void ioncore.x_delete_property(integer win, integer atom)`
Description: Delete a window property.

Synopsis: `string ioncore.x_get_atom_name(integer atom)`
Description: Get the name of an atom. See `XGetAtomName`(3) manual page for details.

Synopsis: `table ioncore.x_get_text_property(integer win, integer atom)`
Description: Get a text property for a window (`STRING`, `COMPOUND_TEXT`, or `UTF8_STRING` property converted). The fields in the returned table (starting from 1) are the null-separated parts of the property. See the `XGetTextProperty`(3) manual page for more information.

Synopsis: `table ioncore.x_get_window_property(integer win, integer atom, integer atom_type, integer n32expected, bool more)`
Description: Get a property `atom` of type `atom_type` for window `win`. The `n32expected` parameter indicates the expected number of 32bit words, and `more` indicates whether all or just this amount of data should be fetched. Each 8, 16 or 32bit element of the property, as deciphered from `atom_type` is a field

in the returned table. See `XGetWindowProperty`(3) manual page for more information.

Synopsis: `integer ioncore.x_intern_atom(string name, bool only_if_exists )`
Description: Create a new atom. See `XInternAtom`(3) manual page for details.

Synopsis: `void ioncore.x_set_text_property(integer win, integer atom, table tab)`
Description: Set a text property for a window. The fields of `tab` starting from 1 should be the different null-separated parts of the property. See the `XSetTextProperty` (3) manual page for more information.

Synopsis: `ioncore.kpress(keyspec, cmd, guard)`
Description: Creates a binding description table for the action of pressing a key given by `keyspec` (with possible modifiers) to the function `func`. For more information on bindings, see section 3.3.

Synopsis: `ioncore.kpress_wait(keyspec, cmd, guard)`
Description: This is similar to `kpress` but after calling `cmd`, Ioncore waits for all modifiers to be released before processing any further actions. For more information on bindings, see section 3.3.

Synopsis: `ioncore.match_winprop_name(prop, cwin)`
Description: The basic name-based winprop matching criteria.

Synopsis: `ioncore.mclick(buttonspec, cmd, guard)`
Description: Creates a binding description table for the action of clicking a mouse button while possible modifier keys are pressed, both given by `buttonspec`, to the function `func`. For more information, see section 3.3.

Synopsis: `ioncore.mdblclick(buttonspec, cmd, guard)`
Description: Similar to `mclick` but for double-click. Also see section 3.3.

Synopsis: `ioncore.mdrag(buttonspec, cmd, guard)`
Description: Creates a binding description table for the action of moving the mouse (or other pointing device) while the button given by `buttonspec` is held pressed and the modifiers given by `buttonspec` were pressed when the button was initially pressed. Also see section 3.3.

Synopsis: `ioncore.menuentry(name, cmd, guard)`
Description: Use this function to define normal menu entries. The string `name` is the string shown in the visual representation of menu, and the parameter `cmd` and `guard` are similar to those of `ioncore.defbindings`.

Synopsis: `ioncore.mpress(buttonspec, cmd, guard)`
Description: Similar to `mclick` but for just pressing the mouse button. Also see section 3.3.

Synopsis: `ioncore.refresh_stylelist()`
Description: Refresh list of known style files.

Synopsis: `ioncore.submap(kcb_, list)`
Description: Returns a function that creates a submap binding description table. When the key press action `keyspec` occurs, Ioncore will wait for a further key presse and act according to the submap. For details, see section 3.3.

Synopsis: `ioncore.submenu(name, sub_or_name, options)`
Description: Use this function to define menu entries for submenus. The parameter `sub_or_name` is either a table of menu entries or the name of an already defined menu. The initial menu entry to highlight can be specified by `options.initial` as either an integer starting from 1, or a function that returns such a number. Another option supported is `options.noautoexpand` that will cause `mod_query.query_menu` to not automatically expand this submenu.

6.1.1 WClientWin functions

Synopsis: `bool WClientWin.attach_transient(WClientWin cwin, WRegion reg)`

Description: Manage `reg` as a transient of `cwin`.

Synopsis: `table WClientWin.get_ident(WClientWin cwin)`
Description: Returns a table containing the properties `WM_CLASS` (table entries `instance` and `class`) and `WM_WINDOW_ROLE` (`role`) properties for `cwin`. If a property is not set, the corresponding field(s) are unset in the table.

Synopsis: `bool WClientWin.is_fullscreen(WClientWin cwin)`
Description: Is `cwin` in full screen mode?

Synopsis: `void WClientWin.kill(WClientWin cwin)`
Description: Attempt to kill (with XKillWindow) the client that owns the X window correspoding to `cwin`.

Synopsis: `table WClientWin.managed_list(WClientWin cwin)`
Description: Returns a list of regions managed by the clientwin (transients, mostly).

Synopsis: `void WClientWin.nudge(WClientWin cwin)`
Description: Attempts to fix window size problems with non-ICCCM compliant programs.

Synopsis: `void WClientWin.quote_next(WClientWin cwin)`
Description: Send next key press directly to `cwin`.

Synopsis: `bool WClientWin.set_fullscreen(WClientWin cwin, string how)`
Description: Set client window `cwin` full screen state according to the parameter `how` (set/unset/toggle). Resulting state is returned, which may not be what was requested.

Synopsis: `double WClientWin.xid(WClientWin cwin)`
Description: Return the X window id for the client window.

6.1.2 WFrame functions

Synopsis: `bool WFrame.is_shaded(WFrame frame)`
Description: Is `frame` shaded?

Synopsis: `bool WFrame.is_tabbar(WFrame frame)`
Description: Is `frame`'s tab-bar visible?

Synopsis: `void WFrame.maximize_horiz(WFrame frame)`
Description: Attempt to toggle horizontal maximisation of `frame`.

Synopsis: `void WFrame.maximize_vert(WFrame frame)`
Description: Attempt to toggle vertical maximisation of `frame`.

Synopsis: `void WFrame.p_switch_tab(WFrame frame)`
Description: Display the region corresponding to the tab that the user pressed on. This function should only be used by binding it to a mouse action.

Synopsis: `void WFrame.p_tabdrag(WFrame frame)`
Description: Start dragging the tab that the user pressed on with the pointing device. This function should only be used by binding it to *mpress* or *mdrag* action with area "tab".

Synopsis: `bool WFrame.set_numbers(WFrame frame, string how)`
Description: Control whether tabs show numbers (set/unset/toggle). Resulting state is returned, which may not be what was requested.

Synopsis: `bool WFrame.set_shaded(WFrame frame, string how)`
Description: Set shading state according to the parameter `how` (set/unset/toggle). Resulting state is returned, which may not be what was requested.

Synopsis: `bool WFrame.set_tabbar(WFrame frame, string how)`
Description: Set tab-bar visibility according to the parameter `how` (set/unset/toggle). Resulting state is returned, which may not be what was requested.

6.1.3 WInfoWin functions

Synopsis: `void WInfoWin.set_text(WInfoWin p, string str)`
Description: Set contents of the info window.

6.1.4 WMPlex functions

Synopsis: `WRegion WMPlex.attach(WMPlex mplex, WRegion reg, table param)`
Description: Attach and reparent existing region `reg` to `mplex`. The table `param` may contain the fields `index` and `switchto` that are interpreted as for `WMPlex.attach_new`.

Synopsis: `WRegion WMPlex.attach_new(WMPlex mplex, table param)`
Description: Create a new region to be managed by `mplex`. At least the following fields in `param` are understood:

Field	Description
`type`	Class name (a string) of the object to be created. Mandatory.
`name`	Name of the object to be created (a string). Optional.
`switchto`	Should the region be switched to (boolean)? Optional.
`index`	Index of the new region in `mplex`'s list of managed objects (integer, 0 = first). Optional.
`layer`	Layer to attach on; 1 (default) or 2.
`passive`	Is a layer 2 object passive/skipped when deciding object to gives focus to (boolean)? Optional.

In addition parameters to the region to be created are passed in this same table.

Synopsis: `void WMPlex.attach_tagged(WMPlex mplex)`
Description: Attach all tagged regions to `mplex`.

Synopsis: `void WMPlex.dec_index(WMPlex mplex, WRegion r)`
Description: Move `r` "right" within objects managed by `mplex`.

Synopsis: `integer WMPlex.get_index(WMPlex mplex, WRegion reg)`
Description: Get index of `reg` within the multiplexer. The first region managed by `mplex` has index zero. If `reg` is not managed by `mplex`, -1 is returned.

Synopsis: `table WMPlex.get_stdisp(WMPlex mplex)`
Description: Get status display information. See `WMPlex.get_stdisp` for information on the fields.

Synopsis: `void WMPlex.inc_index(WMPlex mplex, WRegion r)`
Description: Move `r` "right" within objects managed by `mplex`.

Synopsis: `bool WMPlex.l2_is_hidden(WMPlex mplex, WRegion reg)`
Description: Is `reg` on the layer2 of `mplex` and hidden?

Synopsis: `bool WMPlex.l2_is_passive(WMPlex mplex, WRegion reg)`
Description: Is `reg` on the layer2 of `mplex` and passive?

Synopsis: `bool WMPlex.l2_set_hidden(WMPlex mplex, WRegion reg, string how)`
Description: Set the visibility of the layer2 region `reg` on `mplex` as specified with the parameter `how` (set/unset/toggle). The resulting state is returned.

Synopsis: `bool WMPlex.l2_set_passive(WMPlex mplex, WRegion reg, string how)`
Description: Set the passivity of the layer2 region `reg` on `mplex` as specified with the parameter `how` (set/unset/toggle). The resulting state is returned.

Synopsis: `integer WMPlex.layer(WMPlex mplex, WRegion reg)`
Description: Returns the layer `reg` is on `mplex` or -1 if `reg` is not managed by `mplex`.

Synopsis: `integer WMPlex.lcount(WMPlex mplex, integer l)`
Description: Returns the number of regions managed by `mplex` on layer `l`.

Synopsis: `WRegion WMPlex.lcurrent(WMPlex mplex, integer l)`
Description: Return the managed object currently active within layer `l` of `mplex`.

Synopsis: `table WMPlex.llist(WMPlex mplex, integer l)`
Description: Returns a list of regions managed by `mplex` on layer `l`.

Synopsis: `WRegion WMPlex.lnth(WMPlex mplex, integer l, integer n)`
Description: Returns the `n`:th object managed by `mplex` on the the `l`:th layer..

Synopsis: `void WMPlex.set_index(WMPlex mplex, WRegion reg, integer index )`
Description: Set index of `reg` within the multiplexer to `index`.

Synopsis: `WRegion WMPlex.set_stdisp(WMPlex mplex, table t)`
Description: Set/create status display for `mplex`. Table is a standard description of the object to be created (as passed to e.g. `WMPlex.attach_new`). In addition, the following fields are recognised:

Field	Description
`pos`	The corner of the screen to place the status display in. One of `tl`, `tr`, `bl` or `br`.
`action`	If this field is set to `keep`, `corner` and `orientation` are changed for the existing status display. If this field is set to `remove`, the existing status display is removed. If this field is not set or is set to `replace`, a new status display is created and the old, if any, removed.

Synopsis: `void WMPlex.switch_next(WMPlex mplex)`
Description: Have `mplex` display next (wrt. currently selected) object managed by it.

Synopsis: `void WMPlex.switch_nth(WMPlex mplex, integer n)`
Description: Have `mplex` display the `n`:th object managed by it.

Synopsis: `void WMPlex.switch_prev(WMPlex mplex)`
Description: Have `mplex` display previous (wrt. currently selected) object managed by it.

6.1.5 WMoveresMode functions

Synopsis: `void WMoveresMode.cancel(WMoveresMode mode)`
Description: Return from move/resize cancelling changes if opaque move/resize has not been enabled.

Synopsis: `void WMoveresMode.finish(WMoveresMode mode)`
Description: Return from move/resize mode and apply changes unless opaque move/resize is enabled.

Synopsis: `void WMoveresMode.move(WMoveresMode mode, integer horizmul, integer vertmul)`
Description: Move resize mode target one step:

`horizmul/vertmul`	effect
-1	Move left/up
0	No effect
1	Move right/down

Synopsis: `void WMoveresMode.resize(WMoveresMode mode, integer left, integer right, integer top, integer bottom)`
Description: Shrink or grow resize mode target one step in each direction. Acceptable values for the parameters `left`, `right`, `top` and `bottom` are as follows: -1: shrink along, 0: do not change, 1: grow along corresponding border.

6.1.6 WRegion functions

Synopsis: `WMoveresMode WRegion.begin_kbresize(WRegion reg)`
Description: Enter move/resize mode for `reg`. The bindings set with `ioncore.set_bindings` for WMoveresMode are used in this mode. Of the functions exported by the Ion C core, only `WMoveresMode.resize`, `WMoveresMode.move`, `WMoveresMode.cancel` and `WMoveresMode.end` are allowed to be called while in this mode.

Synopsis: `WRegion WRegion.current(WRegion mgr)`
Description: Return the object, if any, that is considered "currently active" within the objects managed by `mplex`.

Synopsis: `table WRegion.geom(WRegion reg)`
Description: Returns the geometry of `reg` within its parent; a table with fields `x`, `y`, `w` and `h`.

Synopsis: `bool WRegion.goto(WRegion reg)`
Description: Attempt to display `reg`, save region activity status and then warp to (or simply set focus to if warping is disabled) `reg`.
Note that this function is asynchronous; the region will not actually have received the focus when this function returns.

Synopsis: `bool WRegion.is_active(WRegion reg)`
Description: Is `reg` active/does it or one of it's children of focus?

Synopsis: `bool WRegion.is_activity(WRegion reg)`
Description: Is activity notification set on `reg`.

Synopsis: `bool WRegion.is_mapped(WRegion reg)`
Description: Is `reg` visible/is it and all it's ancestors mapped?

Synopsis: `bool WRegion.is_tagged(WRegion reg)`
Description: Is `reg` tagged?

Synopsis: `WRegion WRegion.manager(WRegion reg)`
Description: Returns the region that manages `reg`.

Synopsis: `string WRegion.name(WRegion reg)`
Description: Returns the name for `reg`.

Synopsis: `WWindow WRegion.parent(WRegion reg)`
Description: Returns the parent region of `reg`.

Synopsis: `WRootWin WRegion.rootwin_of(WRegion reg)`
Description: Returns the root window `reg` is on.

Synopsis: `bool WRegion.rqclose(WRegion reg, bool relocate)`
Description: Attempt to close/destroy `reg`. Whether this operation works depends on whether the particular type of region in question has implemented the feature and, in case of client windows, whether the client supports the `WM_DELETE` protocol (see also `WClientWin.kill`). If the operation is likely to succeed, `true` is returned, otherwise `false`. In most cases the region will not have been actually destroyed when this function returns. If `relocate` is not set, and `reg` manages other regions, it will not be closed. Otherwise the managed regions will be attempted to be relocated.

Synopsis: `WRegion WRegion.rqclose_propagate(WRegion reg, WRegion maybe_sub)`
Description: Recursively attempt to close a region or one of the regions managed by it. If `sub` is set, it will be used as the managed region, otherwise `WRegion.current(reg)`. The object to be closed is returned or NULL if nothing can be closed. Also see notes for `WRegion.rqclose`.

Synopsis: `table WRegion.rqgeom(WRegion reg, table g)`
Description: Attempt to resize and/or move `reg`. The table `g` is a usual geometry specification (fields `x`, `y`, `w` and `h`), but may contain missing fields, in which case, `reg`'s manager may attempt to leave that attribute unchanged.

Synopsis: `WScreen WRegion.screen_of(WRegion reg)`
Description: Returns the screen `reg` is on.

Synopsis: `bool WRegion.set_activity(WRegion reg, string how)`
Description: Set activity flag of `reg`. The `how` parameter most be one of (set/unset/toggle).

Synopsis: `bool WRegion.set_name(WRegion reg, string p)`
Description: Set the name of `reg` to `p`. If the name is already in use, an instance number suffix `<n>` will be attempted. If `p` has such a suffix, it will be modified,

otherwise such a suffix will be added. Setting `p` to nil will cause current name to be removed.

Synopsis: `bool WRegion.set_name_exact(WRegion reg, string p)`
Description: Similar to `WRegion.set_name` except if the name is already in use, other instance numbers will not be attempted. The string `p` should not contain a `<n>` suffix or this function will fail.

Synopsis: `bool WRegion.set_tagged(WRegion reg, string how)`
Description: Change tagging state of `reg` as defined by `how` (set/unset/toggle). Resulting state is returned.

Synopsis: `table WRegion.size_hints(WRegion reg)`
Description: Returns size hints for `reg`. The returned table always contains the fields `min_?`, `base_?` and sometimes the fields `max_?`, `base_?` and `inc_?`, where `?`=`w`, `h`.

6.1.7 WRootWin functions

Synopsis: `WScreen WRootWin.current_scr(WRootWin rootwin)`
Description: Returns previously active screen on root window `rootwin`.

6.1.8 WScreen functions

Synopsis: `integer WScreen.id(WScreen scr)`
Description: Return the numerical id for screen `scr`.

Synopsis: `bool WScreen.set_managed_offset(WScreen scr, table offset)`
Description: Set offset of objects managed by the screen from actual screen geometry. The table `offset` should contain the entries `x`, `y`, `w` and `h` indicating offsets of that component of screen geometry.

6.1.9 WWindow functions

Synopsis: `void WWindow.p_move(WWindow wwin)`
Description: Start moving `wwin` with the mouse or other pointing device. This function should only be used by binding it to *mpress* or *mdrag* action.

Synopsis: `void WWindow.p_resize(WWindow wwin)`
Description: Start resizing `wwin` with the mouse or other pointing device. This function should only be used by binding it to *mpress* or *mdrag* action.

Synopsis: `double WWindow.xid(WWindow wwin)`
Description: Return the X window id for `wwin`.

6.1.10 global functions

Synopsis: `export(lib, ...)`
Description: Export a list of functions from `lib` into global namespace.

6.1.11 gr functions

Synopsis: `void gr.read_config()`
Description: Read drawing engine configuration file *draw.lua*.

Synopsis: `void gr.refresh()`
Description: Refresh objects' brushes to update them to use newly loaded style.

Synopsis: `bool gr.select_engine(string engine)`
Description: Future requests for "brushes" are to be forwarded to the drawing engine `engine`. If no engine of such name is known, a module with that name is attempted to be loaded. This function is only intended to be called from colour scheme etc. configuration files and can not be used to change the look of existing objects; for that use `gr.read_config`.

6.1.12 string functions

Synopsis: `string.shell_safe(str)`
Description: Make `str` shell-safe.

6.1.13 table functions

Synopsis: `table.copy(t, deep)`
Description: Make copy of `table`. If `deep` is unset, shallow one-level copy is made, otherwise a deep copy is made.

Synopsis: `table.icat(t1, t2)`
Description: Insert all positive integer entries from t2 into t1.

Synopsis: `table.join(t1, t2)`
Description: Create a table containing all entries from `t1` and those from `t2` that are missing from `t1`.

Synopsis: `table.map(f, t)`
Description: Map all entries of `t` by `f`.

6.2 Functions defined in *mod_ionws*

Synopsis: `table mod_ionws.get()`
Description: Get parameters. For details see `mod_ionws.set`.

Synopsis: `void mod_ionws.set(table tab)`
Description: Set parameters. Currently only `raise_delay` (in milliseconds) is supported.

6.2.1 WIonWS functions

Synopsis: `WRegion WIonWS.farthest(WIonWS ws, string dirstr, bool any)`
Description: Return the most previously active region on `ws` with no other regions next to it in direction `dirstr` (left/right/up/down). If `any` is not set, the status display is not considered.

Synopsis: `WRegion WIonWS.goto_dir(WIonWS ws, string dirstr)`
Description: Go to the most previously active region on `ws` next to `reg` in direction `dirstr` (up/down/left/right), wrapping around to a most recently active farthest region in the opposite direction if `reg` is already the further region in the given direction.
Note that this function is asynchronous; the region will not actually have received the focus when this function returns.

Synopsis: `WRegion WIonWS.goto_dir_nowrap(WIonWS ws, string dirstr)`
Description: Go to the most previously active region on `ws` next to `reg` in direction `dirstr` (up/down/left/right) without wrapping around.

Synopsis: `table WIonWS.managed_list(WIonWS ws)`
Description: Returns a list of regions managed by the workspace (frames, mostly).

Synopsis: `WRegion WIonWS.nextto(WIonWS ws, WRegion reg, string dirstr, bool any)`
Description: Return the most previously active region next to `reg` in direction `dirstr` (left/right/up/down). The region `reg` must be managed by `ws`. If `any` is not set, the status display is not considered.

Synopsis: `WSplitRegion WIonWS.node_of(WIonWS ws, WRegion reg)`
Description: For region `reg` managed by `ws` return the WSplit a leaf of which `reg` is.

Synopsis: `bool WIonWS.set_floating_at(WIonWS ws, WRegion reg, string how, string dirstr)`
Description: Toggle floating of the sides of a split containin `reg` as indicated by the parameters `how` (set/unset/toggle) and `dirstr` (left/right/up/down/any). The new status is returned (and `false` also on error).

Synopsis: `WSplitSplit WIonWS.set_floating(WIonWS ws, WSplitSplit split, string how)`
Description: Toggle floating of a split's sides at `split` as indicated by the parameter `how` (set/unset/toggle). A split of the appropriate is returned, if there was a change.

Synopsis: `WFrame WIonWS.split(WIonWS ws, WSplit node, string dirstr)`
Description: Create a new frame on `ws` above/below/left of/right of `node` as indicated by `dirstr`. If `dirstr` is prefixed with "floating:" a floating split is created.

Synopsis: `WFrame WIonWS.split_at(WIonWS ws, WFrame frame, string dirstr, bool attach_current)`
Description: Split `frame` creating a new frame to direction `dirstr` (one of "left", "right", "top" or "bottom") of `frame`. If `attach_current` is set, the region currently displayed in `frame`, if any, is moved to thenew frame. If `dirstr` is prefixed with "floating:" a floating split is created.

Synopsis: `WFrame WIonWS.split_top(WIonWS ws, string dirstr)`
Description: Same as `WIonWS.split` at the root of the split tree.

Synopsis: `WSplit WIonWS.split_tree(WIonWS ws)`
Description: Returns the root of the split tree.

Synopsis: `bool WIonWS.unsplit_at(WIonWS ws, WFrame frame)`
Description: Try to relocate regions managed by `frame` to another frame and, if possible, destroy the frame.

Synopsis: `bool WIonWS.flip_at(WIonWS ws, WRegion reg)`
Description: Flip `ws` at `reg` or root if nil.

Synopsis: `bool WIonWS.transpose_at(WIonWS ws, WRegion reg)`
Description: Transpose `ws` at `reg` or root if nil.

6.2.2 WSplit functions

Synopsis: `table WSplit.geom(WSplit split)`
Description: Returns the area of workspace used by the regions under `split`.

Synopsis: `WSplitInner WSplit.parent(WSplit split)`
Description: Return parent split for `split`.

Synopsis: `table WSplit.rqgeom(WSplit node, table g)`
Description: Attempt to resize and/or move the split tree starting at `node`. Behaviour and the `g` parameter are as for `WRegion.rqgeom` operating on `node` (if it were a WRegion).

Synopsis: `void WSplit.transpose(WSplit node)`
Description: Transpose contents of `node`.

6.2.3 WSplitInner functions

Synopsis: `WSplit WSplitInner.current(WSplitInner node)`
Description: Returns the most previously active child node of `split`.

6.2.4 WSplitRegion functions

Synopsis: `WRegion WSplitRegion.reg(WSplitRegion node)`
Description: Returns the region contained in `node`.

6.2.5 WSplitSplit functions

Synopsis: `WSplit WSplitSplit.br(WSplitSplit split)`
Description: Returns the bottom or right child node of `split` depending on the direction of the split.

Synopsis: `string WSplitSplit.dir(WSplitSplit split)`
Description: Returns the direction of `split`; either "vertical" or "horizontal".

Synopsis: `void WSplitSplit.flip(WSplitSplit split)`
Description: Flip contents of `node`.

Synopsis: `WSplit WSplitSplit.tl(WSplitSplit split)`
Description: Returns the top or left child node of `split` depending on the direction of the split.

6.3 Functions defined in *mod_floatws*

Synopsis: `table mod_floatws.get()`
Description: Get module basic settings. See `mod_floatws.set` for more information.

Synopsis: `void mod_floatws.set(table tab)`
Description: Set module basic settings. Currently only the `placement_method` parameter is supported.
The method can be one of "udlr", "lrud" (default) and "random". The "udlr" method looks for free space starting from top the top left corner of the workspace moving first down keeping the x coordinate fixed. If it find no free space, it start looking similarly at next x coordinate unoccupied by other objects and so on. "lrud' is the same but with the role of coordinates changed and both fall back to "random" placement if no free area was found.

6.3.1 WFloatFrame functions

Synopsis: `bool WFloatFrame.is_sticky(WFloatFrame frame)`
Description: Is `frame` sticky?

Synopsis: `bool WFloatFrame.set_sticky(WFloatFrame frame, string how)`
Description: Set `frame` stickyness accoding to `how` (set/unset/toggle). The resulting state is returned. This function only works across frames on WFloatWS that have the same WMPlex parent.

6.3.2 WFloatWS functions

Synopsis: `bool WFloatWS.attach(WFloatWS ws, WClientWin cwin, table t)`
Description: Attach client window `cwin` on `ws`. At least the following fields in `t` are supported:

Field	Description
`switchto`	Should the region be switched to (boolean)? Optional.
`geom`	Geometry; `x` and `y`, if set, indicates top-left of the frame to be created while `width` and `height`, if set, indicate the size of the client window within that frame. Optional.

Synopsis: `WRegion WFloatWS.backcirculate(WFloatWS ws)`
Description: Activate previous object in stacking order on `ws`.

Synopsis: `WRegion WFloatWS.circulate(WFloatWS ws)`
Description: Activate next object in stacking order on `ws`.

Synopsis: `void WFloatWS.lower(WFloatWS ws, WRegion reg)`
Description: Lower `reg` that must be managed by `ws`. If `reg` is `nil`, this function silently fails.

Synopsis: `table WFloatWS.managed_list(WFloatWS ws)`
Description: Returns a list of regions managed by the workspace (frames, mostly).

Synopsis: `void WFloatWS.raise(WFloatWS ws, WRegion reg)`
Description: Raise `reg` that must be managed by `ws`. If `reg` is `nil`, this function silently fails.

6.4 Functions defined in *mod_panews*

Synopsis: `mod_panews.get()`
Description: Get some module settings. See `mod_panews.set` for documentation on the contents of the returned table.

Synopsis: `mod_panews.set(s)`
Description: Set some module parameters. Currently `s` may contain the following fields:

Field	Description
`template`	layout template for newly created WPaneWS workspaces. This can be either a table or one of the predefined layouts 'default', 'alternative1', and 'alternative2'.
`scalef`	Scale factor for classification heuristics to work with different screen resolutions. The default is 1.0 and is designed for 1280x1024 at 75dpi.
`valid_classifications`	A table with valid window classifications as valid keys.

6.4.1 WSplitPane functions

Synopsis: `WSplit WSplitPane.contents(WSplitPane pane)`
Description: Get root of contained sub-split tree.

Synopsis: `string WSplitPane.marker(WSplitPane pane)`
Description: Get marker.

Synopsis: `bool WSplitPane.set_marker(WSplitPane pane, string s)`
Description: Set marker.

6.5 Functions defined in *mod_query*

Synopsis: `mod_query.defcmd(cmd, fn)`
Description: Define a command override for the `query_exec` query.

Synopsis: `table mod_query.get()`
Description: Get module configuration. For more information see `mod_query.set`.

Synopsis: `void mod_query.history_clear()`
Description: Clear line editor history.

Synopsis: `string mod_query.history_get(integer n)`
Description: Get entry at index `n` in line editor history, 0 being the latest.

Synopsis: `bool mod_query.history_push(string str)`
Description: Push an entry into line editor history.

Synopsis: `integer mod_query.history_search(string s, integer from, bool bwd)`
Description: Try to find matching history entry.

Synopsis: `table mod_query.history_table()`
Description: Return table of history entries.

Synopsis: `WMessage mod_query.message(WMPlex mplex, string p)`
Description: Display a message in the `mplex`.

Synopsis: `void mod_query.set(table tab)`
Description: Set module configuration. The following are supported:

Field	Description
`autoshowcompl`	(boolean) Is (default: tru
`autoshowcompl_delay`	(integer) au liseconds (de

Synopsis: `WMessage mod_query.warn(WMPlex mplex, string p)`
Description: Display an error message box in the multiplexer `mplex`.

Synopsis: `mod_query.popen_completions(cp, cmd, fn, reshnd)`
Description: This function can be used to read completions from an external source. The parameter `cp` is the completion proxy to be used, and the string `cmd` the shell command to be executed. To its stdout, the command should on the first line write the `common_beg` parameter of `WComplProxy.set_completions` (which `fn` maybe used to override) and a single actual completion on each of the successive lines. The function `reshnd` may be used to override a result table building routine.

Synopsis: `mod_query.query(mplex, prompt, initvalue, handler, completor, context)`
Description: Low-level query routine. `mplex` is the WMPlex to display the query in, `prompt` the prompt string, and `initvalue` the initial contents of the query box. `handler` is a function that receives (`mplex`, result string) as parameter when the query has been succesfully completed, `completor` the completor routine which receives a (`cp`, `str`, `point`) as parameters. The parameter `str` is the string to be completed and `point` cursor's location within it. Completions should be eventually, possibly asynchronously, set with `WComplProxy.set_completions` on `cp`.

Synopsis: `mod_query.query_attachclient(mplex)`
Description: This query asks for the name of a client window and switches focus to the one entered. It uses the completion function `ioncore.complete_clientwin`.

Synopsis: `mod_query.query_editfile(mplex, script, prompt)`
Description: Asks for a file to be edited. This script uses `run-mailcap --mode=edit` by default, but you may provide an alternative script to use. The default prompt is "Edit file:" (translated).

Synopsis: `mod_query.query_exec(mplex)`
Description: This function asks for a command to execute with */bin/sh*. If the command is prefixed with a colon (':'), the command will be run in an XTerm (or other terminal emulator) using the script *ion-runinxterm*. Two colons ('::') will ask you to press enter after the command has finished.

Synopsis: `mod_query.query_gotoclient(mplex)`
Description: This query asks for the name of a client window and attaches it to the frame the query was opened in. It uses the completion function `ioncore.complete_clientwin`.

Synopsis: `mod_query.query_lua(mplex)`
Description: This query asks for Lua code to execute. It sets the variable '_' in the local environment of the string to point to the mplex where the query

was created. It also sets the table `arg` in the local environment to `{_, _: current()}`.

Synopsis: `mod_query.query_man(mplex, prog)`
Description: This query asks for a manual page to display. By default it runs the `man` command in an `xterm` using `ion-runinxterm`, but it is possible to pass another program as the `prog` argument.

Synopsis: `mod_query.query_menu(mplex, themenu, prompt)`
Description: This query can be used to create a query of a defined menu.

Synopsis: `mod_query.query_renameframe(frame)`
Description: This function asks for a name new for the frame where the query was created.

Synopsis: `mod_query.query_renameworkspace(mplex)`
Description: This function asks for a name new for the workspace on which the query resides.

Synopsis: `mod_query.query_restart(mplex)`
Description: This query asks whether the user wants restart Ioncore. If the answer is 'y', 'Y' or 'yes', so will happen.

Synopsis: `mod_query.query_runfile(mplex, script, prompt)`
Description: Asks for a file to be viewed. This script uses `run-mailcap --action=view` by default, but you may provide an alternative script to use. The default prompt is "View file:" (translated).

Synopsis: `mod_query.query_shutdown(mplex)`
Description: This query asks whether the user wants to exit Ion (no session manager) or close the session (running under a session manager that supports such requests). If the answer is 'y', 'Y' or 'yes', so will happen.

Synopsis: `mod_query.query_ssh(mplex, ssh)`
Description: This query asks for a host to connect to with SSH. Hosts to tab-complete are read from *~/.ssh/known_hosts*.

Synopsis: `mod_query.query_workspace(mplex)`
Description: This query asks for the name of a workspace. If a workspace (an object inheriting WGenWS) with such a name exists, it will be switched to. Otherwise a new workspace with the entered name will be created and the user will be queried for the type of the workspace.

Synopsis: `mod_query.query_yesno(mplex, prompt, handler)`
Description: This function query will display a query with prompt `prompt` in `mplex` and if the user answers affirmately, call `handler` with `mplex` as parameter.

Synopsis: `mod_query.show_about_ion(mplex)`
Description: Display an "About Ion" message in `mplex`.

Synopsis: `mod_query.show_clientwin(mplex, cwin)`
Description: Show information about a client window.

6.5.1 WComplProxy functions

Synopsis: `bool WComplProxy.set_completions(WComplProxy proxy, table compls)`
Description: Set completion list of the WEdln that `proxy` refers to to `compls`, if it is still waiting for this completion run. The numerical indexes of `compls` list the found completions. If the entry `common_beg` (`common_end`) exists, it gives an extra common prefix (suffix) of all found completions.

6.5.2 WEdln functions

Synopsis: `void WEdln.back(WEdln wedln)`
Description: Move backward one character.

Synopsis: `void WEdln.backspace(WEdln wedln)`
Description: Delete previous character.

Synopsis: `void WEdln.bkill_word(WEdln wedln)`
Description: Starting from the previous characters, delete possible whitespace and preceding alphanumeric characters until previous non-alphanumeric character.

Synopsis: `void WEdln.bol(WEdln wedln)`
Description: Go to the beginning of line.

Synopsis: `void WEdln.bskip_word(WEdln wedln)`
Description: Go to to beginning of current sequence of alphanumeric characters followed by whitespace.

Synopsis: `void WEdln.clear_mark(WEdln wedln)`
Description: Clear *mark*.

Synopsis: `void WEdln.complete(WEdln wedln, bool cycle)`
Description: Call completion handler with the text between the beginning of line and current cursor position, or select next completion from list if in auto-show-completions mode and `cycle` is set.

Synopsis: `string WEdln.contents(WEdln wedln)`
Description: Get line editor contents.

Synopsis: `string WEdln.context(WEdln wedln)`
Description: Get history context for `wedln`.

Synopsis: `void WEdln.copy(WEdln wedln)`
Description: Copy text between *mark* and current cursor position to clipboard.

Synopsis: `void WEdln.cut(WEdln wedln)`
Description: Copy text between *mark* and current cursor position to clipboard and then delete that sequence.

Synopsis: `void WEdln.delete(WEdln wedln)`
Description: Delete current character.

Synopsis: `void WEdln.eol(WEdln wedln)`
Description: Go to the end of line.

Synopsis: `void WEdln.finish(WEdln wedln)`
Description: Close `wedln` and call any handlers.

Synopsis: `void WEdln.forward(WEdln wedln)`
Description: Move forward one character.

Synopsis: `void WEdln.history_next(WEdln wedln, bool match)`
Description: Replace line editor contents with next entry in history if one exists. If `match` is `true`, the initial part of the history entry must match the current line from beginning to point.

Synopsis: `void WEdln.history_prev(WEdln wedln, bool match)`
Description: Replace line editor contents with previous in history if one exists. If `match` is `true`, the initial part of the history entry must match the current line from beginning to point.

Synopsis: `void WEdln.insstr(WEdln wedln, string str)`
Description: Input `str` in wedln at current editing point.

Synopsis: `void WEdln.kill_line(WEdln wedln)`
Description: Delete the whole line.

Synopsis: `void WEdln.kill_to_bol(WEdln wedln)`
Description: Delete all characters from previous to beginning of line.

Synopsis: `void WEdln.kill_to_eol(WEdln wedln)`
Description: Delete all characters from current to end of line.

Synopsis: `void WEdln.kill_word(WEdln wedln)`
Description: Starting from the current point, delete possible whitespace and following alphanumeric characters until next non-alphanumeric character.

Synopsis: `integer WEdln.mark(WEdln wedln)`
Description: Get current mark (start of selection) for `wedln`. Return value of -1 indicates that there is no mark, and 0 is the beginning of the line.

Synopsis: `bool WEdln.next_completion(WEdln wedln)`
Description: Select next completion.

Synopsis: `void WEdln.paste(WEdln wedln)`

Description: Request selection from application holding such.
Note that this function is asynchronous; the selection will not actually be inserted before Ion receives it. This will be no earlier than Ion return to its main loop.

Synopsis: `integer WEdln.point(WEdln wedln)`
Description: Get current editing point. Beginning of the edited line is point 0.

Synopsis: `bool WEdln.prev_completion(WEdln wedln)`
Description: Select previous completion.

Synopsis: `void WEdln.set_context(WEdln wedln, string context)`
Description: Set history context for `wedln`.

Synopsis: `void WEdln.set_mark(WEdln wedln)`
Description: Set *mark* to current cursor position.

Synopsis: `void WEdln.skip_word(WEdln wedln)`
Description: Go to to end of current sequence of whitespace followed by alphanumeric characters..

6.5.3 WInput functions

Synopsis: `void WInput.cancel(WInput input)`
Description: Close input not calling any possible finish handlers.

Synopsis: `void WInput.scrolldown(WInput input)`
Description: Scroll input `input` text contents down.

Synopsis: `void WInput.scrollup(WInput input)`
Description: Scroll input `input` text contents up.

6.6 Functions defined in *mod_menu*

Synopsis: `mod_menu.grabmenu(mplex, sub, menu_or_name, param)`
Description: This function is similar to `mod_menu.menu`, but input is grabbed and the key given either directly as `param` or as `param.key` is used to cycle through the menu.

Synopsis: `mod_menu.menu(mplex, sub, menu_or_name, param)`
Description: Display a menu in the lower-left corner of `mplex`. The variable `menu_or_name` is either the name of a menu defined with `mod_menu.defmenu` or directly a table similar to ones passesd to this function. When this function is called from a binding handler, `sub` should be set to the second argument of to the binding handler (`_sub`) so that the menu handler will get the same parameters as the binding handler. Extra options can be passed in the table `param`. The initial entry can be specified as the field `initial` as an integer

starting from 1. Menus can be made to use a bigger style by setting the field `big` to `true`.

Synopsis: `table mod_menu.get()`
Description: Get module basic settings. For details, see `mod_menu.set`.

Synopsis: `void mod_menu.set(table tab)`
Description: Set module basic settings. The parameter table may contain the following fields:

Field	Description
`scroll_amount`	Number of pixels to scroll at a time pointer-controlled menus when one extends beyond a border of the screen and the pointer touches that border.
`scroll_delay`	Time between such scrolling events in milliseconds.

Synopsis: `mod_menu.pmenu(win, sub, menu_or_name)`
Description: This function displays a drop-down menu and should only be called from a mouse press handler. The parameters are similar to those of `mod_menu.menu`.

6.6.1 WMenu functions

Synopsis: `void WMenu.cancel(WMenu menu)`
Description: Close `menu` not calling any possible finish handlers.

Synopsis: `void WMenu.finish(WMenu menu)`
Description: If selected entry is a submenu, display that. Otherwise destroy the menu and call handler for selected entry.

Synopsis: `void WMenu.select_next(WMenu menu)`
Description: Select next entry in menu.

Synopsis: `void WMenu.select_nth(WMenu menu, integer n)`
Description: Select `n`:th entry in menu.

Synopsis: `void WMenu.select_prev(WMenu menu)`
Description: Select previous entry in menu.

Synopsis: `void WMenu.typeahead_clear(WMenu menu)`
Description: Clear typeahead buffer.

6.7 Functions defined in *mod_dock*

Synopsis: `void mod_dock.set_floating_shown_on(WMPlex mplex, string how)`
Description: Toggle floating docks on `mplex`.

6.7.1 WDock functions

Synopsis: `bool WDock.attach(WDock dock, WRegion reg)`
Description: Attach `reg` to `dock`.

Synopsis: `table WDock.get(WDock dock)`
Description: Get `dock`'s configuration table. See `WDock.set` for a description of the table.

Synopsis: `void WDock.resize(WDock dock)`
Description: Resizes and refreshes `dock`.

Synopsis: `void WDock.set(WDock dock, table conftab)`
Description: Configure `dock`. `conftab` is a table of key/value pairs:

Key	Values	Description
`name`	string	Name of dock
`pos`	string in $\{t, m, b\} \times \{t, c, b\}$	Dock position. Can only be used in floating mode.
`grow`	up/down/left/right	Growth direction where new dockapps are added. Also sets orientation for dock when working as WMPlex status display (see `WMPlex.set_stdisp`).
`is_auto`	bool	Should `dock` automatically manage new dockapps?

Any parameters not explicitly set in `conftab` will be left unchanged.

6.8 Functions defined in *mod_sp*

Synopsis: `bool mod_sp.set_shown(WFrame sp, string how)`
Description: Toggle displayed status of `sp`. The parameter `how` is one of (set/unset/toggle).

Synopsis: `bool mod_sp.set_shown_on(WMPlex mplex, string how)`
Description: Change displayed status of some scratchpad on `mplex` if one is found. The parameter `how` is one of (set/unset/toggle).

6.9 Functions defined in *de*

Synopsis: `bool de.defstyle(string name, table tab)`
Description: Define a style.

Synopsis: `bool de.defstyle_rootwin(WRootWin rootwin, string name, table tab)`
Description: Define a style for the root window `rootwin`.

Synopsis: `void de.reset()`
Description: Clear all styles from drawing engine memory.

Synopsis: `table de.substyle(string pattern, table tab)`
Description: Define a substyle.

6.10 Hooks

Hook name: `clientwin_do_manage_alt`
Parameters: `(WClientWin, table)`
Description: Called when we want to manage a new client window. The table argument contains the following fields:

Field	Type	Description
`switchto`	bool	Do we want to switch to the client window.
`jumpto`	bool	Do we want to jump to the client window.
`userpos`	bool	Geometry set by user.
`dockapp`	bool	Client window is a dockapp.
`maprq`	bool	Map request (and not initialisation scan).
`gravity`	number	Window gravity.
`geom`	table	Requested geometry; `x`, `y`, `w`, `h`.
`tfor`	WClientWin	Transient for window.

This hook is not called in protected mode and can be used for arbitrary placement policies (deciding in which workspace a new WClientWin should go). In this case, you can call
`reg:attach(cwin)`
where `reg` is the region where the window should go, and `cwin` is the first argument of the function added to the hook.

Hook name: `clientwin_mapped_hook`
Parameters: `WClientWin`
Description: Called when we have started to manage a client window.

Hook name: `clientwin_unmapped_hook`
Parameters: `number`
Description: Called when we no longer manage a client window. The parameter is the X ID of the window; see `WClientWin.xid`.

Hook name: `frame_managed_changed_hook`
Parameters: `table`
Description: Called when there are changes in the objects managed by a frame or their order. The table parameter has the following fields:

Field	Type	Description
`reg`	WFrame	The frame in question
`mode`	string	`"switchonly"`, `"reorder"`, `"add"` or `"remove"`
`sw`	bool	Switch occured
`sub`	WRegion	The managed region (primarily) affected

Hook name: `ioncore_sigchld_hook`
Parameters: `integer`
Description: Called when a child process has exited. The parameter is the PID of the process.

Hook name: `ioncore_deinit_hook`
Parameters: `()`
Description: Called when Ion is deinitialising and about to quit.

Hook name: `ioncore_post_layout_setup_hook`
Parameters: `()`
Description: Called when Ion has done all initialisation and is almost ready to enter the mainloop, except no windows are yet being managed.

Hook name: `ioncore_snapshot_hook`
Parameters: `()`
Description: Called to signal scripts and modules to save their state (if any).

Hook name: `ionws_placement_alt`
Parameters: `table`
Description: Called when a client window is about to be managed by a WIonWS to allow for alternative placement policies. The table has the following fields:

Field	Type	Description
`ws`	WIonWS	The workspace
`reg`	WRegion	The region (always a WClientWin at the moment) to be placed
`mp`	table	This table contains the same fields as the parameter of `clientwin_do_manage_alt`
`res_frame`	WFrame	A succesfull handler should return the target frame here.

This hook is just for placing within a given workspace after the workspace has been decided by the default workspace selection policy. It is called in protected mode. For arbitrary placement policies, `clientwin_do_manage_alt` should be used; it isn't called in protected mode,

Hook name: `panews_init_layout_alt`
Parameters: `table`
Description: Called to initialise panews layout. The table parameter has initially a single field `ws` pointing to the workspace, but the succesfull handler should set the field `layout` to a proper layout (as those saved in the layout savefiles).

Hook name: `panews_make_placement_alt`
Parameters: `table`
Description: Called to make a placement on panews. The parameter table has the following fields:

Field	Type	Description
`ws`	WPaneWS	The workspace
`frame`	WFrame	A frame initially allocated for the region to be placed
`reg`	WRegion	The region to be placed
`specifier`	WRegion	For drag&drop on handling empty areas

The handler should set some of these fields on success:

Field	Type	Description
`res_node`	WSplit	Target split
`res_config`	WFrame	New configuration for it, unless WSplitRegion
`res_w`	integer	New width for target split (optional)
`res_h`	integer	New height for target split (optional)

Hook name: `region_activated_hook`
Parameters: `WRegion`
Description: Signalled when a region or one of its children has received the focus.

Hook name: `region_activity_hook`
Parameters: `WRegion`
Description: This hook is triggered when the activity flag of the parameter region has been changed.

Hook name: `region_do_warp_alt`
Parameters: `WRegion`
Description: This alt-hook exist to allow for alternative pointer warping implementations.

Hook name: `region_inactivated_hook`
Parameters: `WRegion`
Description: Signalled when the focus has moved from the parameter region or one of its children to a non-child region of the parameter region.

Hook name: `screen_managed_changed_hook`
Parameters: `table`
Description: Called when there are changes in the objects managed by a screen or their order. The table parameter is similar to that of `frame_managed_changed_hook`.

Appendix A

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Preamble

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Appendix B

Full class hierarchy visible to Lua-side

```
Obj
 |-->WHook
 |-->WTimer
 |-->WMoveresMode
 |-->WMgmtMode (mod_mgmtmode)
 |-->WRegion
 |    |-->WClientWin
 |    |-->WWindow
 |    |    |-->WRootWin
 |    |    |-->WMPlex
 |    |    |    |-->WScreen
 |    |    |    |-->WFrame
 |    |    |         |-->WFloatFrame (mod_floatws)
 |    |    |         |-->WScratchpad (mod_statusbar)
 |    |    |-->WInfoWin
 |    |    |    |-->WStatusBar (mod_statusbar)
 |    |    |-->WMenu (mod_menu)
 |    |    |-->WInput (mod_query)
 |    |         |-->WEdln (mod_query)
 |    |         |-->WMessage (mod_query)
 |    |
 |    |-->WGenWS
 |         |-->WIonWS (mod_ionws)
 |         |    |-->WPaneWS (mod_ionws)
 |         |-->WFloatWS (mod_floatws)
 |-->WSplit (mod_ionws)
      |-->WSplitInner (mod_ionws)
      |    |-->WSplitSplit
      |    |    |-->WSplitFloat (mod_ionws)
      |    |-->WSplitPane (mod_panews)
      |-->WSplitRegion (mod_ionws)
           |-->WSplitUnused (mod_panews)
```

List of functions

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