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# **DFHack Documentation**

***Release 0.43.05-r1***

**The DFHack Team**

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# CHAPTER 1

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## Introduction

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DFHack is a Dwarf Fortress memory access library, distributed with a wide variety of useful scripts and plugins.

The project is currently hosted at <https://www.github.com/DFHack/dfhack>, and can be downloaded from [the releases page](#).

All new releases are announced in [the bay12 forums thread](#), which is also a good place for discussion and questions.

For users, it provides a significant suite of bugfixes and interface enhancements by default, and more can be enabled. There are also many tools (such as *workflow* or *autodump*) which can make life easier. You can even add third-party scripts and plugins to do almost anything!

For modders, DFBHack makes many things possible. Custom reactions, new interactions, magic creature abilities, and more can be set through *Scripts for Modders* and custom raws. Non-standard DFBHack scripts and inits can be stored in the raw directory, making raws or saves fully self-contained for distribution - or for coexistence in a single DF install, even with incompatible components.

For developers, DFBHack unites the various ways tools access DF memory and allows easier development of new tools. As an open-source project under *various copyleft licences*, contributions are welcome.



### Introduction and Overview

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#### Contents

- *Introduction and Overview*
  - *Installing DFBHack*
  - *Getting started*
  - *Troubleshooting*

## Installing DFHack

DFHack is available for the SDL version of Dwarf Fortress on Windows, any modern Linux distribution, and Mac OS X (10.6.8 and later). It is possible to use Windows DF+DFHack under Wine on Linux or OS X.

Most releases only support the version of DF mentioned in their title - for example, DFHack 0.40.24-r2 only supports DF 0.40.24 - but some releases support earlier DF versions as well. Wherever possible, use the latest version of DFHack built for the target version of DF.

Installing DFhack involves copying files from a release archive into your DF folder, so that:

- On Windows, `SDL.dll` is replaced
- On Linux or OS X, the `dfhack` script is placed in the same folder as the `df` script

Uninstalling is basically the same, in reverse:

- On Windows, replace `SDL.dll` with `SDLreal.dll`, then remove the DFHack files.
- On Linux or OS X, remove the DFHack files.

New players may wish to [get a pack](#) with DFHack preinstalled.

## Getting started

DFHack basically extends DF with something similar to the console found in many PC games.

If DFHack is installed correctly, it will automatically pop up a console window once DF is started as usual on Windows. Linux and Mac OS X require running the `dfhack` script from the terminal, and will use that terminal for the console.

- Basic interaction with `dfhack` involves entering commands into the console. To learn what commands are available, you can keep reading this documentation or skip ahead and use the `ls` and `help` commands.
- Another way to interact with DFHack is to set in-game [keybindings](#) for certain commands. Many of the newer and user-friendly tools are designed to be used this way.
- Commands can also run at startup via [init files](#), or in batches at other times with the `script` command.
- Finally, some commands are persistent once enabled, and will sit in the background managing or changing some aspect of the game if you [enable](#) them.

## Troubleshooting

Don't panic! Even if you need this section, it'll be OK :)

If something goes wrong, check the log files in DF's folder (`stderr.log` and `stdout.log`). Looking at these might help you - or someone else - solve the problem. Take screenshots of any weird error messages, and take notes on what you did to cause them.

If the search function in this documentation isn't enough and the [DF Wiki](#) hasn't helped, try asking in:

- the [#dfhack IRC channel on freenode](#)
- the [Bay12 DFHack thread](#)
- the [/r/dwarffortress](#) questions thread
- the thread for the mod or Starter Pack you're using (if any)



## DFHack Core

### Contents

- *DFHack Core*
  - *Command Implementation*
  - *Using DFHack Commands*
  - *Built-in Commands*
  - *Init Files*
  - *Miscellaneous Notes*

## Command Implementation

DFHack commands can be implemented in three ways, all of which are used in the same way:

**builtin** commands are implemented by the core of DFHack. They manage other DFhack tools, interpret commands, and control basic aspects of DF (force pause or quit).

**plugins** are stored in `hack/plugins/` and must be compiled with the same version of DFHack. They are less flexible than scripts, but used for complex or ongoing tasks because they run faster.

**scripts** are Ruby or Lua scripts stored in `hack/scripts/`. Because they don't need to be compiled, scripts are more flexible about versions, and easier to distribute. Most third-party DFHack addons are scripts.

## Using DFHack Commands

DFHack commands can be executed in a number of ways:

1. Typing the command into the DFHack console (see below)
2. From the OS terminal (see below)
3. Pressing a key combination set up with *keybinding*
4. From one of several *Init Files*, automatically
5. Using *script* to run a batch of commands from a file

### The DFHack Console

The command line has some nice line editing capabilities, including history that's preserved between different runs of DF - use `↑` and `↓` to go through the history.

To include whitespace in the argument/s to some command, quote it in double quotes. To include a double quote character, use `\`.

If the first non-whitespace character is `:`, the command is parsed in an alternative mode. The non-whitespace characters following the `:` are the command name, and the remaining part of the line is used verbatim as the first argument. This is very useful for the *lua* and *ruby* commands. As an example, the following two command lines are exactly equivalent:

```
:foo a b "c d" e f
foo "a b \"c d\" e f"
```

## Using an OS terminal

DFHack commands can be run from an OS terminal at startup, using ‘+ args’, or at any other time using the `dfhack-run` executable.

If DF/DFHack is started with arguments beginning with +, the remaining text is treated as a command in the DFHack console. It is possible to use multiple such commands, which are split on +. For example:

```
./dfhack +load-save region1
"Dwarf Fortress.exe" +devel/print-args Hello! +enable workflow
```

The first example (\*nix), *load-save*, skips the main menu and loads `region1` immediately. The second (Windows) example prints *Hello!* in the DFHack console, and *enables workflow*. Note that the `:foo` syntax for whitespace in arguments is not compatible with ‘+ args’.

If DF and DFHack are already running, calling `dfhack-run my command` in an external terminal is equivalent to calling `my command` in the DFHack console. Direct use of the DFHack console is generally easier, but `dfhack-run` can be useful in a variety of circumstances:

- if the console is unavailable
  - with the init setting `PRINT_MODE:TEXT`
  - while running an interactive command (eg. *liquids* or *tiletypes*)
- from external programs or scripts
- if DF or DFHack are not responding

Examples:

```
./dfhack-run cursecheck
dfhack-run multicmd kill-lua; die
```

The first (\*nix) example *checks for vampires*; the second (Windows) example uses *kill-lua* to cancel a script and exits.

## Built-in Commands

The following commands are provided by the ‘core’ components of DFhack, rather than plugins or scripts.

- *cls*
- *die*
- *enable*
- *fpause*
- *help*
- *hide*
- *keybinding*
- *kill-lua*

- *load*
- *ls*
- *plug*
- *sc-script*
- *script*
- *show*
- *type*
- *Other Commands*

## cls

Clear the terminal. Does not delete command history.

## die

Instantly kills DF without saving.

## enable

Many plugins can be in a distinct enabled or disabled state. Some of them activate and deactivate automatically depending on the contents of the world raws. Others store their state in world data. However a number of them have to be enabled globally, and the init file is the right place to do it.

Most such plugins or scripts support the built-in `enable` and `disable` commands. Calling them at any time without arguments prints a list of enabled and disabled plugins, and shows whether that can be changed through the same commands.

To enable or disable plugins that support this, use their names as arguments for the command:

```
enable manipulator search
```

## fpause

Forces DF to pause. This is useful when your FPS drops below 1 and you lose control of the game.

## help

Most commands support using the `help <command>` built-in command to retrieve further help without having to look at this document. `? <cmd>` and `man <cmd>` are aliases.

Some commands (including many scripts) instead take `help` or `?` as an option on their command line - ie `<cmd> help`.

## hide

Hides the DFHack terminal window. Only available on Windows.

## keybinding

To set keybindings, use the built-in `keybinding` command. Like any other command it can be used at any time from the console, but bindings are not remembered between runs of the game unless re-created in *dfhack\*.init*.

Currently, any combinations of Ctrl/Alt/Shift with A-Z, 0-9, or F1-F12 are supported.

Possible ways to call the command:

**keybinding list <key>** List bindings active for the key combination.

**keybinding clear <key> <key>...** Remove bindings for the specified keys.

**keybinding add <key> "cmdline" "cmdline"...** Add bindings for the specified key.

**keybinding set <key> "cmdline" "cmdline"...** Clear, and then add bindings for the specified key.

The <key> parameter above has the following *case-sensitive* syntax:

```
[Ctrl-] [Alt-] [Shift-] KEY[@context[|context...]]
```

where the *KEY* part can be any recognized key and [] denote optional parts.

When multiple commands are bound to the same key combination, DFHack selects the first applicable one. Later add commands, and earlier entries within one add command have priority. Commands that are not specifically intended for use as a hotkey are always considered applicable.

The *context* part in the key specifier above can be used to explicitly restrict the UI state where the binding would be applicable. If called without parameters, the `keybinding` command among other things prints the current context string.

Only bindings with a *context* tag that either matches the current context fully, or is a prefix ending at a / boundary would be considered for execution, i.e. when in context `foo/bar/baz`, keybindings restricted to any of `@foo/bar/baz`, `@foo/bar`, `@foo` or none will be active.

Multiple contexts can be specified by separating them with a pipe (|) - for example, `@foo|bar|baz/foo` would match anything under `@foo`, `@bar`, or `@baz/foo`.

Interactive commands like *liquids* cannot be used as hotkeys.

## kill-lua

Stops any currently-running Lua scripts. By default, scripts can only be interrupted every 256 instructions. Use `kill-lua force` to interrupt the next instruction.

## load

`load`, `unload`, and `reload` control whether a plugin is loaded into memory - note that plugins are loaded but disabled unless you do something. Usage:

```
load|unload|reload PLUGIN [-a|--all]
```

Allows dealing with plugins individually by name, or all at once.

## ls

`ls` does not list files like the Unix command, but rather available commands - first built in commands, then plugins, and scripts at the end. Usage:

**ls -a** Also list scripts in subdirectories of `hack/scripts/`, which are generally not intended for direct use.

**ls <plugin>** List subcommands for the given plugin.

## plug

Lists available plugins, including their state and detailed description.

**plug** Lists available plugins (*not* commands implemented by plugins)

**plug [PLUGIN] [PLUGIN] . . .** List state and detailed description of the given plugins, including commands implemented by the plugin.

## sc-script

Allows additional scripts to be run when certain events occur (similar to `onLoad*.init` scripts)

## script

Reads a text file, and runs each line as a DFHack command as if it had been typed in by the user - treating the input like *an init file*.

Some other tools, such as *autobutcher* and *workflow*, export their settings as the commands to create them - which are later loaded with `script`

## show

Shows the terminal window after it has been *hidden*. Only available on Windows. You'll need to use it from a *keybinding* set beforehand, or the in-game *command-prompt*.

## type

`type command` shows where `command` is implemented.

## Other Commands

The following commands are *not* built-in, but offer similarly useful functions.

- *command-prompt*
- *hotkeys*
- *lua*
- *multicmd*
- *nopause*
- *quicksave*
- *ruby*
- *repeat*

## Init Files

- *dfhack\*.init*
- *onLoad\*.init*
- *onUnload\*.init*
- *Other init files*

DFHack allows users to automatically run commonly-used DFHack commands when DF is first loaded, when a game is loaded, and when a game is unloaded.

Init scripts function the same way they would if the user manually typed in their contents, but are much more convenient. In order to facilitate savegame portability, mod merging, and general organization of init files, DFHack supports multiple init files both in the main DF directory and save-specific init files in the save folders.

DFHack looks for init files in three places each time they could be run:

1. The main DF directory
2. `data/save/world/raw`, where `world` is the current save, and
3. `data/save/world/raw/objects`

When reading commands from `dfhack.init` or with the *script* command, if the final character on a line is a backslash then the next uncommented line is considered a continuation of that line, with the backslash deleted. Commented lines are skipped, so it is possible to comment out parts of a command with the `#` character.

### dfhack\*.init

If your DF folder contains at least one file named `dfhack*.init` (where `*` is a placeholder for any string), then all such files are executed in alphabetical order when DF is first started.

DFHack is distributed with `/dfhack.init-example` as an example with an up-to-date collection of basic commands; mostly setting standard keybindings and *enabling* plugins. You are encouraged to look through this file to learn which features it makes available under which key combinations. You may also customise it and rename it to `dfhack.init`.

If your DF folder does not contain any `dfhack*.init` files, the example will be run as a fallback.

These files are best used for keybindings and enabling persistent plugins which do not require a world to be loaded.

### onLoad\*.init

When a world is loaded, DFHack looks for files of the form `onLoad*.init`, where `*` can be any string, including the empty string.

All matching init files will be executed in alphabetical order. A world being loaded can mean a fortress, an adventurer, or legends mode.

These files are best used for non-persistent commands, such as setting a *fix* script to run on *repeat*.

### onUnload\*.init

When a world is unloaded, DFHack looks for files of the form `onUnload*.init`. Again, these files may be in any of the above three places. All matching init files will be executed in alphabetical order.

Modders often use such scripts to disable tools which should not affect an unmodded save.

### Other init files

- `onMapLoad*.init` and `onMapUnload*.init` are run when a map, distinct from a world, is loaded. This is good for map-affecting commands (eg *clean*), or avoiding issues in Legends mode.
- Any lua script named `raw/init.d/*.lua`, in the save or main DF directory, will be run when any world or that save is loaded.

## Miscellaneous Notes

This section is for odd but important notes that don't fit anywhere else.

- If a DF H hotkey is named with a DFHack command, pressing the corresponding Fx button will run that command, instead of zooming to the set location. *This feature will be removed in a future version.* (see [Issue 731](#))
- The binaries for 0.40.15-r1 to 0.34.11-r4 are on [DFFD](#). Older versions are available [here](#). *These files will eventually be migrated to GitHub.* (see [Issue 473](#))

## DFHack Plugins

DFHack plugins are the commands, that are compiled with a specific version. They can provide anything from a small keybinding, to a complete overhaul of game subsystems or the entire renderer.

Most commands offered by plugins are listed here, hopefully organised in a way you will find useful.

### Contents

- *DFHack Plugins*
  - *Data inspection and visualizers*
  - *Bugfixes*
  - *UI Upgrades*
  - *Job and Fortress management*
  - *Map modification*
  - *Mods and Cheating*

## Data inspection and visualizers

- *stonesense*
- *blueprint*
- *remotefortressreader*
- *cursecheck*

- *flows*
- *probe*
- *prospect*
- *reveal*
- *showmood*

## stonesense

An isometric visualizer that runs in a second window. Usage:

**stonesense** Open the visualiser in a new window. Alias `ssense`.

**ssense overlay** Overlay DF window, replacing the map area.

For more information, see the full Stonesense README.

## blueprint

Exports a portion of your fortress into QuickFort style blueprint files.:

```
blueprint <x> <y> <z> <name> [dig] [build] [place] [query]
```

Options (If only region and name are given, export all):

**x,y,z** Size of map area to export

**name** Name of export files

**dig** Export dig commands to “<name>-dig.csv”

**build** Export build commands to “<name>-build.csv”

**place** Export stockpile commands to “<name>-place.csv”

**query** Export query commands to “<name>-query.csv”

Goes very well with *fortplan*, for re-importing.

## remotefortressreader

An in-development plugin for realtime fortress visualisation. See [Armok Vision](#).

## cursecheck

Checks a single map tile or the whole map/world for cursed creatures (ghosts, vampires, necromancers, werebeasts, zombies).

With an active in-game cursor only the selected tile will be observed. Without a cursor the whole map will be checked.

By default cursed creatures will be only counted in case you just want to find out if you have any of them running around in your fort. Dead and passive creatures (ghosts who were put to rest, killed vampires, ...) are ignored. Undead skeletons, corpses, bodyparts and the like are all thrown into the curse category “zombie”. Anonymous zombies and resurrected body parts will show as “unnamed creature”.

Options:



**detail** Print full name, date of birth, date of curse and some status info (some vampires might use fake identities in-game, though).

**nick** Set the type of curse as nickname (does not always show up in-game, some vamps don't like nicknames).

**all** Include dead and passive cursed creatures (can result in a quite long list after having FUN with necromancers).

**verbose** Print all curse tags (if you really want to know it all).

Examples:

**cursecheck detail all** Give detailed info about all cursed creatures including deceased ones (no in-game cursor).

**cursecheck nick** Give a nickname all living/active cursed creatures on the map(no in-game cursor).

---

**Note:** If you do a full search (with the option "all") former ghosts will show up with the cursetype "unknown" because their ghostly flag is not set.

Please report any living/active creatures with cursetype "unknown" - this is most likely with mods which introduce new types of curses.

---

## flows

A tool for checking how many tiles contain flowing liquids. If you suspect that your magma sea leaks into HFS, you can use this tool to be sure without revealing the map.

## probe

Can be used to determine tile properties like temperature.

## prospect

Prints a big list of all the present minerals and plants. By default, only the visible part of the map is scanned.

Options:

**all** Scan the whole map, as if it was revealed.

**value** Show material value in the output. Most useful for gems.

**hell** Show the Z range of HFS tubes. Implies 'all'.

If prospect is called during the embark selection screen, it displays an estimate of layer stone availability.

---

**Note:** The results of pre-embark prospect are an *estimate*, and can at best be expected to be somewhere within +/- 30% of the true amount; sometimes it does a lot worse. Especially, it is not clear how to precisely compute how many soil layers there will be in a given embark tile, so it can report a whole extra layer, or omit one that is actually present.

---

Options:

**all** Also estimate vein mineral amounts.

## reveal

This reveals the map. By default, HFS will remain hidden so that the demons don't spawn. You can use `reveal hell` to reveal everything. With hell revealed, you won't be able to unpause until you hide the map again. If you really want to unpause with hell revealed, use `reveal demons`.

Reveal also works in adventure mode, but any of its effects are negated once you move. When you use it this way, you don't need to run `unreveal`.

Usage and related commands:

**reveal** Reveal the whole map, except for HFS to avoid demons spawning

**reveal hell** Also show hell, but requires `unreveal` before unpausing

**reveal demon** Reveals everything and allows unpausing - good luck!

**unreveal** Reverts the effects of `reveal`

**revtoggle** Switches between `reveal` and `unreveal`

**revflood** Hide everything, then reveal tiles with a path to the cursor (useful to make walled-off rooms vanish)

**revforget** Discard info about what was visible before revealing the map. Only useful where (eg) you abandoned with the fort revealed and no longer want the data.

## showmood

Shows all items needed for the currently active strange mood.

## Bugfixes

- *fix-unit-occupancy*
- *fixveins*
- *petcapRemover*
- *tweak*
- *fix-armory*

### fix-unit-occupancy

This plugin fixes issues with unit occupancy, notably phantom “unit blocking tile” messages ([Bug 3499](#)). It can be run manually, or periodically when enabled with the built-in enable/disable commands:

**(no argument)** Run the plugin once immediately, for the whole map.

**-h, here, cursor** Run immediately, only operate on the tile at the cursor

**-n, dry, dry-run** Run immediately, do not write changes to map

**interval <X>** Run the plugin every X ticks (when enabled). The default is 1200 ticks, or 1 day. Ticks are only counted when the game is unpaused.

## fixveins

Removes invalid references to mineral inclusions and restores missing ones. Use this if you broke your embark with tools like [tiletypes](#), or if you accidentally placed a construction on top of a valuable mineral floor.

## petcapRemover

Allows you to remove or raise the pet population cap. In vanilla DF, pets will not reproduce unless the population is below 50 and the number of children of that species is below a certain percentage. This plugin allows removing the second restriction and removing or raising the first. Pets still require PET or PET\_EXOTIC tags in order to reproduce. Type `help petcapRemover` for exact usage. In order to make population more stable and avoid sudden population booms as you go below the raised population cap, this plugin counts pregnancies toward the new population cap. It can still go over, but only in the case of multiple births.

Usage:

**petcapRemover** cause pregnancies now and schedule the next check

**petcapRemover every n** set how often in ticks the plugin checks for possible pregnancies

**petcapRemover cap n** set the new cap to n. if n = 0, no cap

**petcapRemover preptime n** sets the pregnancy duration to n ticks. natural pregnancies are 300000 ticks for the current race and 200000 for everyone else

## tweak

Contains various tweaks for minor bugs.

One-shot subcommands:

**clear-missing** Remove the missing status from the selected unit. This allows engraving slabs for ghostly, but not yet found, creatures.

**clear-ghostly** Remove the ghostly status from the selected unit and mark it as dead. This allows getting rid of bugged ghosts which do not show up in the engraving slab menu at all, even after using clear-missing. It works, but is potentially very dangerous - so use with care. Probably (almost certainly) it does not have the same effects like a proper burial. You've been warned.

**fixmigrant** Remove the resident/merchant flag from the selected unit. Intended to fix bugged migrants/traders who stay at the map edge and don't enter your fort. Only works for dwarves (or generally the player's race in modded games). Do NOT abuse this for 'real' caravan merchants (if you really want to kidnap them, use 'tweak makeown' instead, otherwise they will have their clothes set to forbidden etc).

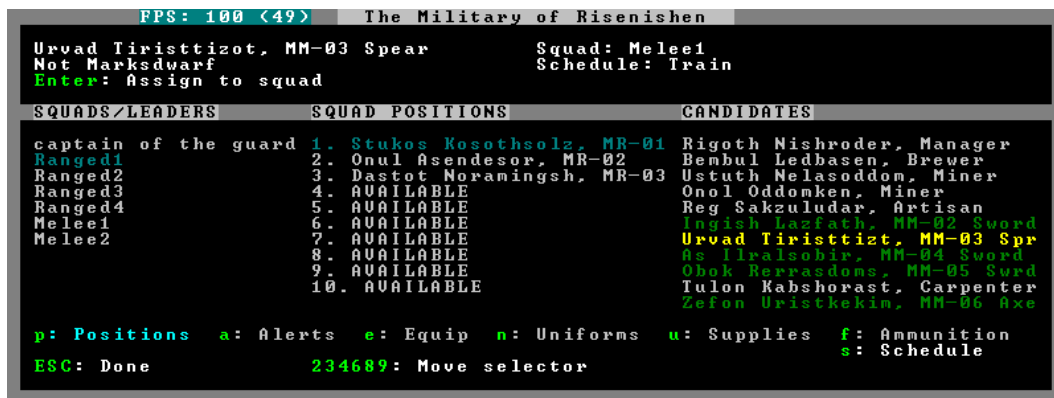
**makeown** Force selected unit to become a member of your fort. Can be abused to grab caravan merchants and escorts, even if they don't belong to the player's race. Foreign sentients (humans, elves) can be put to work, but you can't assign rooms to them and they don't show up in DwarfTherapist because the game treats them like pets. Grabbing draft animals from a caravan can result in weirdness (animals go insane or berserk and are not flagged as tame), but you are allowed to mark them for slaughter. Grabbing wagons results in some funny spam, then they are scuttled.

Subcommands that persist until disabled or DF quits:

**adamantine-cloth-wear** Prevents adamantine clothing from wearing out while being worn ([Bug 6481](#)).

**advmode-contained** Works around [Bug 6202](#), custom reactions with container inputs in advmode. The issue is that the screen tries to force you to select the contents separately from the container. This forcefully skips child reagents.

- block-labors** Prevents labors that can't be used from being toggled
- civ-view-agreement** Fixes overlapping text on the “view agreement” screen
- condition-material** Fixes a crash in the work order condition material list ([Bug 9905](#)).
- craft-age-wear** Fixes the behavior of crafted items wearing out over time ([Bug 6003](#)). With this tweak, items made from cloth and leather will gain a level of wear every 20 years.
- embark-profile-name** Allows the use of lowercase letters when saving embark profiles
- eggs-fertile** Displays a fertility indicator on nestboxes
- farm-plot-select** Adds “Select all” and “Deselect all” options to farm plot menus
- fast-heat** Further improves temperature update performance by ensuring that 1 degree of item temperature is crossed in no more than specified number of frames when updating from the environment temperature. This reduces the time it takes for stable-temp to stop updates again when equilibrium is disturbed.
- fast-trade** Makes Shift-Down in the Move Goods to Depot and Trade screens select the current item (fully, in case of a stack), and scroll down one line.
- fps-min** Fixes the in-game minimum FPS setting
- hide-priority** Adds an option to hide designation priority indicators
- hotkey-clear** Adds an option to clear currently-bound hotkeys (in the H menu)
- import-priority-category** Allows changing the priority of all goods in a category when discussing an import agreement with the liaison
- kitchen-keys** Fixes DF kitchen meal keybindings ([Bug 614](#))
- kitchen-prefs-color** Changes color of enabled items to green in kitchen preferences
- kitchen-prefs-empty** Fixes a layout issue with empty kitchen tabs ([Bug 9000](#))
- max-wheelbarrow** Allows assigning more than 3 wheelbarrows to a stockpile
- military-color-assigned** Color squad candidates already assigned to other squads in yellow/green to make them stand out more in the list.



- military-stable-assign** Preserve list order and cursor position when assigning to squad, i.e. stop the rightmost list of the Positions page of the military screen from constantly resetting to the top.
- nestbox-color** Fixes the color of built nestboxes
- shift-8-scroll** Gives Shift-8 (or \*) priority when scrolling menus, instead of scrolling the map
- stable-cursor** Saves the exact cursor position between t/q/k/d/b/etc menus of fortress mode.

**title-start-rename** Adds a safe rename option to the title screen “Start Playing” menu

**tradereq-pet-gender** Displays pet genders on the trade request screen

### fix-armory

*This plugin requires a binpatch, which has not been available since DF 0.34.11*

## UI Upgrades

---

**Note:** In order to avoid user confusion, as a matter of policy all GUI tools display the word *DFHack* on the screen somewhere while active.

When that is not appropriate because they merely add keybinding hints to existing DF screens, they deliberately use red instead of green for the key.

---

- *automelt*
- *autotrade*
- *command-prompt*
- *hotkeys*
- *ruby*
- *manipulator*
  - *Professions*
- *search*
- *nopause*
- *embark-tools*
- *automaterial*
- *buildingplan*
- *confirm*
- *follow*
- *mousequery*
- *resume*
- *title-folder*
- *title-version*
- *trackstop*
- *sort-items*
- *sort-units*
- *stocks*
- *stocksettings*

- *rename*
- *rendermax*

## automelt

When automelt is enabled for a stockpile, any meltable items placed in it will be designated to be melted. This plugin adds an option to the `q` menu when *enabled*.

## autotrade

When autotrade is enabled for a stockpile, any items placed in it will be designated to be taken to the Trade Depot whenever merchants are on the map. This plugin adds an option to the `q` menu when *enabled*.

## command-prompt

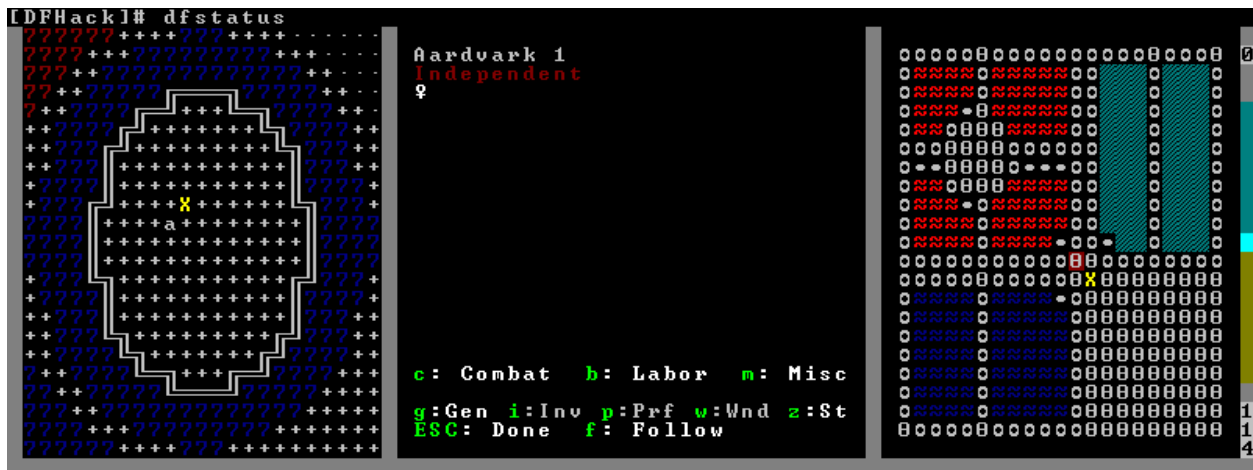
An in-game DFHack terminal, where you can enter other commands.

**Keybinding:** CtrlShiftP

Usage: `command-prompt [entry]`

If called with an entry, it starts with that text filled in. Most useful for developers, who can set a keybinding to open a language interpreter for lua or Ruby by starting with the `:lua` or `:rb` commands.

Otherwise somewhat similar to *gui/quickcmd*.



## hotkeys

Opens an in-game screen showing which DFHack keybindings are active in the current context. See also *hotkey-notes*.



Keybinding: CtrlF1

Keybinding: AltF1

ruby

Ruby language plugin, which evaluates the following arguments as a ruby string. Best used as :rb [string], for the special parsing mode. Alias rb\_eval.

manipulator

An in-game equivalent to the popular program Dwarf Therapist.

To activate, open the unit screen and press l.



The far left column displays the unit's Happiness (color-coded based on its value), Name, Profession/Squad, and the right half of the screen displays each dwarf's labor settings and skill levels (0-9 for Dabbling through Professional, A-E for Great through Grand Master, and U-Z for Legendary through Legendary+5).

Cells with teal backgrounds denote skills not controlled by labors, e.g. military and social skills.

```

Dwarf Manipulator - Manage Labors
Hap. Name Profession rxwMhScKBBPLBSKMFAASDLTSDCOCBPNJLICGFCPAORTCS
144 Obok Ustuthedtûl Engraver 0-3-----00021014-11-10--111-11111-0---
137 Meng Idkêshshak Brewer 2-3-1-2---000041014020-00--22-22--22-0---
121 Endok Isondodók Peasant 0-3-----0-1-0030-2-20--222-2-2222---
162 Solon Otungkulet Surgeon -2-----000-0-2-20--222-222222---
183 Udib Likotidash Glassmaker -2-----000-000-222-222-22---
172 Rakust Metulbonr Brewer -2--2---001-----222-222222---
1169 Zulban Ducinnora Planter -2-----000-----333-333333---
161 Uvash ôsustastes Armorer 0-2-----00-----3333333-3---
210 Udil Govosdishna Planter -2-----000-----333-333333---
185 Stâkud Ceroltang Engraver -2-----000-----333-333333---
181 Solon Ulzestzugl Gem Setter -2-----000-----222-222222---
174 Doren Rinalnil Miner 0-2-----00-----333-433333---
182 Dodók Râlukatîr Carpenter -2-----000-----3333333-3---
194 Datan Sâkzulesht Miner 0-2-----00-----444-44444---

ø Obok Fencegrooved. Engraver: Skilled Swordsman (540/900)
Squad: The Emancipated Armors Pos 3

Enter: Toggle labor, Shift+Enter: Toggle Group, v: ViewCre, c: Zoom-Cre
ESC: Done, t: Toggle View, +-: Sort by Skill, */: Sort by <Tab> Name
DFHack

```

Press `t` to toggle between Profession, Squad, and Job views.

```

Dwarf Manipulator - Manage Labors
Hap. Name Squad rxwMhScKBBPLBSKMFAASDLTSDCOCBPNJLICGFCPAORTCS
152 Asmel Zarethatis 1.Axe Squa 07-0-----0000-123031-10--111-11111-1---
137 Zasit Shetbêthil 8.Axe Squa 04-----00004-123003-30--333-3-3-33-0---
124 Monom Mengberdan 4.Axe Squa 04-----0004-123012-20--222-22222-0---
146 Zas âkildodók 9.Axe Squa 03-----00024-122001-11--222-2-2222-0---
116 Shorast Dishmabt 7.Axe Squa 03-0-----0014-123022-20--332-23333-0-0-
137 Meng Idkêshshak 4.The Eman 2-3-1-2---000041014020-00--22-22--22-0---
223 Sigun Zonenkos 1.The Ench 1--1-9-----000046014123-30--111-1-1111-1---
129 Catten Ushatfiko 10.The Enc 0--0-A-----00049126043-31--122-222121-1---
133 Udib Zefonkikros 5.The Ench 1--1-9-----00048125033-31--111-11111-0---
201 Ducim Amostrinta 02-0-----0-24-132001-10--222-22222-0---
137 Nish Eshtânostat 7.The Ench 1--0-8-----0-36126-24-40--212-22222-0---
124 Udib Berokosh Et 3.The Ench 0--1-B-----00-30125023-30--111-11111-1---
129 Kulet Lemisurvad 6.Axe Squa 02-----00013-122001-10--222--22222-0---
132 Zasit âmalâth êr 4.The Ench 1--0-D-----000-3C125-33-30--111--11-11-1---

ø Asmel Desertstake, militia captain: Talented Fighter (681/1100)
Squad: Axe Squad Pos 1

Enter: Toggle labor, Shift+Enter: Toggle Group, v: ViewCre, c: Zoom-Cre
ESC: Done, t: Toggle View, +-: Sort by Skill, */: Sort by <Tab> Squad
DFHack

```

Use the arrow keys or number pad to move the cursor around, holding `Shift` to move 10 tiles at a time.

Press the Z-Up (`<`) and Z-Down (`>`) keys to move quickly between labor/skill categories. The numpad Z-Up and Z-Down keys seek to the first or last unit in the list. `Backspace` seeks to the top left corner.

Press `Enter` to toggle the selected labor for the selected unit, or `Shift+Enter` to toggle all labors within the selected category.

Press the `+-` keys to sort the unit list according to the currently selected skill/labor, and press the `*/` keys to sort the unit list by Name, Profession/Squad, Happiness, or Arrival order (using `Tab` to select which sort method to use here).

With a unit selected, you can press the `v` key to view its properties (and possibly set a custom nickname or profession) or the `c` key to exit Manipulator and zoom to its position within your fortress.

The following mouse shortcuts are also available:

- Click on a column header to sort the unit list. Left-click to sort it in one direction (descending for happiness or labors/skills, ascending for name, profession or squad) and right-click to sort it in the opposite direction.
- Left-click on a labor cell to toggle that labor. Right-click to move the cursor onto that cell instead of toggling it.
- Left-click on a unit's name, profession or squad to view its properties.
- Right-click on a unit's name, profession or squad to zoom to it.

Pressing `Esc` normally returns to the unit screen, but `ShiftEsc` would exit directly to the main dwarf mode screen.



## Professions

The manipulator plugin supports saving Professions: a named set of Labors labors that can be quickly applied to one or multiple Dwarves.

To save a Profession highlight a Dwarf and press P. The Profession will be saved using the Custom Profession Name of the Dwarf, or the default for that Dwarf if no Custom Profession Name has been set.

To apply a Profession either highlight a single Dwarf, or select multiple with x, and press p to select the Profession to apply. All labors for the selected Dwarves will be reset to the labors of the chosen Profession.

## search

The search plugin adds search to the Stocks, Animals, Trading, Stockpile, Noble (assignment candidates), Military (position candidates), Burrows (unit list), Rooms, Announcements, Job List and Unit List screens.

```

FPS: 100 (49) Dwarf Fortress
Citizens (9) Pets/Livestock (81) Others (19) Dead/Missing (33)
Ustuth Nelasoddon, Miner Store Item in Stockpile
Onol Oddomken, Miner Construct Building
Bim Kellogem, Miner Sleep
Litast Olinrir, Miner No Job
Dastot Noramingish, MR-03 Drink
As Alathgamil, Animal Dissector Make cloth trousers/R
Ablel Thimshurzepon, Blacksmith Store Item in Bin
Bomrek Lorgikut, Weaponsmith Drink
Astesh Uirtulon, Milker No Job

v: ViewCre, c: Zoom-Cre, b: Zoom-Bld, m: Manager, r: Renu Cre
l: Manage labors (DFHack) s: Search: Mi_

```

Searching works the same way as the search option in *Move to Depot*. You will see the Search option displayed on screen with a hotkey (usually s). Pressing it lets you start typing a query and the relevant list will start filtering automatically.

Pressing Enter, Esc or the arrow keys will return you to browsing the now filtered list, which still functions as normal. You can clear the filter by either going back into search mode and backspacing to delete it, or pressing the “shifted” version of the search hotkey while browsing the list (e.g. if the hotkey is s, then hitting Shifts will clear any filter).

Leaving any screen automatically clears the filter.

In the Trade screen, the actual trade will always only act on items that are actually visible in the list; the same effect applies to the Trade Value numbers displayed by the screen. Because of this, the t key is blocked while search is active, so you have to reset the filters first. Pressing AltC will clear both search strings.

In the stockpile screen the option only appears if the cursor is in the rightmost list:



Note that the ‘Permit XXX’/‘Forbid XXX’ keys conveniently operate only on items actually shown in the rightmost list, so it is possible to select only fat or tallow by forbidding fats, then searching for fat/tallow, and using Permit Fats again while the list is filtered.

## nopause

Disables pausing (both manual and automatic) with the exception of pause forced by *reveal* hell. This is nice for digging under rivers.

## embark-tools

A collection of embark-related tools. Usage and available tools:

```
embark-tools enable/disable tool [tool]...
```

**anywhere** Allows embarking anywhere (including sites, mountain-only biomes, and oceans). Use with caution.

**mouse** Implements mouse controls (currently in the local embark region only)

**sand** Displays an indicator when sand is present in the currently-selected area, similar to the default clay/stone indicators.

**sticky** Maintains the selected local area while navigating the world map

## automaterial

This makes building constructions (walls, floors, fortifications, etc) a little bit easier by saving you from having to trawl through long lists of materials each time you place one.

Firstly, it moves the last used material for a given construction type to the top of the list, if there are any left. So if you build a wall with chalk blocks, the next time you place a wall the chalk blocks will be at the top of the list, regardless of distance (it only does this in “grouped” mode, as individual item lists could be huge). This should mean you can place most constructions without having to search for your preferred material type.



Pressing a while highlighting any material will enable that material for “auto select” for this construction type. You can enable multiple materials as autoselect. Now the next time you place this type of construction, the plugin will automatically choose materials for you from the kinds you enabled. If there is enough to satisfy the whole placement, you won’t be prompted with the material screen - the construction will be placed and you will be back in the construction menu as if you did it manually.

When choosing the construction placement, you will see a couple of options:



Use a here to temporarily disable the material autoselection, e.g. if you need to go to the material selection screen so you can toggle some materials on or off.

The other option (auto type selection, off by default) can be toggled on with t. If you toggle this option on, instead of returning you to the main construction menu after selecting materials, it returns you back to this screen. If you use this along with several autoselect enabled materials, you should be able to place complex constructions more conveniently.

## buildingplan

When active (via `enable buildingplan`), this plugin adds a planning mode for furniture placement. You can then place furniture and other buildings before the required materials are available, and the job will be unsuspended when the item is created.

Very useful when combined with *workflow* - you can set a constraint to always have one or two doors/beds/tables/chairs/etc available, and place as many as you like. The plugins then take over and fulfill the orders, with minimal space dedicated to stockpiles.

### confirm

Implements several confirmation dialogs for potentially destructive actions (for example, seizing goods from traders or deleting hauling routes).

Usage:

**enable confirm** Enable all confirmations; alias `confirm enable all`. Replace with `disable` to disable.

**confirm help** List available confirmation dialogues.

**confirm enable option1 [option2...]** Enable (or disable) specific confirmation dialogues.

### follow

Makes the game view follow the currently highlighted unit after you exit from the current menu or cursor mode. Handy for watching dwarves running around. Deactivated by moving the view manually.

### mousequery

Adds mouse controls to the DF interface, eg click-and-drag designations.

Options:

**plugin** enable/disable the entire plugin

**rbutton** enable/disable right mouse button

**track** enable/disable moving cursor in build and designation mode

**edge** enable/disable active edge scrolling (when on, will also enable tracking)

**live** enable/disable query view when unpaused

**delay** Set delay when edge scrolling in tracking mode. Omit amount to display current setting.

Usage:

```
mousequery [plugin] [rbutton] [track] [edge] [live] [enable|disable]
```

### resume

Allows automatic resumption of suspended constructions, along with colored UI hints for construction status.

### title-folder

Displays the DF folder name in the window title bar when enabled.

### title-version

Displays the DFHack version on DF's title screen when enabled.

## trackstop

Adds a `q` menu for track stops, which is completely blank by default. This allows you to view and/or change the track stop's friction and dump direction settings, using the keybindings from the track stop building interface.

## sort-items

Sort the visible item list:

```
sort-items order [order...]
```

Sort the item list using the given sequence of comparisons. The `<` prefix for an order makes undefined values sort first. The `>` prefix reverses the sort order for defined values.

Item order examples:

```
description material wear type quality
```

The orderings are defined in `hack/lua/plugins/sort/*.lua`

## sort-units

Sort the visible unit list:

```
sort-units order [order...]
```

Sort the unit list using the given sequence of comparisons. The `<` prefix for an order makes undefined values sort first. The `>` prefix reverses the sort order for defined values.

Unit order examples:

```
name age arrival squad squad_position profession
```

The orderings are defined in `hack/lua/plugins/sort/*.lua`

**Keybinding:** `AltShiftN` -> `"sort-units name" "sort-items description"`

**Keybinding:** `AltShiftR` -> `"sort-units arrival"`

**Keybinding:** `AltShiftT` -> `"sort-units profession" "sort-items type material"`

**Keybinding:** `AltShiftQ` -> `"sort-units squad_position" "sort-items quality"`

## stocks

Replaces the DF stocks screen with an improved version.

**Keybinding:** `CtrlShiftZ` -> `"stocks show"` in `dwarfmode/Default`

## stocksettings

Offers the following commands to save and load stockpile settings. See [gui/stockpiles](#) for an in-game interface.

**copystock** Copies the parameters of the currently highlighted stockpile to the custom stockpile settings and switches to custom stockpile placement mode, effectively allowing you to copy/paste stockpiles easily.

**Keybinding:** AltP

**savestock** Saves the currently highlighted stockpile's settings to a file in your Dwarf Fortress folder. This file can be used to copy settings between game saves or players. eg: `savestock food_settings.dfstock`

**loadstock** Loads a saved stockpile settings file and applies it to the currently selected stockpile. eg: `loadstock food_settings.dfstock`

To use `savestock` and `loadstock`, use the `q` command to highlight a stockpile. Then run `savestock` giving it a descriptive filename. Then, in a different (or the same!) gameworld, you can highlight any stockpile with `q` then execute the `loadstock` command passing it the name of that file. The settings will be applied to that stockpile.

Note that files are relative to the DF folder, so put your files there or in a subfolder for easy access. Filenames should not have spaces. Generated materials, divine metals, etc are not saved as they are different in every world.

## rename

Allows renaming various things. Use [\*gui/rename\*](#) for an in-game interface.

Options:

**rename squad <index> "name"** Rename squad by index to 'name'.

**rename hotkey <index> \"name\"** Rename hotkey by index. This allows assigning longer commands to the DF hotkeys.

**rename unit "nickname"** Rename a unit/creature highlighted in the DF user interface.

**rename unit-profession "custom profession"** Change profession name of the highlighted unit/creature.

**rename building "name"** Set a custom name for the selected building. The building must be one of stockpile, workshop, furnace, trap, siege engine or an activity zone.

## rendermax

A collection of renderer replacing/enhancing filters. For better effect try changing the black color in palette to non totally black. See [Bay12 forums thread 128487](#) for more info.

Options:

**trippy** Randomizes the color of each tiles. Used for fun, or testing.

**light** Enable lighting engine.

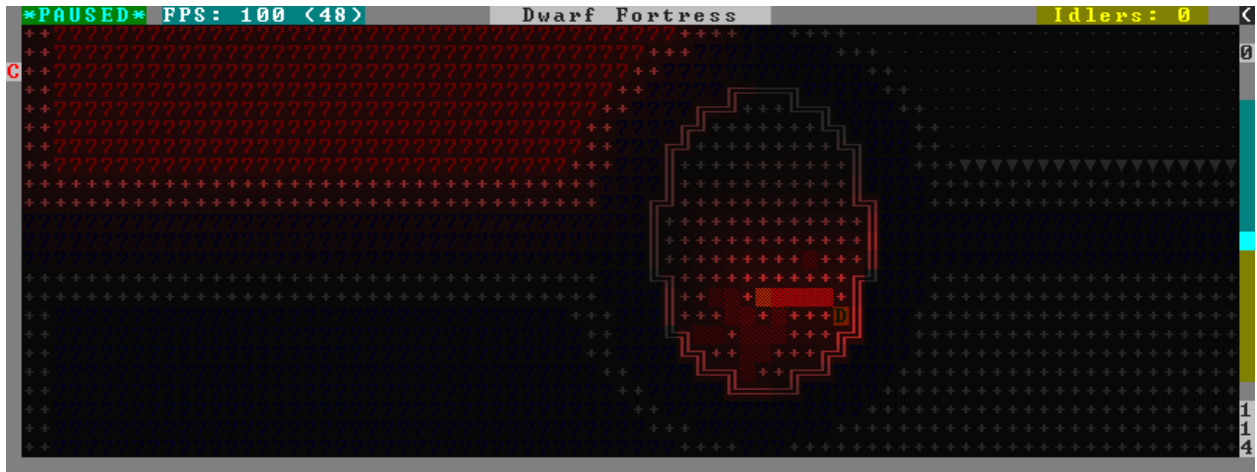
**light reload** Reload the settings file.

**light sun <x>|cycle** Set time to <x> (in hours) or set it to df time cycle.

**occlusionON, occlusionOFF** Show debug occlusion info.

**disable** Disable any filter that is enabled.

An image showing lava and dragon breath. Not pictured here: sunlight, shining items/plants, materials that color the light etc...



## Job and Fortress management

- *autolabor*
- *labormanager*
- *autohauler*
- *job*
- *job-material*
- *job-duplicate*
- *autogems*
- *stockflow*
- *workflow*
  - *Function*
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  - *fix-job-postings*
- *clean*
- *spotclean*
- *autodump*
- *cleanowned*
- *dwarfmonitor*
- *dwarfvet*
- *workNow*
- *seedwatch*
- *zone*

- *Usage with single units*
- *Usage with filters*
- *Mass-renaming*
- *Cage zones*
- *Examples*
- *autonestbox*
- *autobutcher*
- *autochop*

## autolabor

Automatically manage dwarf labors to efficiently complete jobs. Autolabor tries to keep as many dwarves as possible busy but also tries to have dwarves specialize in specific skills.

The key is that, for almost all labors, once a dwarf begins a job it will finish that job even if the associated labor is removed. Autolabor therefore frequently checks which dwarf or dwarves should take new jobs for that labor, and sets labors accordingly. Labors with equipment (mining, hunting, and woodcutting), which are abandoned if labors change mid-job, are handled slightly differently to minimise churn.

**Warning:** *autolabor will override any manual changes you make to labors while it is enabled, including through other tools such as Dwarf Therapist*

Simple usage:

**enable autolabor** Enables the plugin with default settings. (Persistent per fortress)

**disable autolabor** Disables the plugin.

Anything beyond this is optional - autolabor works well on the default settings.

By default, each labor is assigned to between 1 and 200 dwarves (2-200 for mining). By default 33% of the workforce become haulers, who handle all hauling jobs as well as cleaning, pulling levers, recovering wounded, removing constructions, and filling ponds. Other jobs are automatically assigned as described above. Each of these settings can be adjusted.

Jobs are rarely assigned to nobles with responsibilities for meeting diplomats or merchants, never to the chief medical dwarf, and less often to the bookkeeper and manager.

Hunting is never assigned without a butchery, and fishing is never assigned without a fishery.

For each labor a preference order is calculated based on skill, biased against masters of other trades and excluding those who can't do the job. The labor is then added to the best <minimum> dwarves for that labor. We assign at least the minimum number of dwarfs, in order of preference, and then assign additional dwarfs that meet any of these conditions:

- The dwarf is idle and there are no idle dwarves assigned to this labor
- The dwarf has non-zero skill associated with the labor
- The labor is mining, hunting, or woodcutting and the dwarf currently has it enabled.

We stop assigning dwarfs when we reach the maximum allowed.

Advanced usage:



**autolabor** <labor> <minimum> [<maximum>] Set number of dwarves assigned to a labor.

**autolabor** <labor> **haulers** Set a labor to be handled by hauler dwarves.

**autolabor** <labor> **disable** Turn off autolabor for a specific labor.

**autolabor** <labor> **reset** Return a labor to the default handling.

**autolabor** **reset-all** Return all labors to the default handling.

**autolabor** **list** List current status of all labors.

**autolabor** **status** Show basic status information.

See [autolabor-artisans](#) for a differently-tuned setup.

Examples:

**autolabor** **MINE** Keep at least 5 dwarves with mining enabled.

**autolabor** **CUT\_GEM** 1 1 Keep exactly 1 dwarf with gemcutting enabled.

**autolabor** **COOK** 1 1 3 Keep 1 dwarf with cooking enabled, selected only from the top 3.

**autolabor** **FEED\_WATER\_CIVILIANS** **haulers** Have haulers feed and water wounded dwarves.

**autolabor** **CUTWOOD** **disable** Turn off autolabor for wood cutting.

## labormanager

Automatically manage dwarf labors to efficiently complete jobs. Labormanager is derived from autolabor (above) but uses a completely different approach to assigning jobs to dwarves. While autolabor tries to keep as many dwarves busy as possible, labormanager instead strives to get jobs done as quickly as possible.

Labormanager frequently scans the current job list, current list of dwarfs, and the map to determine how many dwarves need to be assigned to what labors in order to meet all current labor needs without starving any particular type of job.

**Warning:** As with *autolabor*, *labormanager* will override any manual changes you make to labors while it is enabled, including through other tools such as *Dwarf Therapist*

Simple usage:

**enable labormanager** Enables the plugin with default settings. (Persistent per fortress)

**disable labormanager** Disables the plugin.

Anything beyond this is optional - labormanager works fairly well on the default settings.

The default priorities for each labor vary (some labors are higher priority by default than others). The way the plugin works is that, once it determines how many of each labor is needed, it then sorts them by adjusted priority. (Labors other than hauling have a bias added to them based on how long it's been since they were last used, to prevent job starvation.) The labor with the highest priority is selected, the “best fit” dwarf for that labor is assigned to that labor, and then its priority is *halved*. This process is repeated until either dwarfs or labors run out.

Because there is no easy way to detect how many haulers are actually needed at any moment, the plugin always ensures that at least one dwarf is assigned to each of the hauling labors, even if no hauling jobs are detected. At least one dwarf is always assigned to construction removing and cleaning because these jobs also cannot be easily detected. Lever pulling is always assigned to everyone. Any dwarfs for which there are no jobs will be assigned hauling, lever pulling, and cleaning labors. If you use animal trainers, note that labormanager will misbehave if you assign specific trainers to specific animals; results are only guaranteed if you use “any trainer”, and animal trainers will probably be overallocated in any case.

Labormanager also sometimes assigns extra labors to currently busy dwarfs so that when they finish their current job, they will go off and do something useful instead of standing around waiting for a job.

There is special handling to ensure that at least one dwarf is assigned to haul food whenever food is detected left in a place where it will rot if not stored. This will cause a dwarf to go idle if you have no storepiles to haul food to.

Dwarfs who are unable to work (child, in the military, wounded, handless, asleep, in a meeting) are entirely excluded from labor assignment. Any dwarf explicitly assigned to a burrow will also be completely ignored by labormanager.

The fitness algorithm for assigning jobs to dwarfs generally attempts to favor dwarfs who are more skilled over those who are less skilled. It also tries to avoid assigning female dwarfs with children to jobs that are “outside”, favors assigning “outside” jobs to dwarfs who are carrying a tool that could be used as a weapon, and tries to minimize how often dwarfs have to reequip.

Labormanager automatically determines medical needs and reserves health care providers as needed. Note that this may cause idling if you have injured dwarfs but no or inadequate hospital facilities.

Hunting is never assigned without a butchery, and fishing is never assigned without a fishery, and neither of these labors is assigned unless specifically enabled.

The method by which labormanager determines what labor is needed for a particular job is complicated and, in places, incomplete. In some situations, labormanager will detect that it cannot determine what labor is required. It will, by default, pause and print an error message on the dfhack console, followed by the message “LABORMANAGER: Game paused so you can investigate the above message.”. If this happens, please open an issue on github, reporting the lines that immediately preceded this message. You can tell labormanager to ignore this error and carry on by typing `labormanager pause-on-error no`, but be warned that some job may go undone in this situation.

Advanced usage:

**labormanager enable** Turn plugin on.

**labormanager disable** Turn plugin off.

**labormanager priority <labor> <value>** Set the priority value (see above) for labor <labor> to <value>.

**labormanager reset <labor>** Reset the priority value of labor <labor> to its default.

**labormanager reset-all** Reset all priority values to their defaults.

**labormanager allow-fishing** Allow dwarfs to fish. *Warning* This tends to result in most of the fort going fishing.

**labormanager forbid-fishing** Forbid dwarfs from fishing. Default behavior.

**labormanager allow-hunting** Allow dwarfs to hunt. *Warning* This tends to result in as many dwarfs going hunting as you have crossbows.

**labormanager forbid-hunting** Forbid dwarfs from hunting. Default behavior.

**labormanager list** Show current priorities and current allocation stats.

**labormanager pause-on-error yes** Make labormanager pause if the labor inference engine fails. See above.

**labormanager pause-on-error no** Allow labormanager to continue past a labor inference engine failure.

## autohauler

Autohauler is an autolabor fork.

Rather than the all-of-the-above means of autolabor, autohauler will instead only manage hauling labors and leave skilled labors entirely to the user, who will probably use Dwarf Therapist to do so.

Idle dwarves will be assigned the hauling labors; everyone else (including those currently hauling) will have the hauling labors removed. This is to encourage every dwarf to do their assigned skilled labors whenever possible, but resort to hauling when those jobs are not available. This also implies that the user will have a very tight skill assignment, with most skilled labors only being assigned to just one dwarf, no dwarf having more than two active skilled labors, and almost every non-military dwarf having at least one skilled labor assigned.

Autohauler allows skills to be flagged as to prevent hauling labors from being assigned when the skill is present. By default this is the unused ALCHEMIST labor but can be changed by the user.

## job

Command for general job query and manipulation.

Options:

**no extra options** Print details of the current job. The job can be selected in a workshop, or the unit/jobs screen.

**list** Print details of all jobs in the selected workshop.

**item-material <item-idx> <material[:subtoken]>** Replace the exact material id in the job item.

**item-type <item-idx> <type[:subtype]>** Replace the exact item type id in the job item.

## job-material

Alter the material of the selected job. Similar to `job item-material ...`

Invoked as:

```
job-material <inorganic-token>
```

**Keybinding:** ShiftA -> "job-material ALUNITE"

**Keybinding:** ShiftM -> "job-material MICROCLINE"

**Keybinding:** ShiftD -> "job-material DACITE"

**Keybinding:** ShiftR -> "job-material RHYOLITE"

**Keybinding:** ShiftI -> "job-material CINNABAR"

**Keybinding:** ShiftB -> "job-material COBALTTITE"

**Keybinding:** ShiftO -> "job-material OBSIDIAN"

**Keybinding:** ShiftT -> "job-material ORTHOCLASE"

**Keybinding:** ShiftG -> "job-material GLASS\_GREEN"

- In `q` mode, when a job is highlighted within a workshop or furnace, changes the material of the job. Only inorganic materials can be used in this mode.
- In `b` mode, during selection of building components positions the cursor over the first available choice with the matching material.

## job-duplicate

In `q` mode, when a job is highlighted within a workshop or furnace building, calling `job-duplicate` instantly duplicates the job.

**Keybinding:** CtrlD

## autogems

Creates a new Workshop Order setting, automatically cutting rough gems when *enabled*.

## stockflow

Allows the fortress bookkeeper to queue jobs through the manager, based on space or items available in stockpiles.

Inspired by *workflow*.

Usage:

**stockflow enable** Enable the plugin.

**stockflow disable** Disable the plugin.

**stockflow fast** Enable the plugin in fast mode.

**stockflow list** List any work order settings for your stockpiles.

**stockflow status** Display whether the plugin is enabled.

While enabled, the `q` menu of each stockpile will have two new options:

- `j`: Select a job to order, from an interface like the manager's screen.
- `J`: Cycle between several options for how many such jobs to order.

Whenever the bookkeeper updates stockpile records, new work orders will be placed on the manager's queue for each such selection, reduced by the number of identical orders already in the queue.

In fast mode, new work orders will be enqueued once per day, instead of waiting for the bookkeeper.

## workflow

Manage control of repeat jobs. *gui/workflow* provides a simple front-end integrated in the game UI.

Usage:

**workflow enable [option...], workflow disable [option...]** If no options are specified, enables or disables the plugin. Otherwise, enables or disables any of the following options:

- `drybuckets`: Automatically empty abandoned water buckets.
- `auto-melt`: Resume melt jobs when there are objects to melt.

**workflow jobs** List workflow-controlled jobs (if in a workshop, filtered by it).

**workflow list** List active constraints, and their job counts.

**workflow list-commands** List active constraints as workflow commands that re-create them; this list can be copied to a file, and then reloaded using the `script` built-in command.

**workflow count <constraint-spec> <cnt-limit> [cnt-gap]** Set a constraint, counting every stack as 1 item.

**workflow amount <constraint-spec> <cnt-limit> [cnt-gap]** Set a constraint, counting all items within stacks.

**workflow unlimit <constraint-spec>** Delete a constraint.

**workflow unlimit-all** Delete all constraints.

## Function

When the plugin is enabled, it protects all repeat jobs from removal. If they do disappear due to any cause, they are immediately re-added to their workshop and suspended.

In addition, when any constraints on item amounts are set, repeat jobs that produce that kind of item are automatically suspended and resumed as the item amount goes above or below the limit. The gap specifies how much below the limit the amount has to drop before jobs are resumed; this is intended to reduce the frequency of jobs being toggled.

## Constraint format

The constraint spec consists of 4 parts, separated with / characters:

```
ITEM[:SUBTYPE] / [GENERIC_MAT, ...] / [SPECIFIC_MAT:...] / [LOCAL, <quality>]
```

The first part is mandatory and specifies the item type and subtype, using the raw tokens for items (the same syntax used custom reaction inputs). For more information, see [this wiki page](#).

The subsequent parts are optional:

- A generic material spec constrains the item material to one of the hard-coded generic classes, which currently include:

```
PLANT WOOD CLOTH SILK LEATHER BONE SHELL SOAP TOOTH HORN PEARL YARN
METAL STONE SAND GLASS CLAY MILK
```

- A specific material spec chooses the material exactly, using the raw syntax for reaction input materials, e.g. `INORGANIC:IRON`, although for convenience it also allows just `IRON`, or `ACACIA:WOOD` etc. See the link above for more details on the unabbreviated raw syntax.
- A comma-separated list of miscellaneous flags, which currently can be used to ignore imported items or items below a certain quality.

## Constraint examples

Keep metal bolts within 900-1000, and wood/bone within 150-200:

```
workflow amount AMMO:ITEM_AMMO_BOLTS/METAL 1000 100
workflow amount AMMO:ITEM_AMMO_BOLTS/WOOD,BONE 200 50
```

Keep the number of prepared food & drink stacks between 90 and 120:

```
workflow count FOOD 120 30
workflow count DRINK 120 30
```

Make sure there are always 25-30 empty bins/barrels/bags:

```
workflow count BIN 30
workflow count BARREL 30
workflow count BOX/CLOTH,SILK,YARN 30
```

Make sure there are always 15-20 coal and 25-30 copper bars:

```
workflow count BAR//COAL 20
workflow count BAR//COPPER 30
```

Produce 15-20 gold crafts:

```
workflow count CRAFTS//GOLD 20
```

Collect 15-20 sand bags and clay boulders:

```
workflow count POWDER_MISC/SAND 20  
workflow count BOULDER/CLAY 20
```

Make sure there are always 80-100 units of dimple dye:

```
workflow amount POWDER_MISC//MUSHROOM_CUP_DIMPLE:MILL 100 20
```

---

**Note:** In order for this to work, you have to set the material of the PLANT input on the Mill Plants job to MUSHROOM\_CUP\_DIMPLE using the *job item-material* command. Otherwise the plugin won't be able to deduce the output material.

---

Maintain 10-100 locally-made crafts of exceptional quality:

```
workflow count CRAFTS///LOCAL,EXCEPTIONAL 100 90
```

### fix-job-postings

This command fixes crashes caused by previous versions of workflow, mostly in DFHack 0.40.24-r4, and should be run automatically when loading a world (but can also be run manually if desired).

### clean

Cleans all the splatter that get scattered all over the map, items and creatures. In an old fortress, this can significantly reduce FPS lag. It can also spoil your !!FUN!!, so think before you use it.

Options:

**map** Clean the map tiles. By default, it leaves mud and snow alone.

**units** Clean the creatures. Will also clean hostiles.

**items** Clean all the items. Even a poisoned blade.

Extra options for map:

**mud** Remove mud in addition to the normal stuff.

**snow** Also remove snow coverings.

### spotclean

Works like `clean map snow mud`, but only for the tile under the cursor. Ideal if you want to keep that bloody entrance `clean map` would clean up.

**Keybinding:** CtrlC

## autodump

This plugin adds an option to the `q` menu for stockpiles when *enabled*. When autodump is enabled for a stockpile, any items placed in the stockpile will automatically be designated to be dumped.

Alternatively, you can use it to quickly move all items designated to be dumped. Items are instantly moved to the cursor position, the dump flag is unset, and the forbid flag is set, as if it had been dumped normally. Be aware that any active dump item tasks still point at the item.

Cursor must be placed on a floor tile so the items can be dumped there.

Options:

**destroy** Destroy instead of dumping. Doesn't require a cursor. If called again before the game is resumed, cancels destroy.

**destroy-here** As **destroy**, but only the selected item in the `k` list, or inside a container. Alias `autodump-destroy-here`, for keybindings.

**Keybinding:** CtrlShiftK

**visible** Only process items that are not hidden.

**hidden** Only process hidden items.

**forbidden** Only process forbidden items (default: only unforbidden).

`autodump-destroy-item` destroys the selected item, which may be selected in the `k` list, or inside a container. If called again before the game is resumed, cancels destruction of the item.

**Keybinding:** CtrlK

## cleanowned

Confiscates items owned by dwarfs. By default, owned food on the floor and rotten items are confiscated and dumped.

Options:

**all** confiscate all owned items

**scattered** confiscated and dump all items scattered on the floor

**x** confiscate/dump items with wear level 'x' and more

**X** confiscate/dump items with wear level 'X' and more

**dryrun** a dry run. combine with other options to see what will happen without it actually happening.

Example:

**cleanowned scattered X** This will confiscate rotten and dropped food, garbage on the floors and any worn items with 'X' damage and above.

## dwarfmonitor

Records dwarf activity to measure fort efficiency.

Options:

**enable <mode>** Start monitoring `mode`. `mode` can be "work", "misery", "weather", or "all". This will enable all corresponding widgets, if applicable.

**disable <mode>** Stop monitoring `mode`, and disable corresponding widgets, if applicable.

**stats** Show statistics summary

**prefs** Show dwarf preferences summary

**reload** Reload configuration file (`dfhack-config/dwarfmonitor.json`)

**Keybinding:** AltM -> "dwarfmonitor prefs" in dwarfmode/Default

**Keybinding:** CtrlF -> "dwarfmonitor stats" in dwarfmode/Default

Widget configuration:

The following types of widgets (defined in `hack/lua/plugins/dwarfmonitor.lua`) can be displayed on the main fortress mode screen:

**date** Show the in-game date

**misery** Show overall happiness levels of all dwarves

**weather** Show current weather (rain/snow)

**cursor** Show the current mouse cursor position

The file `dfhack-config/dwarfmonitor.json` can be edited to control the positions and settings of all widgets displayed. This file should contain a JSON object with the key `widgets` containing an array of objects - see the included file in the `dfhack-config` folder for an example:

```
{
  "widgets": [
    {
      "type": "widget type (weather, misery, etc.)",
      "x": X coordinate,
      "y": Y coordinate
      <...additional options...>
    }
  ]
}
```

X and Y coordinates begin at zero (in the upper left corner of the screen). Negative coordinates will be treated as distances from the lower right corner, beginning at 1 - e.g. an x coordinate of 0 is the leftmost column, while an x coordinate of 1 is the rightmost column.

By default, the x and y coordinates given correspond to the leftmost tile of the widget. Including an `anchor` option set to `right` will cause the rightmost tile of the widget to be located at this position instead.

Some widgets support additional options:

- **date widget:**
  - **format:** specifies the format of the date. The following characters are replaced (all others, such as punctuation, are not modified)
    - \* Y or y: The current year
    - \* M: The current month, zero-padded if necessary
    - \* m: The current month, *not* zero-padded
    - \* D: The current day, zero-padded if necessary
    - \* d: The current day, *not* zero-padded

The default date format is Y-M-D, per the [ISO8601](#) standard.

- **cursor widget:**



- **format**: Specifies the format. X, x, Y, and y are replaced with the corresponding cursor coordinates, while all other characters are unmodified.
- **show\_invalid**: If set to `true`, the mouse coordinates will both be displayed as `-1` when the cursor is outside of the DF window; otherwise, nothing will be displayed.

## dwarfvet

Enables Animal Caretaker functionality

Always annoyed your dragons become useless after a minor injury? Well, with dwarfvet, your animals become first rate members of your fort. It can also be used to train medical skills.

Animals need to be treated in an animal hospital, which is simply a hospital that is also an animal training zone. The console will print out a list on game load, and whenever one is added or removed. Dwarfs must have the Animal Caretaker labor to treat animals. Normal medical skills are used (and no experience is given to the Animal Caretaker skill).

Options:

- enable** Enables Animal Caretakers to treat and manage animals
- disable** Turns off the plugin
- report** Reports all zones that the game considers animal hospitals

## workNow

Don't allow dwarves to idle if any jobs are available.

When workNow is active, every time the game pauses, DF will make dwarves perform any appropriate available jobs. This includes when you one step through the game using the pause menu. Usage:

- workNow** print workNow status
- workNow 0** deactivate workNow
- workNow 1** activate workNow (look for jobs on pause, and only then)
- workNow 2** make dwarves look for jobs whenever a job completes

## seedwatch

Watches the numbers of seeds available and enables/disables seed and plant cooking.

Each plant type can be assigned a limit. If their number falls below that limit, the plants and seeds of that type will be excluded from cookery. If the number rises above the limit + 20, then cooking will be allowed.

The plugin needs a fortress to be loaded and will deactivate automatically otherwise. You have to reactivate with 'seedwatch start' after you load the game.

Options:

- all** Adds all plants from the abbreviation list to the watch list.
- start** Start watching.
- stop** Stop watching.
- info** Display whether seedwatch is watching, and the watch list.
- clear** Clears the watch list.

Examples:

**seedwatch MUSHROOM\_HELMET\_PLUMP 30** add MUSHROOM\_HELMET\_PLUMP to the watch list, limit = 30

**seedwatch MUSHROOM\_HELMET\_PLUMP** removes MUSHROOM\_HELMET\_PLUMP from the watch list.

**seedwatch all 30** adds all plants from the abbreviation list to the watch list, the limit being 30.

## zone

Helps a bit with managing activity zones (pens, pastures and pits) and cages.

**Keybinding:** AltShiftI -> "zone set" in dwarfmode/Zones

Options:

**set** Set zone or cage under cursor as default for future assigns.

**assign** Assign unit(s) to the pen or pit marked with the 'set' command. If no filters are set a unit must be selected in the in-game ui. Can also be followed by a valid zone id which will be set instead.

**unassign** Unassign selected creature from it's zone.

**nick** Mass-assign nicknames, must be followed by the name you want to set.

**remnick** Mass-remove nicknames.

**tocages** Assign unit(s) to cages inside a pasture.

**uinfo** Print info about unit(s). If no filters are set a unit must be selected in the in-game ui.

**zinfo** Print info about zone(s). If no filters are set zones under the cursor are listed.

**verbose** Print some more info.

**filters** Print list of valid filter options.

**examples** Print some usage examples.

**not** Negates the next filter keyword.

Filters:

**all** Process all units (to be used with additional filters).

**count** Must be followed by a number. Process only n units (to be used with additional filters).

**unassigned** Not assigned to zone, chain or built cage.

**minage** Minimum age. Must be followed by number.

**maxage** Maximum age. Must be followed by number.

**race** Must be followed by a race RAW ID (e.g. BIRD\_TURKEY, ALPACA, etc). Negatable.

**caged** In a built cage. Negatable.

**own** From own civilization. Negatable.

**merchant** Is a merchant / belongs to a merchant. Should only be used for pitting, not for stealing animals (slaughter should work).

**war** Trained war creature. Negatable.

**hunting** Trained hunting creature. Negatable.

**tamed** Creature is tame. Negatable.

**trained** Creature is trained. Finds war/hunting creatures as well as creatures who have a training level greater than 'domesticated'. If you want to specifically search for war/hunting creatures use 'war' or 'hunting' Negatable.

**trainablewar** Creature can be trained for war (and is not already trained for war/hunt). Negatable.

**trainablehunt** Creature can be trained for hunting (and is not already trained for war/hunt). Negatable.

**male** Creature is male. Negatable.

**female** Creature is female. Negatable.

**egglayer** Race lays eggs. Negatable.

**grazer** Race is a grazer. Negatable.

**milkable** Race is milkable. Negatable.

## Usage with single units

One convenient way to use the zone tool is to bind the command 'zone assign' to a hotkey, maybe also the command 'zone set'. Place the in-game cursor over a pen/pasture or pit, use 'zone set' to mark it. Then you can select units on the map (in 'v' or 'k' mode), in the unit list or from inside cages and use 'zone assign' to assign them to their new home. Allows pitting your own dwarves, by the way.

## Usage with filters

All filters can be used together with the 'assign' command.

Restrictions: It's not possible to assign units who are inside built cages or chained because in most cases that won't be desirable anyways. It's not possible to cage owned pets because in that case the owner uncages them after a while which results in infinite hauling back and forth.

Usually you should always use the filter 'own' (which implies tame) unless you want to use the zone tool for pitting hostiles. 'own' ignores own dwarves unless you specify 'race DWARF' (so it's safe to use 'assign all own' to one big pasture if you want to have all your animals at the same place). 'egglayer' and 'milkable' should be used together with 'female' unless you have a mod with egg-laying male elves who give milk or whatever. Merchants and their animals are ignored unless you specify 'merchant' (pitting them should be no problem, but stealing and pasturing their animals is not a good idea since currently they are not properly added to your own stocks; slaughtering them should work).

Most filters can be negated (e.g. 'not grazer' -> race is not a grazer).

## Mass-renaming

Using the 'nick' command you can set the same nickname for multiple units. If used without 'assign', 'all' or 'count' it will rename all units in the current default target zone. Combined with 'assign', 'all' or 'count' (and further optional filters) it will rename units matching the filter conditions.

## Cage zones

Using the 'tocages' command you can assign units to a set of cages, for example a room next to your butcher shop(s). They will be spread evenly among available cages to optimize hauling to and butchering from them. For this to work you need to build cages and then place one pen/pasture activity zone above them, covering all cages you want to use. Then use 'zone set' (like with 'assign') and use 'zone tocages filter1 filter2 ...'. 'tocages' overwrites 'assign' because it would make no sense, but can be used together with 'nick' or 'remnick' and all the usual filters.

## Examples

**zone assign all own ALPACA minage 3 maxage 10** Assign all own alpacas who are between 3 and 10 years old to the selected pasture.

**zone assign all own caged grazer nick ineedgrass** Assign all own grazers who are sitting in cages on stockpiles (e.g. after buying them from merchants) to the selected pasture and give them the nickname 'ineedgrass'.

**zone assign all own not grazer not race CAT** Assign all own animals who are not grazers, excluding cats.

**zone assign count 5 own female milkable** Assign up to 5 own female milkable creatures to the selected pasture.

**zone assign all own race DWARF maxage 2** Throw all useless kids into a pit :)

**zone nick donttouchme** Nicknames all units in the current default zone or cage to 'donttouchme'. Mostly intended to be used for special pastures or cages which are not marked as rooms you want to protect from autobutcher.

**zone tocages count 50 own tame male not grazer** Stuff up to 50 owned tame male animals who are not grazers into cages built on the current default zone.

## autonestbox

Assigns unpastured female egg-layers to nestbox zones. Requires that you create pen/pasture zones above nestboxes. If the pen is bigger than 1x1 the nestbox must be in the top left corner. Only 1 unit will be assigned per pen, regardless of the size. The age of the units is currently not checked, most birds grow up quite fast. Egglayers who are also grazers will be ignored, since confining them to a 1x1 pasture is not a good idea. Only tame and domesticated own units are processed since pasturing half-trained wild egglayers could destroy your neat nestbox zones when they revert to wild. When called without options autonestbox will instantly run once.

Options:

**start** Start running every X frames (df simulation ticks). Default: X=6000, which would be every 60 seconds at 100fps.

**stop** Stop running automatically.

**sleep** Must be followed by number X. Changes the timer to sleep X frames between runs.

## autobutcher

Assigns livestock for slaughter once it reaches a specific count. Requires that you add the target race(s) to a watch list. Only tame units will be processed.

Units will be ignored if they are:

- Nicknamed (for custom protection; you can use the *rename* unit tool individually, or *zone nick* for groups)
- Caged, if and only if the cage is defined as a room (to protect zoos)
- Trained for war or hunting

Creatures who will not reproduce (because they're not interested in the opposite sex or have been gelded) will be butchered before those who will. Older adults and younger children will be butchered first if the population is above the target (default 1 male, 5 female kids and adults). Note that you may need to set a target above 1 to have a reliable breeding population due to asexuality etc. See *fix-ster* if this is a problem.

Options:

**example** Print some usage examples.

**start** Start running every X frames (df simulation ticks). Default: X=6000, which would be every 60 seconds at 100fps.

**stop** Stop running automatically.

**sleep <x>** Changes the timer to sleep X frames between runs.

**watch R** Start watching a race. R can be a valid race RAW id (ALPACA, BIRD\_TURKEY, etc) or a list of ids separated by spaces or the keyword 'all' which affects all races on your current watchlist.

**unwatch R** Stop watching race(s). The current target settings will be remembered. R can be a list of ids or the keyword 'all'.

**forget R** Stop watching race(s) and forget it's/their target settings. R can be a list of ids or the keyword 'all'.

**autowatch** Automatically adds all new races (animals you buy from merchants, tame yourself or get from migrants) to the watch list using default target count.

**noautowatch** Stop auto-adding new races to the watchlist.

**list** Print the current status and watchlist.

**list\_export** Print the commands needed to set up status and watchlist, which can be used to import them to another save (see notes).

**target <fk> <mk> <fa> <ma> <R>** Set target count for specified race(s). The first four arguments are the number of female and male kids, and female and male adults. R can be a list of species ids, or the keyword `all` or `new`. R = 'all': change target count for all races on watchlist and set the new default for the future. R = 'new': don't touch current settings on the watchlist, only set the new default for future entries.

**list\_export** Print the commands required to rebuild your current settings.

---

**Note:** Settings and watchlist are stored in the savegame, so that you can have different settings for each save. If you want to copy your watchlist to another savegame you must export the commands required to recreate your settings.

To export, open an external terminal in the DF directory, and run `dfhack-run autobutcher list_export > filename.txt`. To import, load your new save and run `script filename.txt` in the DFHack terminal.

---

Examples:

You want to keep max 7 kids (4 female, 3 male) and max 3 adults (2 female, 1 male) of the race alpaca. Once the kids grow up the oldest adults will get slaughtered. Excess kids will get slaughtered starting with the youngest to allow that the older ones grow into adults. Any unnamed cats will be slaughtered as soon as possible.

```
autobutcher target 4 3 2 1 ALPACA BIRD_TURKEY
autobutcher target 0 0 0 0 CAT
autobutcher watch ALPACA BIRD_TURKEY CAT
autobutcher start
```

Automatically put all new races onto the watchlist and mark unnamed tame units for slaughter as soon as they arrive in your fort. Settings already made for specific races will be left untouched.

```
autobutcher target 0 0 0 0 new
autobutcher autowatch
autobutcher start
```

Stop watching the races alpaca and cat, but remember the target count settings so that you can use ‘unwatch’ without the need to enter the values again. Note: ‘autobutcher unwatch all’ works, but only makes sense if you want to keep the plugin running with the ‘autowatch’ feature or manually add some new races with ‘watch’. If you simply want to stop it completely use ‘autobutcher stop’ instead.

```
autobutcher unwatch ALPACA CAT
```

### autochop

Automatically manage tree cutting designation to keep available logs withing given quotas.

Open the dashboard by running:

```
enable autochop
```

The plugin must be activated (with d-t-c-a) before it can be used. You can then set logging quotas and restrict designations to specific burrows (with ‘Enter’) if desired. The plugin’s activity cycle runs once every in game day.

If you add `enable autochop` to your `dfhack.init` there will be a hotkey to open the dashboard from the chop designation menu.

### Map modification

- *3dveins*
- *alltraffic*
- *burrow*
- *changelayer*
- *changevein*
- *changeitem*
- *cleanconst*
- *deramp*
- *dig*
- *digexp*
- *digcircle*
- *digtype*
- *digFlood*
- *filltraffic*
- *fortplan*
- *getplants*
- *infiniteSky*
- *liquids*
- *Commands*

- *liquids-here*
- *plant*
- *regrass*
- *restrictice*
- *restrictliquids*
- *tiletypes*
  - *tiletypes-command*
  - *tiletypes-here*
  - *tiletypes-here-point*
- *tubefill*

### 3dveins

Removes all existing veins from the map and generates new ones using 3D Perlin noise, in order to produce a layout that smoothly flows between Z levels. The vein distribution is based on the world seed, so running the command for the second time should produce no change. It is best to run it just once immediately after embark.

This command is intended as only a cosmetic change, so it takes care to exactly preserve the mineral counts reported by *prospect all*. The amounts of different layer stones may slightly change in some cases if vein mass shifts between Z layers.

The only undo option is to restore your save from backup.

### alltraffic

Set traffic designations for every single tile of the map - useful for resetting traffic designations. See also *filltraffic*, *restrictice*, and *restrictliquids*.

Options:

- H** High Traffic
- N** Normal Traffic
- L** Low Traffic
- R** Restricted Traffic

### burrow

Miscellaneous burrow control. Allows manipulating burrows and automated burrow expansion while digging.

Options:

- enable feature ...** Enable features of the plugin.
- disable feature ...** Disable features of the plugin.
- clear-unit burrow burrow ...** Remove all units from the burrows.
- clear-tiles burrow burrow ...** Remove all tiles from the burrows.
- set-units target-burrow src-burrow ...** Clear target, and adds units from source burrows.

**add-units target-burrow src-burrow ...** Add units from the source burrows to the target.

**remove-units target-burrow src-burrow ...** Remove units in source burrows from the target.

**set-tiles target-burrow src-burrow ...** Clear target and adds tiles from the source burrows.

**add-tiles target-burrow src-burrow ...** Add tiles from the source burrows to the target.

**remove-tiles target-burrow src-burrow ...** Remove tiles in source burrows from the target.

For these three options, in place of a source burrow it is possible to use one of the following keywords: ABOVE\_GROUND, SUBTERRANEAN, INSIDE, OUTSIDE, LIGHT, DARK, HIDDEN, REVEALED

Features:

**auto-grow** When a wall inside a burrow with a name ending in '+' is dug out, the burrow is extended to newly-revealed adjacent walls. This final '+' may be omitted in burrow name args of commands above. Digging 1-wide corridors with the miner inside the burrow is SLOW.

## changelayer

Changes material of the geology layer under cursor to the specified inorganic RAW material. Can have impact on all surrounding regions, not only your embark! By default changing stone to soil and vice versa is not allowed. By default changes only the layer at the cursor position. Note that one layer can stretch across lots of z levels. By default changes only the geology which is linked to the biome under the cursor. That geology might be linked to other biomes as well, though. Mineral veins and gem clusters will stay on the map. Use *changevein* for them.

tl;dr: You will end up with changing quite big areas in one go, especially if you use it in lower z levels. Use with care.

Options:

**all\_biomes** Change selected layer for all biomes on your map. Result may be undesirable since the same layer can AND WILL be on different z-levels for different biomes. Use the tool 'probe' to get an idea how layers and biomes are distributed on your map.

**all\_layers** Change all layers on your map (only for the selected biome unless 'all\_biomes' is added). Candy mountain, anyone? Will make your map quite boring, but tidy.

**force** Allow changing stone to soil and vice versa. !!THIS CAN HAVE WEIRD EFFECTS, USE WITH CARE!! Note that soil will not be magically replaced with stone. You will, however, get a stone floor after digging so it will allow the floor to be engraved. Note that stone will not be magically replaced with soil. You will, however, get a soil floor after digging so it could be helpful for creating farm plots on maps with no soil.

**verbose** Give some details about what is being changed.

**trouble** Give some advice about known problems.

Examples:

**changelayer GRANITE** Convert layer at cursor position into granite.

**changelayer SILTY\_CLAY force** Convert layer at cursor position into clay even if it's stone.

**changelayer MARBLE all\_biomes all\_layers** Convert all layers of all biomes which are not soil into marble.

---

**Note:**



- If you use changelayer and nothing happens, try to pause/unpause the game for a while and try to move the cursor to another tile. Then try again. If that doesn't help try temporarily changing some other layer, undo your changes and try again for the layer you want to change. Saving and reloading your map might also help.
  - You should be fine if you only change single layers without the use of 'force'. Still it's advisable to save your game before messing with the map.
  - When you force changelayer to convert soil to stone you might experience weird stuff (flashing tiles, tiles changed all over place etc). Try reverting the changes manually or even better use an older savegame. You did save your game, right?
- 

### changevein

Changes material of the vein under cursor to the specified inorganic RAW material. Only affects tiles within the current 16x16 block - for veins and large clusters, you will need to use this command multiple times.

Example:

**changevein NATIVE\_PLATINUM** Convert vein at cursor position into platinum ore.

### changeitem

Allows changing item material and base quality. By default the item currently selected in the UI will be changed (you can select items in the 'k' list or inside containers/inventory). By default change is only allowed if materials is of the same subtype (for example wood<->wood, stone<->stone etc). But since some transformations work pretty well and may be desired you can override this with 'force'. Note that some attributes will not be touched, possibly resulting in weirdness. To get an idea how the RAW id should look like, check some items with 'info'. Using 'force' might create items which are not touched by crafters/haulers.

Options:

**info** Don't change anything, print some info instead.

**here** Change all items at the cursor position. Requires in-game cursor.

**material, m** Change material. Must be followed by valid material RAW id.

**quality, q** Change base quality. Must be followed by number (0-5).

**force** Ignore subtypes, force change to new material.

Examples:

**changeitem m INORGANIC:GRANITE here** Change material of all items under the cursor to granite.

**changeitem q 5** Change currently selected item to masterpiece quality.

### cleanconst

Cleans up construction materials.

This utility alters all constructions on the map so that they spawn their building component when they are disassembled, allowing their actual build items to be safely deleted. This can improve FPS in extreme situations.

## deramp

Removes all ramps designated for removal from the map. This is useful for replicating the old channel digging designation. It also removes any and all 'down ramps' that can remain after a cave-in (you don't have to designate anything for that to happen).

## dig

This plugin makes many automated or complicated dig patterns easy.

Basic commands:

**digv** Designate all of the selected vein for digging.

**digvx** Also cross z-levels, digging stairs as needed. Alias for `digv x`.

**digl** Like `digv`, for layer stone. Also supports an `undo` option to remove designations, for if you accidentally set 50 levels at once.

**diglx** Also cross z-levels, digging stairs as needed. Alias for `digl x`.

**Keybinding:** CtrlV

**Keybinding:** CtrlShiftV -> "`digv x`"

## digexp

This command is for [exploratory mining](#).

There are two variables that can be set: pattern and filter.

Patterns:

**diag5** diagonals separated by 5 tiles

**diag5r** diag5 rotated 90 degrees

**ladder** A 'ladder' pattern

**ladderr** ladder rotated 90 degrees

**clear** Just remove all dig designations

**cross** A cross, exactly in the middle of the map.

Filters:

**all** designate whole z-level

**hidden** designate only hidden tiles of z-level (default)

**designated** Take current designation and apply pattern to it.

After you have a pattern set, you can use `expdig` to apply it again.

Examples:

**expdig diag5 hidden** Designate the diagonal 5 patter over all hidden tiles

**expdig** Apply last used pattern and filter

**expdig ladder designated** Take current designations and replace them with the ladder pattern

## digcircle

A command for easy designation of filled and hollow circles. It has several types of options.

Shape:

- hollow** Set the circle to hollow (default)
- filled** Set the circle to filled
- #** Diameter in tiles (default = 0, does nothing)

Action:

- set** Set designation (default)
- unset** Unset current designation
- invert** Invert designations already present

Designation types:

- dig** Normal digging designation (default)
- ramp** Ramp digging
- ustair** Staircase up
- dstair** Staircase down
- xstair** Staircase up/down
- chan** Dig channel

After you have set the options, the command called with no options repeats with the last selected parameters.

Examples:

**digcircle filled 3** Dig a filled circle with diameter = 3.

**digcircle** Do it again.

## digtype

For every tile on the map of the same vein type as the selected tile, this command designates it to have the same designation as the selected tile. If the selected tile has no designation, they will be dig designated. If an argument is given, the designation of the selected tile is ignored, and all appropriate tiles are set to the specified designation.

Options:

- dig**
- channel**
- ramp**
- updown** up/down stairs
- up** up stairs
- down** down stairs
- clear** clear designation

## digFlood

Automatically digs out specified veins as they are discovered. It runs once every time a dwarf finishes a dig job. It will only dig out appropriate tiles that are adjacent to the finished dig job. To add a vein type, use `digFlood 1 [type]`. This will also enable the plugin. To remove a vein type, use `digFlood 0 [type] 1` to disable, then remove, then re-enable.

Usage:

**help digflood** detailed help message

**digFlood 0** disable the plugin

**digFlood 1** enable the plugin

**digFlood 0 MICROCLINE COAL\_BITUMINOUS 1** disable plugin, remove microcline and bituminous coal from monitoring, then re-enable the plugin

**digFlood CLEAR** remove all inorganics from monitoring

**digFlood digAll1** ignore the monitor list and dig any vein

**digFlood digAll0** disable digAll mode

## filltraffic

Set traffic designations using flood-fill starting at the cursor. See also [alltraffic](#), [restrictice](#), and [restrictliquids](#). Options:

**H** High Traffic

**N** Normal Traffic

**L** Low Traffic

**R** Restricted Traffic

**X** Fill across z-levels.

**B** Include buildings and stockpiles.

**P** Include empty space.

Example:

**filltraffic H** When used in a room with doors, it will set traffic to HIGH in just that room.

## fortplan

Usage: `fortplan [filename]`

Designates furniture for building according to a `.csv` file with quickfort-style syntax. Companion to [digfort](#).

The first line of the file must contain the following:

```
#build start(X; Y; <start location description>)
```

...where X and Y are the offset from the top-left corner of the file's area where the in-game cursor should be located, and `<start location description>` is an optional description of where that is. You may also leave a description of the contents of the file itself following the closing parenthesis on the same line.

The syntax of the file itself is similar to [digfort](#) or [quickfort](#). At present, only buildings constructed of an item with the same name as the building are supported. All other characters are ignored. For example:

```
` , ` , d , ` , `
` , f , ` , t , `
` , s , b , c , `
```

This section of a file would designate for construction a door and some furniture inside a bedroom: specifically, clockwise from top left, a cabinet, a table, a chair, a bed, and a statue.

All of the building designation uses *buildingplan*, so you do not need to have the items available to construct all the buildings when you run fortplan with the .csv file.

## getplants

This tool allows plant gathering and tree cutting by RAW ID. Specify the types of trees to cut down and/or shrubs to gather by their plant names, separated by spaces.

Options:

- t Select trees only (exclude shrubs)
- s Select shrubs only (exclude trees)
- c Clear designations instead of setting them
- x Apply selected action to all plants except those specified (invert selection)
- a Select every type of plant (obeys -t/-s)

Specifying both -t and -s will have no effect. If no plant IDs are specified, all valid plant IDs will be listed.

## infiniteSky

Automatically allocates new z-levels of sky at the top of the map as you build up, or on request allocates many levels all at once.

Usage:

**infiniteSky n** Raise the sky by n z-levels.

**infiniteSky enable/disable** Enables/disables monitoring of constructions. If you build anything in the second to highest z-level, it will allocate one more sky level. This is so you can continue to build stairs upward.

Sometimes new z-levels disappear and cause cave-ins. Saving and loading after creating new z-levels should fix the problem.

## liquids

Allows adding magma, water and obsidian to the game. It replaces the normal dfhack command line and can't be used from a hotkey. Settings will be remembered as long as dfhack runs. Intended for use in combination with the command *liquids-here* (which can be bound to a hotkey). See also [Issue 80](#).

---

**Note:** Spawning and deleting liquids can mess up pathing data and temperatures (creating heat traps). You've been warned.

---

Settings will be remembered until you quit DF. You can call *liquids-here* to execute the last configured action, which is useful in combination with keybindings.

Usage: point the DF cursor at a tile you want to modify and use the commands.

If you only want to add or remove water or magma from one tile, *source* may be easier to use.

## Commands

Misc commands:

- q** quit
- help, ?** print this list of commands
- <empty line>** put liquid

Modes:

- m** switch to magma
- w** switch to water
- o** make obsidian wall instead
- of** make obsidian floors
- rs** make a river source
- f** flow bits only
- wclean** remove salt and stagnant flags from tiles

Set-Modes and flow properties (only for magma/water):

- s+** only add mode
- s.** set mode
- s-** only remove mode
- f+** make the spawned liquid flow
- f.** don't change flow state (read state in flow mode)
- f-** make the spawned liquid static

Permaflow (only for water):

- pf.** don't change permaflow state
- pf-** make the spawned liquid static
- pf[NS][EW]** make the spawned liquid permanently flow
- 0-7** set liquid amount

Brush size and shape:

- p, point** Single tile
- r, range** Block with cursor at bottom north-west (any place, any size)
- block** DF map block with cursor in it (regular spaced 16x16x1 blocks)
- column** Column from cursor, up through free space
- flood** Flood-fill water tiles from cursor (only makes sense with wclean)

## liquids-here

Run the liquid spawner with the current/last settings made in liquids (if no settings in liquids were made it paints a point of 7/7 magma by default).

Intended to be used as keybinding. Requires an active in-game cursor.

## plant

A tool for creating shrubs, growing, or getting rid of them.

Subcommands:

**create** Creates a new sapling under the cursor. Takes a raw ID as argument (e.g. TOWER\_CAP). The cursor must be located on a dirt or grass floor tile.

**grow** Turns saplings into trees; under the cursor if a sapling is selected, or every sapling on the map if the cursor is hidden.

**extirpate** Kills the tree or shrub under the cursor, instantly turning them to ashes.

**immolate** Sets the plants on fire instead. The fires can and *will* spread ;)

For mass effects, use one of the additional options:

**shrubs** affect all shrubs on the map

**trees** affect all trees on the map

**all** affect every plant!

## regrass

Regrows all the grass. Not much to it ;)

## restrictice

Restrict traffic on all tiles on top of visible ice. See also [alltraffic](#), [filltraffic](#), and [restrictliquids](#).

## restrictliquids

Restrict traffic on all visible tiles with liquid. See also [alltraffic](#), [filltraffic](#), and [restrictice](#).

## tiletypes

Can be used for painting map tiles and is an interactive command, much like [liquids](#). If something goes wrong, [fixveins](#) may help.

The tool works with two set of options and a brush. The brush determines which tiles will be processed. First set of options is the filter, which can exclude some of the tiles from the brush by looking at the tile properties. The second set of options is the paint - this determines how the selected tiles are changed.

Both paint and filter can have many different properties including things like general shape (WALL, FLOOR, etc.), general material (SOIL, STONE, MINERAL, etc.), state of 'designated', 'hidden' and 'light' flags.

The properties of filter and paint can be partially defined. This means that you can for example turn all stone fortifications into floors, preserving the material:

```
filter material STONE
filter shape FORTIFICATION
paint shape FLOOR
```

Or turn mineral vein floors back into walls:

```
filter shape FLOOR
filter material MINERAL
paint shape WALL
```

The tool also allows tweaking some tile flags:

```
paint hidden 1
paint hidden 0
```

This will hide previously revealed tiles (or show hidden with the 0 option).

More recently, the tool supports changing the base material of the tile to an arbitrary stone from the raws, by creating new veins as required. Note that this mode paints under ice and constructions, instead of overwriting them. To enable, use:

```
paint stone MICROCLINE
```

This mode is incompatible with the regular `material` setting, so changing it cancels the specific stone selection:

```
paint material ANY
```

Since different vein types have different drop rates, it is possible to choose which one to use in painting:

```
paint veintype CLUSTER_SMALL
```

When the chosen type is `CLUSTER` (the default), the tool may automatically choose to use layer stone or lava stone instead of veins if its material matches the desired one.

Any paint or filter option (or the entire paint or filter) can be disabled entirely by using the `ANY` keyword:

```
paint hidden ANY
paint shape ANY
filter material any
filter shape any
filter any
```

You can use several different brushes for painting tiles:

**point** a single tile

**range** a rectangular range

**column** a column ranging from current cursor to the first solid tile above

**block** a DF map block - 16x16 tiles, in a regular grid

Example:

```
range 10 10 1
```

This will change the brush to a rectangle spanning 10x10 tiles on one z-level. The range starts at the position of the cursor and goes to the east, south and up.

For more details, use `tiletypes help`.



### tiletypes-command

Runs tiletypes commands, separated by ;. This makes it possible to change tiletypes modes from a hotkey or via dfhack-run.

### tiletypes-here

Apply the current tiletypes options at the in-game cursor position, including the brush. Can be used from a hotkey.

### tiletypes-here-point

Apply the current tiletypes options at the in-game cursor position to a single tile. Can be used from a hotkey.

### tubefill

Fills all the adamantine veins again. Veins that were hollow will be left alone.

Options:

**hollow** fill in naturally hollow veins too

Beware that filling in hollow veins will trigger a demon invasion on top of your miner when you dig into the region that used to be hollow.

## Mods and Cheating

- *add-spatter*
- *adv-bodyswap*
- *createitem*
- *diggingInvaders*
- *fastdwarf*
- *forceequip*
- *generated-creature-renamer*
- *lair*
- *misery*
- *mode*
- *strangemood*
- *siege-engine*
- *power-meter*
- *steam-engine*
  - *Construction*
  - *Operation*

- *Explosions*
- *Save files*

### add-spatter

This plugin makes reactions with names starting with SPATTER\_ADD\_ produce contaminants on the items instead of improvements. The plugin is intended to give some use to all those poisons that can be bought from caravans, so they're immune to being washed away by water or destroyed by *clean*.

### adv-bodyswap

This allows taking control over your followers and other creatures in adventure mode. For example, you can make them pick up new arms and armor and equip them properly.

Usage:

- When viewing unit details, body-swaps into that unit.
- In the main adventure mode screen, reverts transient swap.

**Keybinding:** CtrlB in dungeonmode

**Keybinding:** CtrlShiftB -> "adv-bodyswap force" in dungeonmode

### createitem

Allows creating new items of arbitrary types and made of arbitrary materials. By default, items created are spawned at the feet of the selected unit.

Specify the item and material information as you would indicate them in custom reaction raws, with the following differences:

- Separate the item and material with a space rather than a colon
- If the item has no subtype, omit the :NONE
- If the item is REMAINS, FISH, FISH\_RAW, VERMIN, PET, or EGG, specify a CREATURE:CASTE pair instead of a material token.

Corpses, body parts, and prepared meals cannot be created using this tool.

Examples:

```
createitem GLOVES:ITEM_GLOVES_GAUNTLETS INORGANIC:STEEL 2
    Create 2 pairs of steel gauntlets.
createitem WOOD PLANT_MAT:TOWER_CAP:WOOD
    Create tower-cap logs.
```

For more examples, [see this wiki page](#).

To change where new items are placed, first run the command with a destination type while an appropriate destination is selected.

Options:

- floor** Subsequent items will be placed on the floor beneath the selected unit's feet.
- item** Subsequent items will be stored inside the currently selected item.

**building** Subsequent items will become part of the currently selected building. Good for loading traps; do not use with workshops (or deconstruct to use the item).

## diggingInvaders

Makes invaders dig or destroy constructions to get to your dwarves.

To enable/disable the plugging, use: `diggingInvaders (1|enable) | (0|disable)`

Basic usage:

**add GOBLIN** registers the race GOBLIN as a digging invader. Case-sensitive.

**remove GOBLIN** unregisters the race GOBLIN as a digging invader. Case-sensitive.

**now** makes invaders try to dig now, if plugin is enabled

**clear** clears all digging invader races

**edgesPerTick n** makes the pathfinding algorithm work on at most n edges per tick. Set to 0 or lower to make it unlimited.

You can also use `diggingInvaders setCost (race) (action) n` to set the pathing cost of particular action, or `setDelay` to set how long it takes. Costs and delays are per-tile, and the table shows default values.

Action	Cost	De- lay	Notes
walk	1	0	base cost in the path algorithm
destroyBuilding	2	1,000	delay adds to the <code>job_completion_timer</code> of destroy building jobs that are assigned to invaders
dig	10,000	1,000	digging soil or natural stone
destroyRoughConstruction	1,000	1,000	constructions made from boulders
destroySmoothConstruction	100	100	constructions made from blocks or bars

## fastdwarf

Controls speedydwarf and teledwarf. Speedydwarf makes dwarves move quickly and perform tasks quickly. Teledwarf makes dwarves move instantaneously, but do jobs at the same speed.

**fastdwarf 0** disables both (also `0 0`)

**fastdwarf 1** enables speedydwarf and disables teledwarf (also `1 0`)

**fastdwarf 2** sets a native debug flag in the game memory that implements an even more aggressive version of speedydwarf.

**fastdwarf 0 1** disables speedydwarf and enables teledwarf

**fastdwarf 1 1** enables both

See *superdwarf* for a per-creature version.

## forceequip

Forceequip moves local items into a unit's inventory. It is typically used to equip specific clothing/armor items onto a dwarf, but can also be used to put armor onto a war animal or to add unusual items (such as crowns) to any unit.

For more information run `forceequip help`. See also *modtools/equip-item*.

## generated-creature-renamer

Automatically renames generated creatures, such as forgotten beasts, titans, etc, to have raw token names that match the description given in-game.

The `list-generated` command can be used to list the token names of all generated creatures in a given save, with an optional `detailed` argument to show the accompanying description.

The `save-generated-raws` command will save a sample creature graphics file in the Dwarf Fortress root directory, to use as a start for making a graphics set for generated creatures using the new names that they get with this plugin.

The new names are saved with the save, and the plugin, when enabled, only runs once per save, unless there's an update.

## lair

This command allows you to mark the map as a monster lair, preventing item scatter on abandon. When invoked as `lair reset`, it does the opposite.

Unlike *reveal*, this command doesn't save the information about tiles - you won't be able to restore state of real monster lairs using `lair reset`.

Options:

**lair** Mark the map as monster lair

**lair reset** Mark the map as ordinary (not lair)

## misery

When enabled, fake bad thoughts will be added to all dwarves.

Usage:

**misery enable n** enable misery with optional magnitude n. If specified, n must be positive.

**misery n** same as "misery enable n"

**misery enable** same as "misery enable 1"

**misery disable** stop adding new negative thoughts. This will not remove existing negative thoughts. Equivalent to "misery 0".

**misery clear** remove fake thoughts, even after saving and reloading. Does not change factor.

## mode

This command lets you see and change the game mode directly.

**Warning:** Only use `mode` after making a backup of your save!

Not all combinations are good for every situation and most of them will produce undesirable results. There are a few good ones though.

Examples:

- You are in fort game mode, managing your fortress and paused.

- You switch to the arena game mode, *assume control of a creature* and then
- switch to adventure game mode(1). You just lost a fortress and gained an adventurer. Alternatively:
- You are in fort game mode, managing your fortress and paused at the esc menu.
- You switch to the adventure game mode, assume control of a creature, then save or retire.
- You just created a returnable mountain home and gained an adventurer.

## strangemood

Creates a strange mood job the same way the game itself normally does it.

Options:

- force** Ignore normal strange mood preconditions (no recent mood, minimum moodable population, artifact limit not reached).
- unit** Make the strange mood strike the selected unit instead of picking one randomly. Unit eligibility is still enforced.
- type <T>** Force the mood to be of a particular type instead of choosing randomly based on happiness. Valid values for T are “fey”, “secretive”, “possessed”, “fell”, and “macabre”.
- skill S** Force the mood to use a specific skill instead of choosing the highest moodable skill. Valid values are “miner”, “carpenter”, “engraver”, “mason”, “tanner”, “weaver”, “clothier”, “weaponsmith”, “armorsmith”, “metalsmith”, “gemcutter”, “gemsetter”, “woodcrafter”, “stonecrafter”, “metalcrafter”, “glassmaker”, “leatherworker”, “bonecarver”, “bowyer”, and “mechanic”.

Known limitations: if the selected unit is currently performing a job, the mood will not be started.

## siege-engine

Siege engines in DF haven’t been updated since the game was 2D, and can only aim in four directions. To make them useful above-ground, this plugin allows you to:

- link siege engines to stockpiles
- restrict operator skill levels (like workshops)
- load any object into a catapult, not just stones
- aim at a rectangular area in any direction, and across Z-levels

The front-end is implemented by *gui/siege-engine*.

## power-meter

The power-meter plugin implements a modified pressure plate that detects power being supplied to gear boxes built in the four adjacent N/S/W/E tiles.

The configuration front-end is implemented by *gui/power-meter*.

## steam-engine

The steam-engine plugin detects custom workshops with STEAM\_ENGINE in their token, and turns them into real steam engines.

The vanilla game contains only water wheels and windmills as sources of power, but windmills give relatively little power, and water wheels require flowing water, which must either be a real river and thus immovable and limited in supply, or actually flowing and thus laggy.

Compared to the [water reactor](#) exploit, steam engines make a lot of sense!

### Construction

The workshop needs water as its input, which it takes via a passable floor tile below it, like usual magma workshops do. The magma version also needs magma.

Due to DFHack limits, the workshop will collapse over true open space. However down stairs are passable but support machines, so you can use them.

After constructing the building itself, machines can be connected to the edge tiles that look like gear boxes. Their exact position is extracted from the workshop raws.

Like with collapse above, due to DFHack limits the workshop can only immediately connect to machine components built AFTER it. This also means that engines cannot be chained without intermediate axles built after both engines.

### Operation

In order to operate the engine, queue the Stoke Boiler job (optionally on repeat). A furnace operator will come, possibly bringing a bar of fuel, and perform it. As a result, a “boiling water” item will appear in the  $\tau$  view of the workshop.

---

**Note:** The completion of the job will actually consume one unit of the appropriate liquids from below the workshop. This means that you cannot just raise 7 units of magma with a piston and have infinite power. However, liquid consumption should be slow enough that water can be supplied by a pond zone bucket chain.

---

Every such item gives 100 power, up to a limit of 300 for coal, and 500 for a magma engine. The building can host twice that amount of items to provide longer autonomous running. When the boiler gets filled to capacity, all queued jobs are suspended; once it drops back to 3+1 or 5+1 items, they are re-enabled.

While the engine is providing power, steam is being consumed. The consumption speed includes a fixed 10% waste rate, and the remaining 90% are applied proportionally to the actual load in the machine. With the engine at nominal 300 power with 150 load in the system, it will consume steam for actual  $300 \cdot (10\% + 90\% \cdot 150/300) = 165$  power.

Masterpiece mechanism and chain will decrease the mechanical power drawn by the engine itself from 10 to 5. Masterpiece barrel decreases waste rate by 4%. Masterpiece piston and pipe decrease it by further 4%, and also decrease the whole steam use rate by 10%.

### Explosions

The engine must be constructed using barrel, pipe and piston from fire-safe, or in the magma version magma-safe metals.

During operation weak parts get gradually worn out, and eventually the engine explodes. It should also explode if toppled during operation by a building destroyer, or a tantruming dwarf.

## Save files

It should be safe to load and view engine-using fortresses from a DF version without DFHack installed, except that in such case the engines won't work. However actually making modifications to them, or machines they connect to (including by pulling levers), can easily result in inconsistent state once this plugin is available again. The effects may be as weird as negative power being generated.

## DFHack Scripts

Lua or ruby scripts placed in the `hack/scripts/` directory are considered for execution as if they were native DFHack commands.

The following pages document all the scripts in the DFHack standard library.

### Basic Scripts

Basic scripts are not stored in any subdirectory, and can be invoked directly. They are generally useful tools for any player.

#### Contents

- *Basic Scripts*
  - *adaptation*
  - *add-thought*
  - *adv-max-skills*
  - *adv-rumors*
  - *armoks-blessing*
  - *autofarm*
  - *autolabor-artisans*
  - *autounsuspend*
  - *ban-cooking*
  - *binpatch*
  - *brainwash*
  - *burial*
  - *catsplosion*
  - *colonies*
  - *combine-drinks*
  - *combine-plants*
  - *create-items*
  - *deathcause*
  - *deteriorateclothes*

- *deterioratecorpses*
- *deterioratefood*
- *digfort*
- *drain-aquifer*
- *elevate-mental*
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- *embark-skills*
- *emigration*
- *exportlegends*
- *exterminate*
- *feature*
- *fix-ster*
- *fixnaked*
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- *forum-dwarves*
- *full-heal*
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- *item-descriptions*
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- *points*
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- *troubleshoot-item*
- *twaterlvl*
- *undump-buildings*
- *unforbid*
- *unsuspend*
- *view-item-info*
- *warn-starving*
- *weather*

## **adaptation**

View or set level of cavern adaptation for the selected unit or the whole fort. Usage: `adaptation <show|set> <him|all> [value]`. The value must be between 0 and 800,000 inclusive.

### add-thought

Adds a thought or emotion to the selected unit. Can be used by other scripts, or the gui invoked by running `add-thought gui` with a unit selected.

### adv-max-skills

When creating an adventurer, raises all changeable skills and attributes to their maximum level.

### adv-rumors

Improves the “Bring up specific incident or rumor” menu in Adventure mode.

### armoks-blessing

Runs the equivalent of *rejuvenate*, *elevate-physical*, *elevate-mental*, and *brainwash* on all dwarves currently on the map. This is an extreme change, which sets every stat to an ideal - legendary skills, great traits, and easy-to-satisfy preferences.

Without arguments, all attributes, age & personalities are adjusted. Arguments allow for skills to be adjusted as well.

### autofarm

Automatically handle crop selection in farm plots based on current plant stocks. Selects a crop for planting if current stock is below a threshold. Selected crops are dispatched on all farmplots.

Usage:

```
autofarm start
autofarm default 30
autofarm threshold 150 helmet_plump tail_pig
```

### autolabor-artisans

Runs an *autolabor* command, for all labors where skill level influences output quality. Examples:

```
autolabor-artisans 0 2 3
autolabor-artisans disable
```

### autounsuspend

Automatically unsuspend jobs in workshops, on a recurring basis. See *unsuspend* for one-off use, or *resume* all.

### ban-cooking

A more convenient way to ban cooking various categories of foods than the kitchen interface. Usage: `ban-cooking <type>`. Valid types are `booze`, `honey`, `tallow`, `oil`, `seeds` (non-tree plants with seeds), `brew`, `fruit`, `mill`, `thread`, and `milk`.

## binpatch

Implements functions for in-memory binpatches. See *Patching the DF binary*.

## brainwash

Modify the personality traits of the selected dwarf to match an idealised personality - for example, as stable and reliable as possible to prevent tantrums even after months of misery.

Usage: `brainwash <type>`, with one of the following types:

- ideal** reliable, with generally positive personality traits
- baseline** reset all personality traits to the average
- stepford** amplifies all good qualities to an excessive degree
- wrecked** amplifies all bad qualities to an excessive degree

## burial

Sets all unowned coffins to allow burial. `burial -pets` also allows burial of pets.

## catsplosion

Makes cats (and other animals) just *multiply*. It is not a good idea to run this more than once or twice.

Usage:

- catsplosion** Make all cats pregnant
- catsplosion list** List IDs of all animals on the map
- catsplosion ID ...** Make animals with given ID(s) pregnant

Animals will give birth within two in-game hours (100 ticks or fewer).

## colonies

List vermin colonies, place honey bees, or convert all vermin to honey bees. Usage:

- colonies** List all vermin colonies on the map.
- colonies place** Place a honey bee colony under the cursor.
- colonies convert** Convert all existing colonies to honey bees.

The `place` and `convert` subcommands by default create or convert to honey bees, as this is the most commonly useful. However both accept an optional flag to use a different vermin type, for example `colonies place ANT` creates an ant colony and `colonies convert TERMITE` ends your beekeeping industry.

## combine-drinks

Merge stacks of drinks in the selected stockpile.

## combine-plants

Merge stacks of plants or plant growths in the selected container or stockpile.

## create-items

Spawn items under the cursor, to get your fortress started.

The first argument gives the item category, the second gives the material, and the optionnal third gives the number of items to create (defaults to 20).

Currently supported item categories: boulder, bar, plant, log, web.

Instead of material, using `list` makes the script list eligible materials.

The `web` item category will create an uncollected cobweb on the floor.

Note that the script does not enforce anything, and will let you create boulders of toad blood and stuff like that. However the `list` mode will only show ‘normal’ materials.

Examples:

```
create-items boulders COAL_BITUMINOUS 12
create-items plant tail_pig
create-items log list
create-items web CREATURE:SPIDER_CAVE_GIANT:SILK
create-items bar CREATURE:CAT:SOAP
create-items bar adamantine
```

## deathcause

Select a body part ingame, or a unit from the `u` unit list, and this script will display the cause of death of the creature.

## deteriorateclothes

Somewhere between a “mod” and a “fps booster”, with a small impact on vanilla gameplay. All of those slightly worn wool shoes that dwarves scatter all over the place will deteriorate at a greatly increased rate, and eventually just crumble into nothing. As warm and fuzzy as a dining room full of used socks makes your dwarves feel, your FPS does not like it.

Usage: `deteriorateclothes (start|stop)`

## deterioratecorpses

Somewhere between a “mod” and a “fps booster”, with a small impact on vanilla gameplay.

In long running forts, especially evil biomes, you end up with a lot of toes, teeth, fingers, and limbs scattered all over the place. Various corpses from various sieges, stray kitten corpses, probably some heads. Basically, your map will look like a giant pile of assorted body parts, all of which individually eat up a small part of your FPS, which collectively eat up quite a bit.

In addition, this script also targets various butchery byproducts. Enjoying your thriving animal industry? Your FPS does not. Those thousands of skulls, bones, hooves, and wool eat up precious FPS that could be used to kill goblins and elves. Whose corpses will also get destroyed by the script to kill more goblins and elves.

This script causes all of those to rot away into nothing after several months.

Usage: `deterioratecorpses (start|stop)`

### deterioratefood

Somewhere between a “mod” and a “fps booster”, with a small impact on vanilla gameplay.

With this script running, all food and plants wear out and disappear after several months. Barrels and stockpiles will keep them from rotting, but it won’t keep them from decaying. No more sitting on a hundred years worth of food. No more keeping barrels of pig tails sitting around until you decide to use them. Either use it, eat it, or lose it. Seeds, are excluded from this, if you aren’t planning on using your pig tails, hold onto the seeds for a rainy day.

This script is...pretty far reaching. However, almost all long running forts I’ve had end up sitting on thousands and thousands of food items. Several thousand cooked meals, three thousand plump helmets, just as many fish and meat. It gets pretty absurd. And your FPS doesn’t like it.

Usage: `deterioratefood (start|stop)`

### digfort

A script to designate an area for digging according to a plan in csv format.

This script, inspired from quickfort, can designate an area for digging. Your plan should be stored in a .csv file like this:

```
# this is a comment
d;d;u;d;d;skip this tile;d
d;d;d;i
```

Available tile shapes are named after the ‘dig’ menu shortcuts: `d` for dig, `u` for upstairs, `j` downstairs, `i` updown, `h` channel, `r` upward ramp, `x` remove designation. Unrecognized characters are ignored (eg the ‘skip this tile’ in the sample).

Empty lines and data after a `#` are ignored as comments. To skip a row in your design, use a single `;`.

One comment in the file may contain the phrase `start(3,5)`. It is interpreted as an offset for the pattern: instead of starting at the cursor, it will start 3 tiles left and 5 tiles up from the cursor.

The script takes the plan filename, starting from the root `df` folder (where `Dwarf Fortress.exe` is found).

### drain-aquifer

Remove all ‘aquifer’ tags from the map blocks. Irreversible.

### elevate-mental

Set all mental attributes of the selected dwarf to the maximum possible, or any number numbers between 0 and 5000 passed as an argument: `elevate-mental 100` for example would make the dwarf very stupid indeed.

### elevate-physical

Set all physical attributes of the selected dwarf to the maximum possible, or any number numbers between 0 and 5000 passed as an argument. Higher is usually better, but an ineffective hammerer can be useful too...

## embark-skills

Adjusts dwarves' skills when embarking.

Note that already-used skill points are not taken into account or reset.

**points N** Sets the skill points remaining of the selected dwarf to N.

**points N all** Sets the skill points remaining of all dwarves to N.

**max** Sets all skills of the selected dwarf to "Proficient".

**max all** Sets all skills of all dwarves to "Proficient".

**legendary** Sets all skills of the selected dwarf to "Legendary".

**legendary all** Sets all skills of all dwarves to "Legendary".

## emigration

Allows dwarves to emigrate from the fortress when stressed, in proportion to how badly stressed they are and adjusted for who they would have to leave with - a dwarven merchant being more attractive than leaving alone (or with an elf). The check is made monthly.

A happy dwarf (ie with negative stress) will never emigrate.

Usage: `emigration enable|disable`

## exportlegends

Controls legends mode to export data - especially useful to set-and-forget large worlds, or when you want a map of every site when there are several hundred.

The 'info' option exports more data than is possible in vanilla, to a `region-date-legends_plus.xml` file developed to extend [World Viewer](#) and other legends utilities.

Options:

**info** Exports the world/gen info, the legends XML, and a custom XML with more information

**custom** Exports a custom XML with more information

**sites** Exports all available site maps

**maps** Exports all seventeen detailed maps

**all** Equivalent to calling all of the above, in that order

**Keybinding:** CtrlA -> `"exportlegends all"` in legends

## exterminate

Kills any unit of a given race.

With no argument, lists the available races and count eligible targets.

With the special argument `him`, targets only the selected creature.

With the special argument `undead`, targets all undeads on the map, regardless of their race.

When specifying a race, a caste can be specified to further restrict the targeting. To do that, append and colon and the caste name after the race.

Any non-dead non-caged unit of the specified race gets its `blood_count` set to 0, which means immediate death at the next game tick. For creatures such as vampires, it also sets `animal.vanish_countdown` to 2.

An alternate mode is selected by adding a 2nd argument to the command, `magma`. In this case, a column of 7/7 magma is generated on top of the targets until they die (Warning: do not call on magma-safe creatures. Also, using this mode on birds is not recommended.) The final alternate mode is `butcher`, which marks them for butchering but does not kill.

Will target any unit on a revealed tile of the map, including ambushers, but ignore caged/chained creatures.

Ex:

```
exterminate gob
exterminate gob:male
```

To kill a single creature, select the unit with the ‘v’ cursor and:

```
exterminate him
```

To purify all elves on the map with fire (may have side-effects):

```
exterminate elve magma
```

## feature

Enables management of map features.

- Discovering a magma feature (magma pool, volcano, magma sea, or curious underground structure) permits magma workshops and furnaces to be built.
- Discovering a cavern layer causes plants (trees, shrubs, and grass) from that cavern to grow within your fortress.

Options:

**list** Lists all map features in your current embark by index.

**magma** Enable magma furnaces (discovers a random magma feature).

**show X** Marks the selected map feature as discovered.

**hide X** Marks the selected map feature as undiscovered.

## fix-ster

Utilizes the orientation tag to either fix infertile creatures or inflict infertility on creatures that you do not want to breed. Usage:

```
fix-ster [fert|ster] [all|animals|only:<creature>]
```

`fert` or `ster` is a required argument; whether to make the target fertile or sterile. Optional arguments specify the target: no argument for the selected unit, `all` for all units on the map, `animals` for all non-dwarf creatures, or `only:<creature>` to only process matching creatures.

## fixnaked

Removes all unhappy thoughts due to lack of clothing.

## force

A simpler wrapper around the *modtools/force* script.

Usage:

- `force event_type`
- `force event_type civ_id` - civ ID required for Diplomat and Caravan events

See *modtools/force* for a complete list of event types.

## forum-dwarves

Saves a copy of a text screen, formatted in bbcode for posting to the Bay12 Forums. See *markdown* to export for Reddit etc.

This script will attempt to read the current df-screen, and if it is a text-viewscreen (such as the dwarf ‘thoughts’ screen or an item ‘description’) then append a marked-up version of this text to the target file. Previous entries in the file are not overwritten, so you may use the ‘forumdwarves’ command multiple times to create a single document containing the text from multiple screens (eg: text screens from several dwarves, or text screens from multiple artifacts/items, or some combination).

The screens which have been tested and known to function properly with this script are:

1. dwarf/unit ‘thoughts’ screen
2. item/art ‘description’ screen
3. individual ‘historical item/figure’ screens

There may be other screens to which the script applies. It should be safe to attempt running the script with any screen active, with an error message to inform you when the selected screen is not appropriate for this script.

The target file’s name is ‘forumdwarves.txt’. A reminder to this effect will be displayed if the script is successful.

---

**Note:** The text will be encoded in CP437, which is likely to be incompatible with the system default. This causes incorrect display of special characters (eg. `é ò ç` = `é ò ç`). You can fix this by opening the file in an editor such as Notepad++ and selecting the correct encoding before using the text.

---

**Keybinding:** CtrlShiftF in dwarfmode

## full-heal

Attempts to fully heal the selected unit from anything, optionally including death. Usage:

**full-heal** Completely heal the currently selected unit.

**full-heal -unit [unitId]** Apply command to the unit with the given ID, instead of selected unit.

**full-heal -r [-keep\_corpse]** Heal the unit, raising from the dead if needed. Add `-keep_corpse` to avoid removing their corpse.

For example, `full-heal -r -keep_corpse -unit ID_NUM` will fully heal unit ID\_NUM. If this unit was dead, it will be resurrected without deleting the corpse - creepy!



## gaydar

Shows the sexual orientation of units, useful for social engineering or checking the viability of livestock breeding programs.

Targets:

- all** shows orientation of every creature
- citizens** shows only orientation of citizens in fort mode
- named** shows orientation of all named units on map
- (no target)** shows orientation of the unit under the cursor

Orientation filters:

- notStraight** only creatures who are not strictly straight
- gayOnly** only creatures who are strictly gay
- biOnly** only creatures who can get into romances with both sexes
- straightOnly** only creatures who are strictly straight
- asexualOnly** only creatures who are strictly asexual

## growcrops

Instantly grow seeds inside farming plots.

With no argument, this command list the various seed types currently in use in your farming plots. With a seed type, the script will grow 100 of these seeds, ready to be harvested. Set the number with a 2nd argument.

For example, to grow 40 plump helmet spawn:

```
growcrops plump 40
```

## hfs-pit

Creates a pit to the underworld at the cursor, taking three numbers as arguments. Usage: hfs-pit <size> <walls> <stairs>

The first argument is size of the (square) pit in all directions. The second is 1 to wall off the sides of the pit on all layers except the underworld, or anything else to leave them open. The third parameter is 1 to add stairs. Stairs are buggy; they will not reveal the bottom until you dig somewhere, but underworld creatures will path in.

Examples:

```
hfs-pit 1 0 0
  A single-tile wide pit with no walls or stairs.
  This is the default if no numbers are given.

hfs-pit 4 0 1
  A four-across pit with no stairs but adding walls.

hfs-pit 2 1 0
  A two-across pit with stairs but no walls.
```

## hotkey-notes

Lists the key, name, and jump position of your hotkeys in the DFHack console.

## install-info

Saves information about the current DFHack installation to `install-info.txt` in the current DF folder. Useful for bug reports.

## item-descriptions

Exports a table with custom description text for every item in the game. Used by [view-item-info](#); see instructions there for how to override for mods.

## launch

Activate with a cursor on screen and you will go there rapidly. Attack something first to send them there.

## lever

Allow manipulation of in-game levers from the dfhack console.

Can list levers, including state and links, with:

```
lever list
```

To queue a job so that a dwarf will pull the lever 42, use `lever pull 42`. This is the same as `q` querying the building and queue a `P` pull request.

To magically toggle the lever immediately, use:

```
lever pull 42 --now
```

## load-save

When run on the title screen or “load game” screen, loads the save with the given folder name without requiring interaction.

Example: `load-save region`

This can also be run when starting DFHack from the command line:

```
./dfhack +load-game region1
```

(This is currently untested on Windows)

## locate-ore

Scan the map for metal ores.

Finds and designate for digging one tile of a specific metal ore. Only works for native metal ores, does not handle reaction stuff (eg STEEL).

When invoked with the `list` argument, lists metal ores available on the map.

Examples:

```
locate-ore list
locate-ore hematite
locate-ore iron
```

## lua

There are the following ways to invoke this command:

1. `lua` (without any parameters)

This starts an interactive lua interpreter.

2. `lua -f "filename"` or `lua --file "filename"`

This loads and runs the file indicated by filename.

3. `lua -s ["filename"]` or `lua --save ["filename"]`

This loads and runs the file indicated by filename from the save directory. If the filename is not supplied, it loads “dfhack.lua”.

4. `:lua lua statement...`

Parses and executes the lua statement like the interactive interpreter would.

## make-legendary

Makes the selected dwarf legendary in one skill, a group of skills, or all skills. View groups with `make-legendary classes`, or all skills with `make-legendary list`. Use `make-legendary MINING` when you need something dug up, or `make-legendary all` when only perfection will do.

## make-monarch

Make the selected unit King or Queen of your civilisation.

## markdown

Save a copy of a text screen in markdown (for reddit among others). See [forum-dwarves](#) for BBCode export (for eg. the Bay12 Forums).

This script will attempt to read the current df-screen, and if it is a text-viewscreen (such as the dwarf ‘thoughts’ screen or an item / creature ‘description’) or an announcement list screen (such as announcements and combat reports) then append a marked-down version of this text to the target file (for easy pasting on reddit for example). Previous entries in the file are not overwritten, so you may use the “markdown” command multiple times to create a single document containing the text from multiple screens (eg: text screens from several dwarves, or text screens from multiple artifacts/items, or some combination).

Usage: `markdown [/n] [filename]`

**/n** overwrites contents of output file

**filename** if provided, save to `md_filename.md` instead of the default `md_export.md`

The screens which have been tested and known to function properly with this script are:

1. dwarf/unit ‘thoughts’ screen
2. item/art ‘description’ screen
3. individual ‘historical item/figure’ screens
4. manual
5. announcements screen
6. combat reports screen
7. latest news (when meeting with liaison)

There may be other screens to which the script applies. It should be safe to attempt running the script with any screen active, with an error message to inform you when the selected screen is not appropriate for this script.

---

**Note:** The text will be encoded in CP437, which is likely to be incompatible with the system default. This causes incorrect display of special characters (eg. *é ò ç* = *é ò ç*). You can fix this by opening the file in an editor such as Notepad++ and selecting the correct encoding before using the text.

---

## masspit

Designate all creatures in cages on top of a pit/pond activity zone for pitting. Works best with an animal stockpile on top of the zone.

Works with a zone number as argument (eg `Activity Zone #6 -> masspit 6`) or with the game cursor on top of the area.

## migrants-now

Forces an immediate migrant wave. Only works after migrants have arrived naturally. Equivalent to *modtools/force-eventType migrants*

## multicmd

Run multiple dfhack commands. The argument is split around the character ; and all parts are run sequentially as independent dfhack commands. Useful for hotkeys.

Example:

```
multicmd locate-ore IRON ; digv ; digcircle 16
```

## names

Rename units or items. Usage:

- help print this help message
- item if viewing an item
- unit if viewing a unit
- first [Somename | “Some Names like This” if a first name is desired, leave blank to clear current first name

## open-legends

Open a legends screen when in fortress mode. Compatible with *exportlegends*.

## points

Sets available points at the embark screen to the specified number. Eg. `points 1000000` would allow you to buy everything, or `points 0` would make life quite difficult.

## position

Reports the current time: date, clock time, month, and season. Also reports location: z-level, cursor position, window size, and mouse location.

## pref-adjust

A two-stage script: `pref-adjust clear` removes preferences from all dwarves, and `pref-adjust` inserts an 'ideal' set which is easy to satisfy:

```
Feb Idashzefon likes wild strawberries for their vivid red color,
fisher berries for their round shape, prickle berries for their
precise thorns, plump helmets for their rounded tops, prepared meals,
plants, drinks, doors, thrones, tables and beds. When possible, she
prefers to consume wild strawberries, fisher berries, prickle
berries, plump helmets, strawberry wine, fisher berry wine, prickle
berry wine, and dwarven wine.
```

## prefchange

Sets preferences for mooding to include a weapon type, equipment type, and material. If you also wish to trigger a mood, see *strangemood*.

Valid options:

- show** show preferences of all units
- c** clear preferences of selected unit
- all** clear preferences of all units
- axp** likes axes, breastplates, and steel
- has** likes hammers, mail shirts, and steel
- swb** likes short swords, high boots, and steel
- spb** likes spears, high boots, and steel
- mas** likes maces, shields, and steel
- xbh** likes crossbows, helms, and steel
- pig** likes picks, gauntlets, and steel
- log** likes long swords, gauntlets, and steel
- dap** likes daggers, greaves, and steel

Feel free to adjust the values as you see fit, change the has steel to platinum, change the axp axes to great axes, whatnot.

### putontable

Makes item appear on the table, like in adventure mode shops. Arguments: `-a` or `--all` for all items.

### quicksave

If called in dwarf mode, makes DF immediately saves the game by setting a flag normally used in seasonal auto-save.

**Keybinding:** CtrlAltS in dwarfmode/Default

### region-pops

Show or modify the populations of animals in the region.

Usage:

**region-pops list [pattern]** Lists encountered populations of the region, possibly restricted by pattern.

**region-pops list-all [pattern]** Lists all populations of the region.

**region-pops boost <TOKEN> <factor>** Multiply all populations of TOKEN by factor. If the factor is greater than one, increases the population, otherwise decreases it.

**region-pops boost-all <pattern> <factor>** Same as above, but match using a pattern acceptable to list.

**region-pops incr <TOKEN> <factor>** Augment (or diminish) all populations of TOKEN by factor (additive).

**region-pops incr-all <pattern> <factor>** Same as above, but match using a pattern acceptable to list.

### rejuvenate

Set the age of the selected dwarf to 20 years. Useful if valuable citizens are getting old, or there are too many babies around...

### remove-stress

Sets stress to -1,000,000; the normal range is 0 to 500,000 with very stable or very stressed dwarves taking on negative or greater values respectively. Applies to the selected unit, or use `remove-stress -all` to apply to all units.

### remove-wear

Sets the wear on items in your fort to zero. Usage:

**remove-wear all** Removes wear from all items in your fort.

**remove-wear ID1 ID2 ...** Removes wear from items with the given ID numbers.

### repeat

Repeatedly calls a lua script at the specified interval. This allows neat background changes to the function of the game, especially when invoked from an init file.

Usage examples:

```
repeat -name jim -time delay -timeUnits units -command [ printArgs 3 1 2 ]
repeat -time 1 -timeUnits months -command [ multicmd cleanowned scattered x; clean_
↪all ] -name clean
```

The first example is abstract; the second will regularly remove all contaminants and worn items from the game.

Arguments:

- name** sets the name for the purposes of cancelling and making sure you don't schedule the same repeating event twice. If not specified, it's set to the first argument after **-command**.
- time DELAY -timeUnits UNITS** DELAY is some positive integer, and UNITS is some valid time unit for `dfhack.timeout` (default "ticks"). Units can be in simulation-time "frames" (raw FPS) or "ticks" (only while unpaused), while "days", "months", and "years" are by in-world time.
- command [ ... ]** ... specifies the command to be run
- cancel NAME** cancels the repetition with the name NAME

## season-palette

Swap color palettes when the seasons change.

For this script to work you need to add *at least* one color palette file to your save raw directory.

**Palette file names:** "colors.txt": The world "default" (worldgen and replacement) palette. "colors\_spring.txt": The palette displayed during spring. "colors\_summer.txt": The palette displayed during summer. "colors\_autumn.txt": The palette displayed during autumn. "colors\_winter.txt": The palette displayed during winter.

If you do not provide a world default palette, palette switching will be disabled for the current world. The seasonal palettes are optional, the default palette is not! The default palette will be used to replace any missing seasonal palettes and during worldgen.

When the world is unloaded or this script is disabled, the system default color palette ("data/init/colors.txt") will be loaded. The system default palette will always be used in the main menu, but your custom palettes should be used everywhere else.

Usage:

**season-palette start|enable or enable season-palette:** Begin swapping seasonal color palettes.

**season-palette stop|disable or disable season-palette:** Stop swapping seasonal color palettes and load the default color palette.

If loaded as a module this script will export a single Lua function:

**LoadPalette(path):** Load a color palette from the text file at "path". This file must be in the same format as "data/init/colors.txt". If there is an error any changes will be reverted and this function will return false (returns true normally).

## setfps

Run `setfps <number>` to set the FPS cap at runtime, in case you want to watch combat in slow motion or something.

## show-unit-syndromes

Show syndromes affecting units and the remaining and maximum duration, along with (optionally) substantial detail on the effects.

Use one or more of the following options:

**help** Show the help message

**showall** Show units even if not affected by any syndrome

**showeffects** Show detailed effects of each syndrome

**showdisplayeffects** Show effects that only change the look of the unit

**selected** Show selected unit

**dwarves** Show dwarves

**livestock** Show livestock

**wildanimals** Show wild animals

**hostile** Show hostiles (e.g. invaders, thieves, forgotten beasts etc)

**world** Show all defined syndromes in the world

**export** `export:<filename>` sends output to the given file, showing all syndromes affecting each unit with the maximum and present duration.

## siren

Wakes up sleeping units, cancels breaks and stops parties either everywhere, or in the burrows given as arguments. In return, adds bad thoughts about noise, tiredness and lack of protection. Also, the units with interrupted breaks will go on break again a lot sooner. The script is intended for emergencies, e.g. when a siege appears, and all your military is partying.

## source

Create an infinite magma or water source or drain on a tile. For more complex commands, try the *liquids* plugin.

This script registers a map tile as a liquid source, and every 12 game ticks that tile receives or remove 1 new unit of flow based on the configuration.

Place the game cursor where you want to create the source (must be a flow-passable tile, and not too high in the sky) and call:

```
source add [magma|water] [0-7]
```

The number argument is the target liquid level (0 = drain, 7 = source).

To add more than 1 unit everytime, call the command again on the same spot.

To delete one source, place the cursor over its tile and use `source delete`. To remove all existing sources, call `source clear`.

The `list` argument shows all existing sources.

Examples:



```
source add water      - water source
source add magma 7    - magma source
source add water 0    - water drain
```

## spawnunit

Provides a simpler interface to *modtools/create-unit*, for creating units.

Usage: spawnunit [-command] RACE CASTE [NAME] [x y z] [...]

The `-command` flag prints the generated *modtools/create-unit* command instead of running it. RACE and CASTE specify the race and caste of the unit to be created. The name and coordinates of the unit are optional. Any further arguments are simply passed on to *modtools/create-unit*.

## startdwarf

Use at the embark screen to embark with the specified number of dwarves. Eg. `startdwarf 500` would lead to a severe food shortage and FPS issues, while `startdwarf 10` would just allow a few more warm bodies to dig in. The number must be 7 or greater.

## starvingdead

Somewhere between a “mod” and a “fps booster”, with a small impact on vanilla gameplay. It mostly helps prevent undead cascades in the caverns, where constant combat leads to hundreds of undead roaming the caverns and destroying your FPS.

With this script running, all undead that have been on the map for one month gradually decay, losing strength, speed, and toughness. After six months, they collapse upon themselves, never to be reanimated.

Usage: starvingdead (start|stop)

## stripcaged

For dumping items inside cages. Will mark selected items for dumping, then a dwarf may come and actually dump them (or you can use *autodump*).

Arguments:

- list** display the list of all cages and their item content on the console
- items** dump items in the cage, excluding stuff worn by caged creatures
- weapons** dump equipped weapons
- armor** dump everything worn by caged creatures (including armor and clothing)
- all** dump everything in the cage, on a creature or not

Without further arguments, all commands work on all cages and animal traps on the map. With the `here` argument, considers only the in-game selected cage (or the cage under the game cursor). To target only specific cages, you can alternatively pass cage IDs as arguments:

```
stripcaged weapons 25321 34228
```

## superdwarf

Similar to *fastdwarf*, per-creature.

To make any creature superfast, target it ingame using 'v' and:

```
superdwarf add
```

Other options available: `del`, `clear`, `list`.

This script also shortens the 'sleeping' and 'on break' periods of targets.

## teleport

Teleports a unit to given coordinates. Examples:

**teleport -showunitid** prints ID of unit beneath cursor

**teleport -showpos** prints coordinates beneath cursor

**teleport -unit 1234 -x 56 -y 115 -z 26** teleports unit 1234 to 56,115,26

## tidlers

Toggle between all possible positions where the idlers count can be placed.

## troubleshoot-item

Print various properties of the selected item.

## twaterlvl

Toggle between displaying/not displaying liquid depth as numbers.

**Keybinding:** CtrlW

## undump-buildings

Undesignates building base materials for dumping.

## unforbid

unforbid all

Options available: `all`, ``help``

## unsuspend

Unsuspend jobs in workshops, on a one-off basis. See *autounsuspend* for regular use.

## view-item-info

A script to extend the item or unit viewscreen with additional information including a custom description of each item (when available), and properties such as material statistics, weapon attacks, armor effectiveness, and more.

The associated script *item-descriptions.lua* supplies custom descriptions of items. Individual descriptions can be added or overridden by a similar script `raw/scripts/more-item-descriptions.lua`. Both work as sparse lists, so missing items simply go undescribed if not defined in the fallback.

## warn-starving

If any (live) units are starving, very thirsty, or very drowsy, the game will be paused and a warning shown and logged to the console. Use with the *repeat* command for regular checks.

Use `warn-starving all` to display a list of all problematic units.

## weather

Prints a map of the local weather, or with arguments `clear`, `rain`, and `snow` changes the weather.

## Development Scripts

`devel/*` scripts are intended for developer use, but many may be of interest to anyone investigating odd phenomena or just messing around. They are documented to encourage such inquiry.

Some can PERMANENTLY DAMAGE YOUR SAVE if misused, so please be careful. The warnings are real; if in doubt make backups before running the command.

### Contents

- *Development Scripts*
  - *devel/all-bob*
  - *devel/annc-monitor*
  - *devel/check-release*
  - *devel/clear-script-env*
  - *devel/click-monitor*
  - *devel/cmptiles*
  - *devel/export-dt-ini*
  - *devel/find-offsets*
  - *devel/inject-raws*
  - *devel/inspect-screen*
  - *devel/light*
  - *devel/list-filters*
  - *devel/lsmem*
  - *devel/lua-example*

- *devel/modstate-monitor*
- *devel/nuke-items*
- *devel/pop-screen*
- *devel/prepare-save*
- *devel/print-args*
- *devel/print-args2*
- *devel/save-version*
- *devel/scanitemother*
- *devel/send-key*
- *devel/spawn-unit-helper*
- *devel/test-perlin*
- *devel/unforbidall*
- *devel/unit-path*
- *devel/watch-minecarts*

### **devel/all-bob**

Changes the first name of all units to “Bob”. Useful for testing *modtools/interaction-trigger* events.

### **devel/annc-monitor**

Displays announcements and reports in the console.

**enable|start** Begins monitoring

**disable|stop** Stops monitoring

**interval X** Sets the delay between checks for new announcements to X frames

### **devel/check-release**

Basic checks for release readiness

### **devel/clear-script-env**

Clears the environment of the specified lua script(s).

### **devel/click-monitor**

Displays the grid coordinates of mouse clicks in the console. Useful for plugin/script development.

Usage: `devel/click-monitor start|stop`

### devel/cmptiles

Lists and/or compares two tiletype material groups.

Usage: `devel/cmptiles material1 [material2]`

### devel/export-dt-ini

Exports an ini file containing memory addresses for Dwarf Therapist.

### devel/find-offsets

WARNING: THIS SCRIPT IS STRICTLY FOR DFHACK DEVELOPERS.

Running this script on a new DF version will NOT MAKE IT RUN CORRECTLY if any data structures changed, thus possibly leading to CRASHES AND/OR PERMANENT SAVE CORRUPTION.

Finding the first few globals requires this script to be started immediately after loading the game, WITHOUT first loading a world. The rest expect a loaded save, not a fresh embark. Finding `current_weather` requires a special save previously processed with *devel/prepare-save* on a DF version with working dfhack.

The script expects vanilla game configuration, without any custom tilesets or init file changes. Never unpause the game unless instructed. When done, quit the game without saving using 'die'.

Arguments:

- `global` names to force finding them
- `all` to force all globals
- `nofeed` to block automated fake input searches
- `nozoom` to disable neighboring object heuristics

### devel/inject-raws

WARNING: THIS SCRIPT CAN PERMANENLY DAMAGE YOUR SAVE.

This script attempts to inject new raw objects into your world. If the injected references do not match the actual edited raws, your save will refuse to load, or load but crash.

This script can handle reaction, item and building definitions.

The savegame contains a list of the relevant definition tokens in the right order, but all details are read from raws every time. This allows just adding stub definitions, and simply saving and reloading the game.

This is useful enough for modders and some users to justify the danger.

Usage example:

```
devel/inject-raws trapcomp ITEM_TRAPCOMP_STEAM_PISTON workshop STEAM_ENGINE MAGMA_  
↪STEAM_ENGINE reaction STOKE_BOILER
```

### devel/inspect-screen

Read the tiles from the screen and display info about them.

### **devel/light**

An experimental lighting engine for DF, using the *rendermax* plugin.

Call `devel/light static` to not recalculate lighting when in game. Press `~` to recalculate lighting. Press ``` to exit.

### **devel/list-filters**

List input items for the building currently being built. This is where the filters in `lua/dfhack/buildings.lua` come from.

### **devel/lsmem**

Prints memory ranges of the process.

### **devel/lua-example**

An example lua script, which reports the number of times it has been called. Useful for testing environment persistence.

### **devel/modstate-monitor**

Display changes in key modifier state, ie Ctrl/Alt/Shift.

**enable|start** Begin monitoring

**disable|stop** End monitoring

### **devel/nuke-items**

Deletes ALL items not held by units, buildings or jobs. Intended solely for lag investigation.

### **devel/pop-screen**

For killing bugged out gui script screens.

### **devel/prepare-save**

WARNING: THIS SCRIPT IS STRICTLY FOR DFHACK DEVELOPERS.

This script prepares the current savegame to be used with *devel/find-offsets*. It CHANGES THE GAME STATE to predefined values, and initiates an immediate *quicksave*, thus PERMANENTLY MODIFYING the save.

### **devel/print-args**

Prints all the arguments you supply to the script on their own line. Useful for debugging other scripts.

### **devel/print-args2**

Prints all the arguments you supply to the script on their own line with quotes around them.

**devel/save-version**

Display DF version information about the current save

**devel/scanitemother**

List indices in `world.item.other[]` where current selected item appears.

**devel/send-key**

Send a key to the current screen or a parent

Usage:

**devel/send-key KEY\_NAME** Send KEY\_NAME

**devel/send-key KEY\_NAME X** Send KEY\_NAME to the screen X screens above the current screen

**devel/spawn-unit-helper**

Setup stuff to allow arena creature spawn after a mode change.

With Arena spawn data initialized:

- enter the k menu and change mode using `rb_eval df.gametype = :DWARF_ARENA`
- spawn creatures (c ingame)
- revert to game mode using `rb_eval df.gametype = #{df.gametype.inspect}`
- To convert spawned creatures to livestock, select each one with the v menu, and enter `rb_eval df.unit_find.civ_id = df.ui.civ_id`

**devel/test-perlin**

Generates an image using multiple octaves of perlin noise.

**devel/unforbidall**

Unforbid all items.

**devel/unit-path**

Show the internal path a unit is currently following.

**devel/watch-minecarts**

Logs minecart coordinates and speeds to console.

Usage: `devel/watch-minecarts start|stop`

## Bugfixing Scripts

`fix/*` scripts fix various bugs and issues, some of them obscure.

### Contents

- *Bugfixing Scripts*
  - *fix/blood-del*
  - *fix/build-location*
  - *fix/dead-units*
  - *fix/diplomats*
  - *fix/dry-buckets*
  - *fix/fat-dwarves*
  - *fix/feeding-timers*
  - *fix/item-occupancy*
  - *fix/loyaltycascade*
  - *fix/merchants*
  - *fix/population-cap*
  - *fix/stable-temp*
  - *fix/stuckdoors*
  - *fix/tile-occupancy*

### **fix/blood-del**

Makes it so that future caravans won't bring barrels full of blood, ichor, or goo.

### **fix/build-location**

Fixes construction jobs that are stuck trying to build a wall while standing on the same exact tile ([Bug 5991](#)), designates the tile restricted traffic to hopefully avoid jamming it again, and unsuspends them.

### **fix/dead-units**

Removes uninteresting dead units from the unit list. Doesn't seem to give any noticeable performance gain, but migrants normally stop if the unit list grows to around 3000 units, and this script reduces it back.

### **fix/diplomats**

Adds a Diplomat position to all Elven civilizations, allowing them to negotiate tree cutting quotas - and you to violate them and start wars. This was vanilla behaviour until 0.31.12, in which the "bug" was "fixed".



### fix/dry-buckets

Removes water from all buckets in your fortress, allowing them to be used for making lye. Skips buckets in buildings (eg a well), being carried, or currently used by a job.

### fix/fat-dwarves

Avoids 5-10% FPS loss due to constant recalculation of insulation for dwarves at maximum fatness, by reducing the cap from 1,000,000 to 999,999. Recalculation is triggered in steps of 250 units, and very fat dwarves constantly bounce off the maximum value while eating.

### fix/feeding-timers

Reset the GiveWater and GiveFood timers of all living citizens.

### fix/item-occupancy

Diagnoses and fixes issues with nonexistent 'items occupying site', usually caused by *autodump* bugs or other hacking mishaps. Checks that:

1. Item has `flags.on_ground`  $\Leftrightarrow$  it is in the correct block item list
2. A tile has items in block item list  $\Leftrightarrow$  it has `occupancy.item`
3. The block item lists are sorted

### fix/loyaltycascade

Aborts loyalty cascades by fixing units whose own civ is the enemy.

### fix/merchants

Adds the Guild Representative position to all Human civilizations, allowing them to make trade agreements. This was the default behaviour in 0.28.181.40d and earlier.

### fix/population-cap

Run this after every migrant wave to ensure your population cap is not exceeded.

The reason for population cap problems is that the population value it is compared against comes from the last dwarven caravan that successfully left for mountainhomes. This script instantly updates it. Note that a migration wave can still overshoot the limit by 1-2 dwarves because of the last migrant bringing his family. Likewise, king arrival ignores cap.

### fix/stable-temp

Instantly sets the temperature of all free-lying items to be in equilibrium with the environment, which stops temperature updates until something changes. To maintain this efficient state, use *tweak fast-heat*.

### fix/stuckdoors

Fix doors that are stuck open due to incorrect map occupancy flags, eg due to incorrect use of *teleport*.

### fix/tile-occupancy

Clears bad occupancy flags at the selected tile. Useful for getting rid of phantom “building present” messages. Currently only supports issues with building and unit occupancy. Requires that a tile is selected with the in-game cursor (k).

Can be used to fix problematic tiles caused by [Issue 1047](#).

## GUI Scripts

`gui/*` scripts implement dialogs in the main game window.

In order to avoid user confusion, as a matter of policy all these tools display the word *DFHack* on the screen somewhere while active. When that is not appropriate because they merely add keybinding hints to existing DF screens, they deliberately use red instead of green for the key.

### Contents

- *GUI Scripts*
  - *gui/advfort*
  - *gui/advfort\_items*
  - *gui/assign-rack*
  - *gui/autobutcher*
  - *gui/choose-weapons*
  - *gui/clone-uniform*
  - *gui/companion-order*
  - *gui/confirm-opts*
  - *gui/create-item*
  - *gui/dfstatus*
  - *gui/extended-status*
  - *gui/family-affairs*
  - *gui/gm-editor*
  - *gui/gm-unit*
  - *gui/guide-path*
  - *gui/hack-wish*
  - *gui/hello-world*
  - *gui/liquids*
  - *gui/load-screen*
  - *gui/manager-quantity*
  - *gui/mechanisms*
  - *gui/mod-manager*

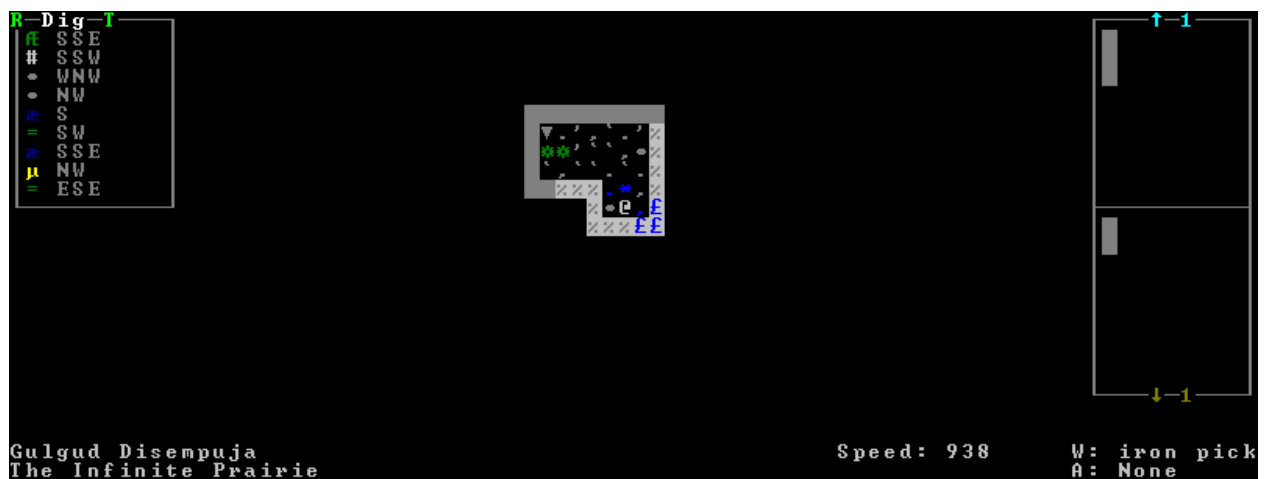
- *gui/no-dfhack-init*
- *gui/power-meter*
- *gui/prerelease-warning*
- *gui/quickcmd*
- *gui/rename*
- *gui/room-list*
- *gui/settings-manager*
- *gui/siege-engine*
- *gui/stockpiles*
- *gui/unit-info-viewer*
- *gui/workflow*
- *gui/workshop-job*

## gui/advfort

This script allows to perform jobs in adventure mode. For more complete help press ? while script is running. It's most comfortable to use this as a keybinding. (e.g. `keybinding set Ctrl-T gui/advfort`). Possible arguments:

- a**, –**nodfassign** uses different method to assign items.
- i**, –**inventory** checks inventory for possible items to use in the job.
- c**, –**cheat** relaxes item requirements for buildings (e.g. walls from bones). Implies -a
- job** selects that job (e.g. Dig or FellTree)

An example of player digging in adventure mode:



**WARNING:** changes only persist in non procedural sites, namely: player forts, caves, and camps.

## gui/advfort\_items

Does something with items in adventure mode jobs.

### gui/assign-rack

*This script requires a [binpatch](#), which has not been available since DF 0.34.11*

See [Bug 1445](#) for more info about the patches.

**Keybinding:** P in dwarfmode/QueryBuilding/Some/Weaponrack

### gui/autobutcher

An in-game interface for *autobutcher*. This script must be called from either the overall status screen or the animal list screen.

**Keybinding:** ShiftB in pet/List/Unit

### gui/choose-weapons

Activate in the *Equip->View/Customize* page of the military screen.

Depending on the cursor location, it rewrites all ‘individual choice weapon’ entries in the selected squad or position to use a specific weapon type matching the assigned unit’s top skill. If the cursor is in the rightmost list over a weapon entry, it rewrites only that entry, and does it even if it is not ‘individual choice’.

Rationale: individual choice seems to be unreliable when there is a weapon shortage, and may lead to inappropriate weapons being selected.

**Keybinding:** CtrlW in layer\_military/Equip/Customize/View

### gui/clone-uniform

When invoked, the script duplicates the currently selected uniform template, and selects the newly created copy. Activate in the Uniforms page of the military screen with the cursor in the leftmost list.

**Keybinding:** CtrlC in layer\_military/Uniforms

### gui/companion-order

A script to issue orders for companions. Select companions with lower case chars, issue orders with upper case. Must be in look or talk mode to issue command on tile.



- move - orders selected companions to move to location. If companions are following they will move no more than 3 tiles from you.
- equip - try to equip items on the ground.
- pick-up - try to take items into hand (also wield)
- unequip - remove and drop equipment
- unwield - drop held items
- wait - temporarily remove from party
- follow - rejoin the party after “wait”
- leave - remove from party (can be rejoined by talking)

**Keybinding:** ShiftO in `dungeonmode`

### gui/confirm-opts

A basic configuration interface for the *confirm* plugin.

### gui/create-item

A graphical interface for creating items.

See also: *createitem*, *modtools/create-item*, [Issue 735](#)

### gui/dfstatus

Show a quick overview of critical stock quantities, including food, drinks, wood, and various bars. Sections can be enabled/disabled/configured by editing `dfhack-config/dfstatus.lua`.

**Keybinding:** CtrlShiftI in `dwarfmode/Default`

**Keybinding:** CtrlShiftI in `dfhack/lua/dfstatus`

### gui/extended-status

Adds more subpages to the z status screen.

Usage:

```
gui/extended-status enable|disable|help|subpage_names
enable|disable gui/extended-status
```

### gui/family-affairs

A user-friendly interface to view romantic relationships, with the ability to add, remove, or otherwise change them at your whim - fantastic for depressed dwarves with a dead spouse (or matchmaking players...).

The target/s must be alive, sane, and in fortress mode.



**gui/family-affairs** [unitID] shows GUI for the selected unit, or the specified unit ID

**gui/family-affairs divorce** [unitID] removes all spouse and lover information from the unit and it's partner, bypassing almost all checks.

**gui/family-affairs** [unitID] [unitID] divorces the two specified units and their partners, then arranges for the two units to marry, bypassing almost all checks. Use with caution.

## gui/gm-editor

This editor allows to change and modify almost anything in df. Press ? for in-game help. There are three ways to open this editor:

- Calling **gui/gm-editor** from a command or keybinding opens the editor on whatever is selected or viewed (e.g. unit/item description screen)
- using **gui/gm-editor** <lua command> - executes lua command and opens editor on its results (e.g. **gui/gm-editor "df.global.world.items.all"** shows all items)
- using **gui/gm-editor** dialog - shows an in game dialog to input lua command. Works the same as version above.
- using **gui/gm-editor toggle** - will hide (if shown) and show (if hidden) editor at the same position you left it

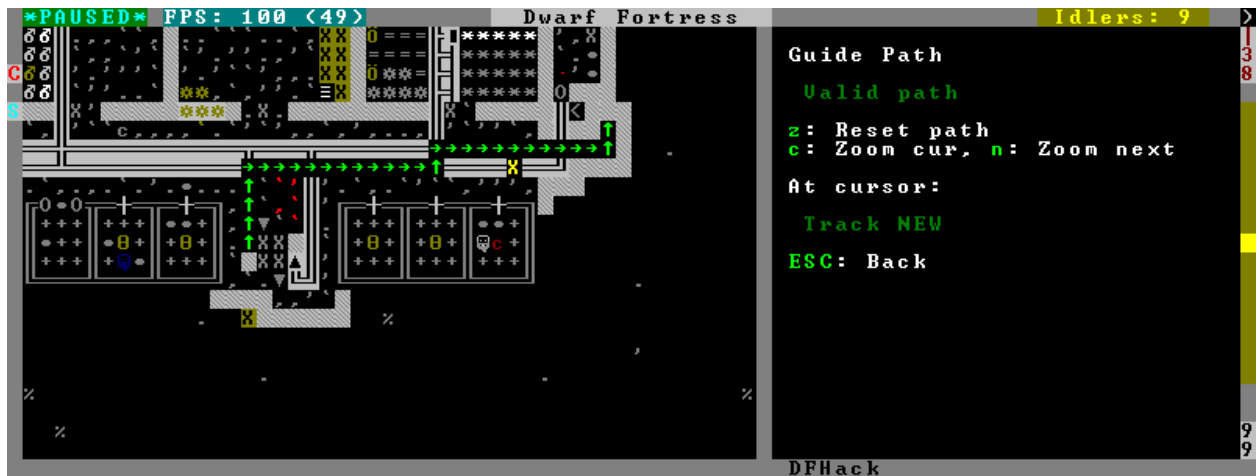


## gui/gm-unit

An editor for various unit attributes.

## gui/guide-path

Activate in the *Hauling* menu with the cursor over a *Guide* order.



The script displays the cached path that will be used by the order; the game computes it when the order is executed for the first time.

**Keybinding:** AltP in dwarfmode/Hauling/DefineStop/Cond/Guide

### gui/hack-wish

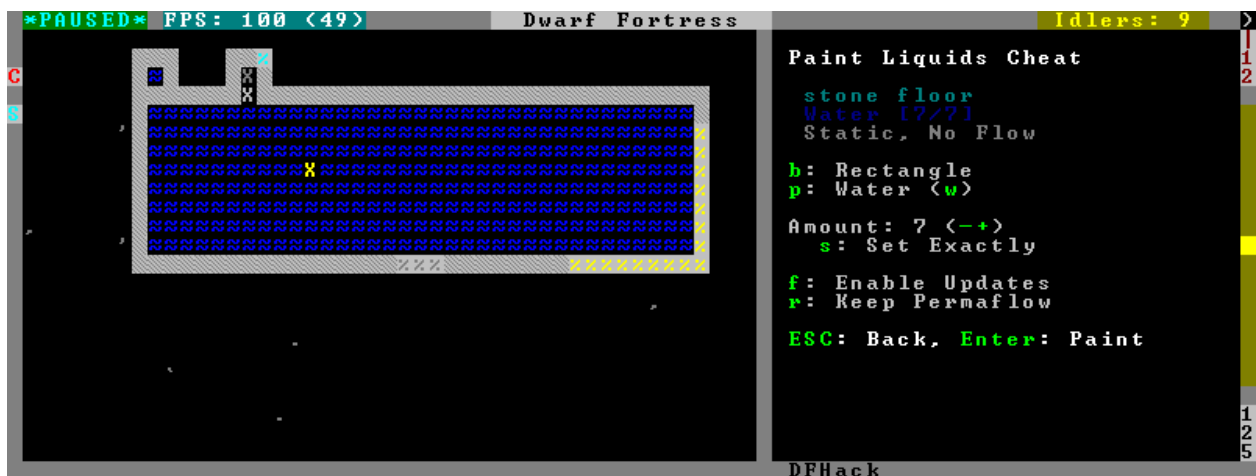
An alias for *gui/create-item*. Deprecated.

### gui/hello-world

A basic example for testing, or to start your own script from.

### gui/liquids

This script is a gui front-end to *liquids* and works similarly, allowing you to add or remove water & magma, and create obsidian walls & floors.



**Warning:** There is **no undo support**. Bugs in this plugin have been known to create pathfinding problems and heat traps.

The `b` key changes how the affected area is selected. The default *Rectangle* mode works by selecting two corners like any ordinary designation. The `p` key chooses between adding water, magma, obsidian walls & floors, or just tweaking flags.

When painting liquids, it is possible to select the desired level with `+-`, and choose between setting it exactly, only increasing or only decreasing with `s`.

In addition, `f` allows disabling or enabling the flowing water computations for an area, and `r` operates on the “permanent flow” property that makes rivers power water wheels even when full and technically not flowing.

After setting up the desired operations using the described keys, use `Enter` to apply them.

**Keybinding:** `AltL` in `dwarfmode/LookAround`

## gui/load-screen

A replacement for the “continue game” screen.

Usage: `gui/load-screen enable|disable`

## gui/manager-quantity

Sets the quantity of the selected manager job

Sample usage:

```
keybinding add Alt-Q@jobmanagement gui/manager-quantity
```

**Keybinding:** `AltQ` in `jobmanagement`

## gui/mechanisms

Lists mechanisms connected to the building, and their links. Navigating the list centers the view on the relevant linked buildings.



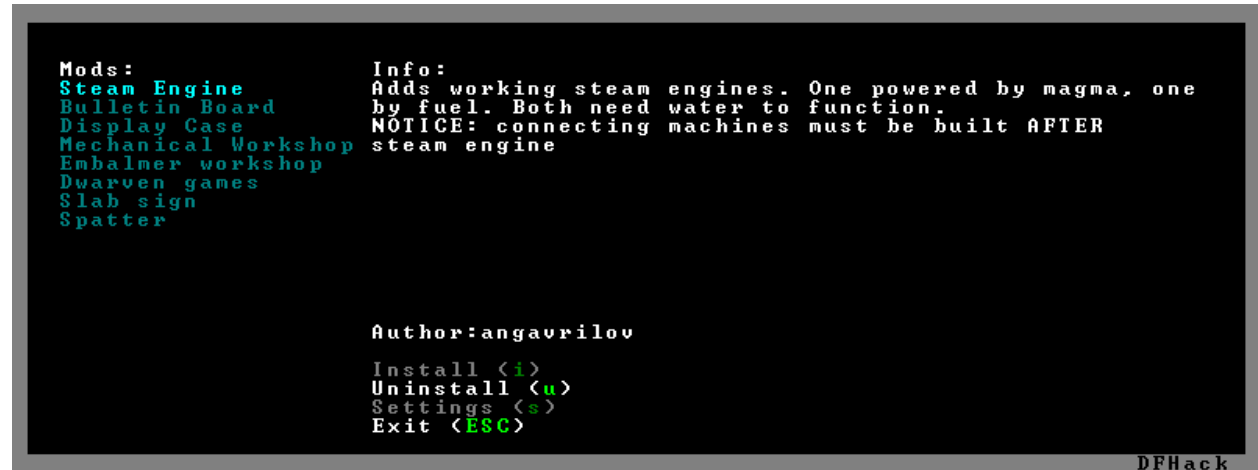
To exit, press `Esc` or `Enter`; `Esc` recenters on the original building, while `Enter` leaves focus on the current one. `ShiftEnter` has an effect equivalent to pressing `Enter`, and then re-entering the mechanisms UI.

**Keybinding:** `CtrlM` in `dwarfmode/QueryBuilding/Some`



## gui/mod-manager

A simple way to install and remove small mods, which are not included in DFHack. Examples are [available here](#).



```

Mods:
Steam Engine
Bulletin Board
Display Case
Mechanical Workshop
Embalmer workshop
Dwarven games
Slab sign
Spatter

Info:
Adds working steam engines. One powered by magma, one
by fuel. Both need water to function.
NOTICE: connecting machines must be built AFTER
steam engine

Author: angavrilov

Install <i>
Uninstall <u>
Settings <s>
Exit <ESC>
  
```

DFHack

Each mod is a lua script located in `<DF>/mods/`, which MUST define the following variables:

**name** a name that is displayed in list

**author** mod author, also displayed

**description** a description of the mod

Of course, this doesn't actually make a mod - so one or more of the following should also be defined:

**raws\_list** a list (table) of file names that need to be copied over to df raws

**patch\_entity** a chunk of text to patch entity *TODO: add settings to which entities to add*

**patch\_init** a chunk of lua to add to lua init

**patch\_dofile** a list (table) of files to add to lua init as "dofile"

**patch\_files** a table of files to patch

**filename** a filename (in raws folder) to patch

**patch** what to add

**after** a string after which to insert

**guard** a token that is used in raw files to find additions and remove them on uninstall

**guard\_init** a token for lua file

**[pre]post](un)install** Callback functions, which can trigger more complicated behavior

## gui/no-dfhack-init

Shows a warning at startup if no valid `dfhack.init` file is found.

## gui/power-meter

Activate an in-game interface for *power-meter* after selecting *Pressure Plate* in the build menu.



The script follows the general look and feel of the regular pressure plate build configuration page, but configures parameters relevant to the modded power meter building.

**Keybinding:** CtrlShiftM in dwarfmode/Build/Position/Trap

### gui/prerelease-warning

Shows a warning on world load for pre-release builds.

With no arguments passed, the warning is shown unless the “do not show again” option has been selected. With the force argument, the warning is always shown.

### gui/quickcmd

A list of commands which you can edit while in-game, and which you can execute quickly and easily. For stuff you use often enough to not want to type it, but not often enough to be bothered to find a free keybinding.

### gui/rename

Backed by *rename*, this script allows entering the desired name via a simple dialog in the game ui.

- `gui/rename [building]` in q mode changes the name of a building.



The selected building must be one of stockpile, workshop, furnace, trap, or siege engine. It is also possible to rename zones from the `i` menu.

- `gui/rename [unit]` with a unit selected changes the nickname.

Unlike the built-in interface, this works even on enemies and animals.

- `gui/rename unit-profession` changes the selected unit's custom profession name.



Likewise, this can be applied to any unit, and when used on animals it overrides their species string.

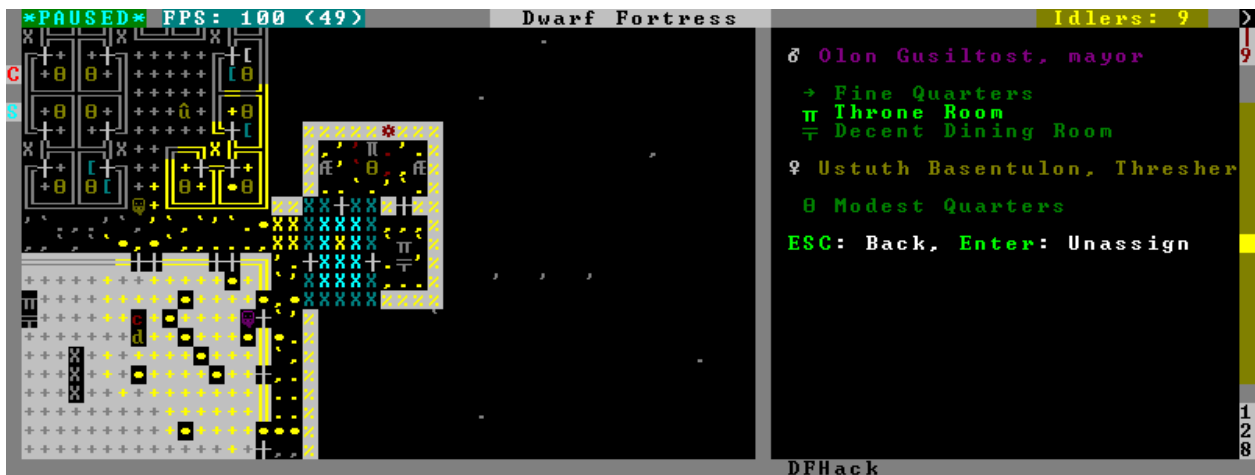
The building or unit options are automatically assumed when in relevant UI state.

**Keybinding:** `CtrlShiftN`

**Keybinding:** `CtrlShiftT -> "gui/rename unit-profession"`

## gui/room-list

Activate in `q` mode, either immediately or after opening the assign owner page.



The script lists other rooms owned by the same owner, or by the unit selected in the assign list, and allows unassigning them.

**Keybinding:** `AltR` in `dwarfmode/QueryBuilding/Some`

## gui/settings-manager

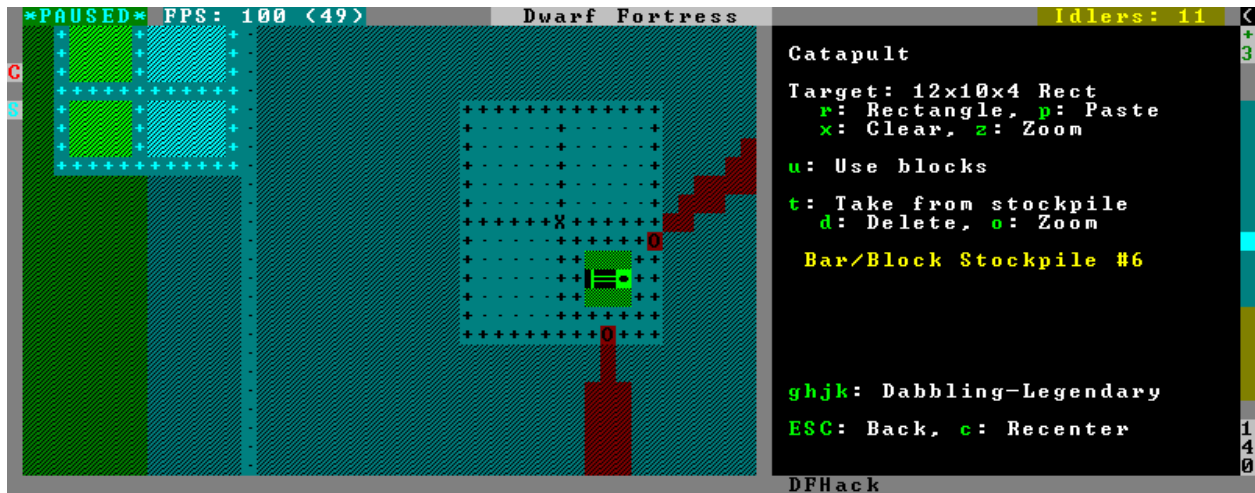
An in-game manager for settings defined in `init.txt` and `d_init.txt`.

**Keybinding:** AltS in `title`

**Keybinding:** AltS in `dwarfmode/Default`

## gui/siege-engine

Activate an in-game interface for *siege-engine*, after selecting a siege engine in `q` mode.



The main mode displays the current target, selected ammo item type, linked stockpiles and the allowed operator skill range. The map tile color is changed to signify if it can be hit by the selected engine: green for fully reachable, blue for out of range, red for blocked, yellow for partially blocked.

Pressing `r` changes into the target selection mode, which works by highlighting two points with `Enter` like all designations. When a target area is set, the engine projectiles are aimed at that area, or units within it (this doesn't actually change the original aiming code, instead the projectile trajectory parameters are rewritten as soon as it appears).

After setting the target in this way for one engine, you can 'paste' the same area into others just by pressing `p` in the main page of this script. The area to paste is kept until you quit DF, or select another area manually.

Pressing `t` switches to a mode for selecting a stockpile to take ammo from.

Exiting from the siege engine script via `Esc` reverts the view to the state prior to starting the script. `ShiftEsc` retains the current viewport, and also exits from the `q` mode to main menu.

**Keybinding:** AltA in `dwarfmode/QueryBuilding/Some/SiegeEngine`

## gui/stockpiles

An in-game interface for *stocksettings*, to load and save stockpile settings from the `q` menu.

Usage:

**gui/stockpiles -save** to save the current stockpile

**gui/stockpiles -load** to load settings into the current stockpile

**gui/stockpiles -dir <path>** set the default directory to save settings into

**gui/stockpiles -help** to see this message

Don't forget to enable `stockpiles` and create the `stocksettings` directory in the DF folder before trying to use the GUI.

**Keybinding:** AltL -> "gui/stockpiles -load" in dwarfmode/QueryBuilding/Some/Stockpile

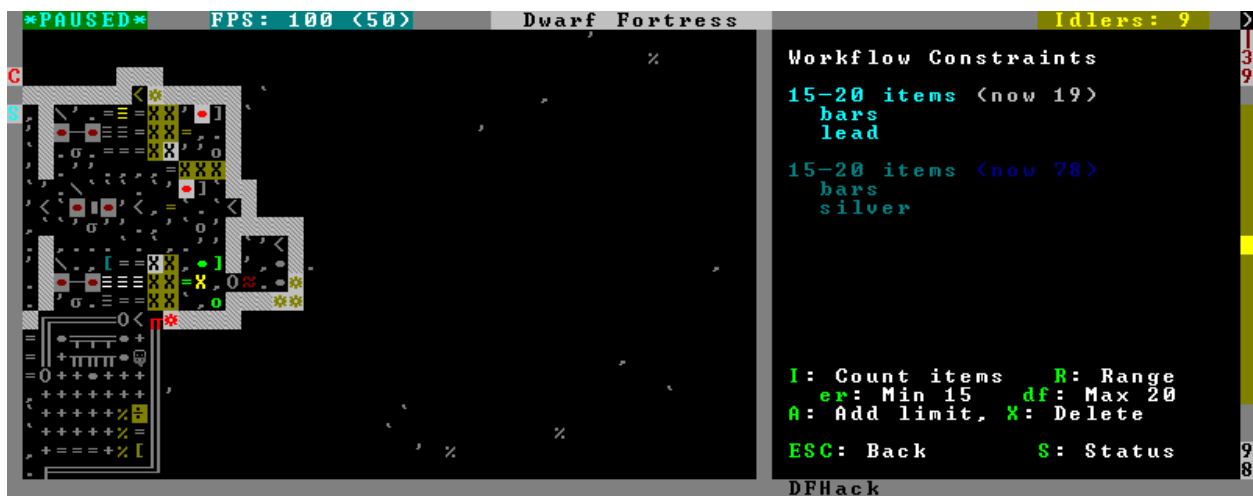
**Keybinding:** AltS -> "gui/stockpiles -save" in dwarfmode/QueryBuilding/Some/Stockpile

### gui/unit-info-viewer

Displays age, birth, maxage, shearing, milking, grazing, egg laying, body size, and death info about a unit. Recommended keybinding AltI.

### gui/workflow

Bind to a key (the example config uses Alt-W), and activate with a job selected in a workshop in q mode.



This script provides a simple interface to constraints managed by `workflow`. When active, it displays a list of all constraints applicable to the current job, and their current status.

A constraint specifies a certain range to be compared against either individual *item* or whole *stack* count, an item type and optionally a material. When the current count is below the lower bound of the range, the job is resumed; if it is above or equal to the top bound, it will be suspended. Within the range, the specific constraint has no effect on the job; others may still affect it.

Pressing `i` switches the current constraint between counting stacks or items. Pressing `r` lets you input the range directly; `e`, `r`, `d`, `f` adjust the bounds by 5, 10, or 20 depending on the direction and the `i` setting (counting items and expanding the range each gives a 2x bonus).

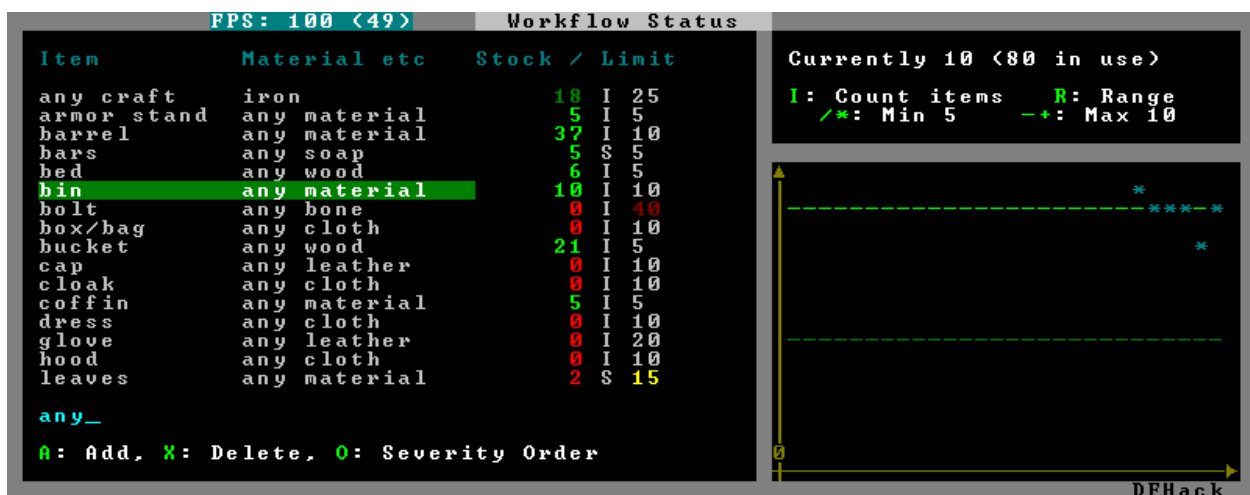
Pressing `a` produces a list of possible outputs of this job as guessed by workflow, and lets you create a new constraint by choosing one as template. If you don't see the choice you want in the list, it likely means you have to adjust the job material first using `job item-material` or `gui/workshop-job`, as described in the `workflow` documentation. In this manner, this feature can be used for troubleshooting jobs that don't match the right constraints.



If you select one of the outputs with Enter, the matching constraint is simply added to the list. If you use ShiftEnter, the interface proceeds to the next dialog, which allows you to edit the suggested constraint parameters to suit your need, and set the item count range.



Pressing s (or, with the example config, Alt-W in the z stocks screen) opens the overall status screen:



This screen shows all currently existing workflow constraints, and allows monitoring and/or changing them from one

screen. The constraint list can be filtered by typing text in the field below.

The color of the stock level number indicates how “healthy” the stock level is, based on current count and trend. Bright green is very good, green is good, red is bad, bright red is very bad.

The limit number is also color-coded. Red means that there are currently no workshops producing that item (i.e. no jobs). If it’s yellow, that means the production has been delayed, possibly due to lack of input materials.

The chart on the right is a plot of the last 14 days (28 half day plots) worth of stock history for the selected item, with the rightmost point representing the current stock value. The bright green dashed line is the target limit (maximum) and the dark green line is that minus the gap (minimum).

**Keybinding:** AltW in dwarfmode/QueryBuilding/Some/Workshop/Job

**Keybinding:** AltW -> "gui/workflow status" in overallstatus

**Keybinding:** AltW -> "gui/workflow status" in dfhack/lua/status\_overlay

## gui/workshop-job

Run with a job selected in a workshop in the q mode.



The script shows a list of the input reagents of the selected job, and allows changing them like the *job* item-type and *job* item-material commands.

Specifically, pressing the i key pops up a dialog that lets you select an item type from a list.



Pressing `m`, unless the item type does not allow a material, lets you choose a material.



Since there are a lot more materials than item types, this dialog is more complex and uses a hierarchy of sub-menus. List choices that open a sub-menu are marked with an arrow on the left.

**Warning:** Due to the way input reagent matching works in DF, you must select an item type if you select a material, or the material will be matched incorrectly in some cases. If you press `m` without choosing an item type, the script will auto-choose if there is only one valid choice, or pop up an error message box instead of the material selection dialog.

Note that both materials and item types presented in the dialogs are filtered by the job input flags, and even the selected item type for material selection, or material for item type selection. Many jobs would let you select only one input item type.

For example, if you choose a *plant* input item type for your prepare meal job, it will only let you select cookable materials.

If you choose a *barrel* item instead (meaning things stored in barrels, like drink or milk), it will let you select any material, since in this case the material is matched against the barrel itself. Then, if you select, say, iron, and then try to change the input item type, now it won't let you select *plant*; you have to unset the material first.

**Keybinding:** `AltA` in `dwarfmode/QueryBuilding/Some/Workshop/Job`

## Scripts for Modders

`modtools/*` scripts provide tools for modders, often with changes to the raw files, and are not intended to be called manually by end-users.

They all have standard arguments: arguments are of the form `tool -argName1 argVal1 -argName2 argVal2`. This is equivalent to `tool -argName2 argVal2 -argName1 argVal1`. It is not necessary to provide a value to an argument name: `tool -argName3` is fine.

Argument names are preceded with a dash, and supplying the same argument name multiple times will result in an error.

The `-help` argument to any `modtools` script will print a descriptive usage string describing the arguments, similar to the documentation here.

For multiple word argument values, brackets must be used: `tool -argName4 [ sadf1 sadf2 sadf3 ]`. In order to allow passing literal braces as part of the argument, backslashes are used: `tool -argName4 [ \] asdf`



`\foo ] sets argName4 to \] asdf foo.` The `*-trigger` scripts have a similar policy with backslashes.

## Contents

- *Scripts for Modders*
  - *modtools/add-syndrome*
  - *modtools/anonymous-script*
  - *modtools/change-build-menu*
  - *modtools/create-item*
  - *modtools/create-unit*
  - *modtools/equip-item*
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  - *modtools/interaction-trigger*
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  - *modtools/reaction-trigger*
  - *modtools/reaction-trigger-transition*
  - *modtools/skill-change*
  - *modtools/spawn-flow*
  - *modtools/syndrome-trigger*
  - *modtools/transform-unit*

## modtools/add-syndrome

This allows adding and removing syndromes from units.

Arguments:

```
-syndrome name
    the name of the syndrome to operate on
examples:
    "gila monster bite"
-resetPolicy policy
```

```
specify a policy of what to do if the unit already has an
instance of the syndrome.  examples:
    NewInstance
        default behavior: create a new instance of the syndrome
    DoNothing
    ResetDuration
    AddDuration
-erase
    instead of adding an instance of the syndrome, erase one
-eraseAll
    erase every instance of the syndrome
-eraseClass SYN_CLASS
    erase every instance of every syndrome with the given SYN_CLASS
-target id
    the unit id of the target unit
    examples:
        0
        28
-skipImmunities
    add the syndrome to the target even if it is immune to the syndrome
```

### modtools/anonymous-script

This allows running a short simple Lua script passed as an argument instead of running a script from a file. This is useful when you want to do something too complicated to make with the existing modtools, but too simple to be worth its own script file. Example:

```
anonymous-script "print(args[1])" arg1 arg2
# prints "arg1"
```

### modtools/change-build-menu

Change the build sidebar menus.

This script provides a flexible and comprehensive system for adding and removing items from the build sidebar menus. You can add or remove workshops/furnaces by text ID, or you can add/remove ANY building via a numeric building ID triplet.

Changes made with this script do not survive a save/load. You will need to redo your changes each time the world loads.

Just to be clear: You CANNOT use this script AT ALL if there is no world loaded!

#### Usage:

```
modtools/change-build-menu start|enable:
```

```
enable modtools/change-build-menu:
```

Start the ticker. This needs to be done before any changes will take effect. Note that you can make changes before or after starting the ticker, both options should work equally well.

```
modtools/change-build-menu stop|disable:
```

```
disable modtools/change-build-menu:
```

Stop the ticker. Does not clear stored changes. The ticker will automatically stop when the current world is unloaded.

modtools/change-build-menu add <ID> <CATEGORY> [<KEY>]:

Add the workshop or furnace with the ID <ID> to <CATEGORY>. <KEY> is an optional DF hotkey ID.

**<CATEGORY> may be one of:**

- MAIN\_PAGE
- SIEGE\_ENGINES
- TRAPS
- WORKSHOPS
- FURNACES
- CONSTRUCTIONS
- MACHINES
- CONSTRUCTIONS\_TRACK

**Valid <ID> values for hardcoded buildings are as follows:**

- CARPENTERS
- FARMERS
- MASONS
- CRAFTSDWARFS
- JEWELERS
- METALSMITHSFORGE
- MAGMAFORGE
- BOWYERS
- MECHANICS
- SIEGE
- BUTCHERS
- LEATHERWORKS
- TANNERS
- CLOTHIERS
- FISHERY
- STILL
- LOOM
- QUERN
- KENNELS
- ASHERY
- KITCHEN
- DYERS
- TOOL
- MILLSTONE

- WOOD\_FURNACE
- SMELTER
- GLASS\_FURNACE
- MAGMA\_SMELTER
- MAGMA\_GLASS\_FURNACE
- MAGMA\_KILN
- KILN

```
modtools/change-build-menu remove <ID> <CATEGORY>:
```

Remove the workshop or furnace with the ID <ID> from <CATEGORY>.

<CATEGORY> and <ID> may have the same values as for the “add” option.

```
modtools/change-build-menu revert <ID> <CATEGORY>:
```

Revert an earlier remove or add operation. It is NOT safe to “remove” an “add”ed building or vice versa, use this option to reverse any changes you no longer want/need.

### Module Usage:

To use this script as a module put the following somewhere in your own script:

```
local buildmenu = reqscript "change-build-menu"
```

Then you can call the functions documented here like so:

- Example: Remove the carpenters workshop:

```
buildmenu.ChangeBuilding("CARPENTERS", "WORKSHOPS", false)
```

- Example: Make it impossible to build walls (not recommended!):

```
local typ, styp = df.building_type.Construction, df.construction_type.Wall
buildmenu.ChangeBuildingAdv(typ, styp, -1, "CONSTRUCTIONS", false)
```

Note that to allow any of your changes to take effect you need to start the ticker. See the “Command Usage” section.

### Global Functions:

**GetWShopID(btype, bsubtype, bcustom):** GetWShopID returns a workshop’s or furnace’s string ID based on its numeric ID triplet. This string ID *should* match what is expected by eventful for hardcoded buildings.

**GetWShopType(id):** GetWShopIDs returns a workshop or furnace’s ID numbers as a table. The passed in ID should be the building’s string identifier, it makes no difference if it is a custom building or a hardcoded one. The return table is structured like so: {type, subtype, custom}

**IsEntityPermitted(id):** IsEntityPermitted returns true if DF would normally allow you to build a workshop or furnace. Use this if you want to change a building, but only if it is permitted in the current entity. You do not need to specify an entity, the current fortress race is used.

```
ChangeBuilding(id, category, [add, [key]]):
```

**ChangeBuildingAdv(typ, subtyp, custom, category, [add, [key]]):** These two functions apply changes to the build sidebar menus. If “add” is true then the building is added to the specified category, else it is removed. When adding you may specify “key”, a string DF hotkey ID.

The first version of this function takes a workshop or furnace ID as a string, the second takes a numeric ID triplet (which can specify any building, not just workshops or furnaces).

`RevertBuildingChanges(id, category):`

**RevertBuildingChangesAdv(typ, subtyp, custom, category):** These two functions revert changes made by “ChangeBuilding” and “ChangeBuildingAdv”. Like those two functions there are two versions, a simple one that takes a string ID and one that takes a numeric ID triplet.

## modtools/create-item

Replaces the *createitem* plugin, with standard arguments. The other versions will be phased out in a later version.

Arguments:

```
-creator id
    specify the id of the unit who will create the item,
    or \\LAST to indicate the unit with id df.global.unit_next_id-1
    examples:
        0
        2
        \\LAST
-material matstring
    specify the material of the item to be created
    examples:
        INORGANIC:IRON
        CREATURE_MAT:DWARF:BRAIN
        PLANT_MAT:MUSHROOM_HELMET_PLUMP:DRINK
-item itemstr
    specify the itemdef of the item to be created
    examples:
        WEAPON:ITEM_WEAPON_PICK
-matchingShoes
    create two of this item
-matchingGloves
    create two of this item, and set handedness appropriately
```

## modtools/create-unit

Creates a unit. Usage:

```
-race raceName
    specify the race of the unit to be created
    examples:
        DWARF
        HUMAN
-caste casteName
    specify the caste of the unit to be created
    examples:
        MALE
        FEMALE
-domesticate
    if the unit can't learn or can't speak, make it a friendly animal
-setUnitToFort
    Sets the groupId and civId to the local fort.
-civId id
    Make the created unit a member of the specified civ
```

```
(or none if id = -1). If id is \\LOCAL, make it a member of the
civ associated with the fort; otherwise id must be an integer
-groupId id
    Make the created unit a member of the specified group
    (or none if id = -1). If id is \\LOCAL, make it a member of the
    group associated with the fort; otherwise id must be an integer
-name entityRawName
    set the unit's name to be a random name appropriate for the
    given entity.  examples:
        MOUNTAIN
-nick nickname
    set the unit's nickname directly
-location [ x y z ]
    create the unit at the specified coordinates
-age howOld
    set the birth date of the unit by current age
-flagSet [ flag1 flag2 ... ]
    set the specified unit flags in the new unit to true
    flags may be selected from df.unit_flags1, df.unit_flags2,
    or df.unit_flags3
-flagClear [ flag1 flag2 ... ]
    set the specified unit flags in the new unit to false
    flags may be selected from df.unit_flags1, df.unit_flags2,
    or df.unit_flags3
```

### modtools/equip-item

Force a unit to equip an item with a particular body part; useful in conjunction with the create scripts above. See also *forceequip*.

### modtools/extra-gamelog

This script writes extra information to the gamelog. This is useful for tools like *Soundsense*.

### modtools/force

This tool triggers events like megabeasts, caravans, and migrants.

Usage:

```
-eventType event
    specify the type of the event to trigger
    examples:
        MegaBeast
        Migrants
        Caravan
        Diplomat
        WildlifeCurious
        WildlifeMischievous
        WildlifeFlier
        NightCreature
-civ entity
    specify the civ of the event, if applicable
    examples:
```

```

player
MOUNTAIN
EVIL
28

```

## modtools/if-entity

Run a command if the current entity matches a given ID.

To use this script effectively it needs to be called from “raw/onload.init”. Calling this from the main dfhack.init file will do nothing, as no world has been loaded yet.

Usage:

- **id:** Specify the entity ID to match
- **cmd [ commandStrs ]:** Specify the command to be run if the current entity matches the entity given via -id

All arguments are required.

Example:

```

# Print a message if you load an elf fort, but not a dwarf, human, etc # fort. if-entity -id "FOREST" -cmd
[ lua "print('Dirty hippies.')" ]

```

## modtools/interaction-trigger

This triggers events when a unit uses an interaction on another. It works by scanning the announcements for the correct attack verb, so the attack verb must be specified in the interaction. It includes an option to suppress this announcement after it finds it.

Usage:

```

-clear
    unregisters all triggers
-onAttackStr str
    trigger the command when the attack verb is "str". both onAttackStr and
    ↳onDefendStr MUST be specified
-onDefendStr str
    trigger the command when the defend verb is "str". both onAttackStr and
    ↳onDefendStr MUST be specified
-suppressAttack
    delete the attack announcement from the combat logs
-suppressDefend
    delete the defend announcement from the combat logs
-command [ commandStrs ]
    specify the command to be executed
    commandStrs
        \\ATTACK_VERB
        \\DEFEND_VERB
        \\ATTACKER_ID
        \\DEFENDER_ID
        \\ATTACK_REPORT
        \\DEFEND_REPORT
        \\anything -> \anything
        anything -> anything

```

You must specify both an attack string and a defend string to guarantee correct performance. Either will trigger the script when it happens, but it will not be triggered twice in a row if both happen.

### **modtools/invader-item-destroyer**

This tool configurably destroys invader items to prevent clutter or to prevent the player from getting tools exclusive to certain races.

Arguments:

```
-clear
    reset all registered data
-allEntities [true/false]
    set whether it should delete items from invaders from any civ
-allItems [true/false]
    set whether it should delete all invader items regardless of
    type when an appropriate invader dies
-item itemdef
    set a particular itemdef to be destroyed when an invader
    from an appropriate civ dies.  examples:
        ITEM_WEAPON_PICK
-entity entityName
    set a particular entity up so that its invaders destroy their
    items shortly after death.  examples:
        MOUNTAIN
        EVIL
```

### **modtools/item-trigger**

This powerful tool triggers DFHack commands when a unit equips, unequips, or attacks another unit with specified item types, specified item materials, or specified item contaminants.

Arguments:

```
-clear
    clear all registered triggers
-checkAttackEvery n
    check the attack event at least every n ticks
-checkInventoryEvery n
    check inventory event at least every n ticks
-itemType type
    trigger the command for items of this type
    examples:
        ITEM_WEAPON_PICK
        RING
-onStrike
    trigger the command on appropriate weapon strikes
-onEquip
    trigger the command when someone equips an appropriate item
-onUnequip
    trigger the command when someone unequips an appropriate item
-material mat
    trigger the command on items with the given material
    examples
        INORGANIC:IRON
        CREATURE_MAT:DWARF:BRAIN
```



```

    PLANT_MAT:MUSHROOM_HELMET_PLUMP:DRINK
-contaminant mat
    trigger the command on items with a given material contaminant
    examples
        INORGANIC:IRON
        CREATURE_MAT:DWARF:BRAIN
        PLANT_MAT:MUSHROOM_HELMET_PLUMP:DRINK
-command [ commandStrs ]
    specify the command to be executed
    commandStrs
        \\ATTACKER_ID
        \\DEFENDER_ID
        \\ITEM_MATERIAL
        \\ITEM_MATERIAL_TYPE
        \\ITEM_ID
        \\ITEM_TYPE
        \\CONTAMINANT_MATERIAL
        \\CONTAMINANT_MATERIAL_TYPE
        \\CONTAMINANT_MATERIAL_INDEX
        \\MODE
        \\UNIT_ID
        \\anything -> \anything
        anything -> anything

```

### modtools/moddable-gods

This is a standardized version of Putnam's moddableGods script. It allows you to create gods on the command-line.

Arguments:

```

-name godName
    sets the name of the god to godName
    if there's already a god of that name, the script halts
-spheres [ sphereList ]
    define a space-separated list of spheres of influence of the god
-depictedAs str
    often depicted as a str
-domain str
    set the domain of the god
-description str
    set the description of the god

```

### modtools/outside-only

This allows you to specify certain custom buildings as outside only, or inside only. If the player attempts to build a building in an inappropriate location, the building will be destroyed.

Arguments:

```

-clear
    clears the list of registered buildings
-checkEvery n
    set how often existing buildings are checked for whether they
    are in the appropriate location to n ticks
-type [EITHER, OUTSIDE_ONLY, INSIDE_ONLY]
    specify what sort of restriction to put on the building

```

```
-building name
    specify the id of the building
```

### modtools/projectile-trigger

This triggers dfhack commands when projectiles hit their targets. Usage:

```
-clear
    unregister all triggers
-material
    specify a material for projectiles that will trigger the command
    examples:
        INORGANIC:IRON
        CREATURE_MAT:DWARF:BRAIN
        PLANT_MAT:MUSHROOM_HELMET_PLUMP:DRINK
-command [ commandList ]
    \\LOCATION
    \\PROJECTILE_ID
    \\FIRER_ID
    \\anything -> \anything
    anything -> anything
```

### modtools/random-trigger

Trigger random dfhack commands with specified probabilities. Register a few scripts, then tell it to “go” and it will pick one based on the probability weights you specified.

Events are mutually-exclusive - register a list of scripts along with relative weights, then tell the script to select and run one with the specified probabilities. The weights must be positive integers, but they do NOT have to sum to any particular number.

The outcomes are mutually exclusive: only one will be triggered. If you want multiple independent random events, call the script multiple times.

99% of the time, you won’t need to worry about this, but just in case, you can specify a name of a list of outcomes to prevent interference from other scripts that call this one. That also permits situations where you don’t know until runtime what outcomes you want. For example, you could make a *modtools/reaction-trigger* that registers the worker as a mayor candidate, then run this script to choose a random mayor from the list of units that did the mayor reaction.

Arguments:

```
-outcomeListName name
    specify the name of this list of outcomes to prevent interference
    if two scripts are registering outcomes at the same time. If none
    is specified, the default outcome list is selected automatically.
-command [ commandStrs ]
    specify the command to be run if this outcome is selected
    must be specified unless the -trigger argument is given
-weight n
    the relative probability weight of this outcome
    n must be a non-negative integer
    if not specified, n=1 is used by default
-trigger
    selects a random script based on the specified outcomeList
    (or the default one if none is specified)
-preserveList
```

```

    when combined with trigger, preserves the list of outcomes so you
    don't have to register them again.
-withProbability p
    p is a real number between 0 and 1 inclusive
    triggers the command immediately with this probability
-seed s
    sets the random seed for debugging purposes
    (guarantees the same sequence of random numbers will be produced)
    use
-listOutcomes
    lists the currently registered list of outcomes of the outcomeList
    along with their probability weights, for debugging purposes
-clear
    unregister everything

```

**Note:** `-preserveList` is something of a beta feature, which should be avoided by users without a specific reason to use it.

It is highly recommended that you always specify `-outcomeListName` when you give this command to prevent almost certain interference. If you want to trigger one of 5 outcomes three times, you might want this option even without `-outcomeListName`.

The list is NOT retained across game save/load, as nobody has yet had a use for this feature. Contact expwnent if you would use it; it's not that hard but if nobody wants it he won't bother.

## modtools/raw-lint

Checks for simple issues with raw files. Can be run automatically.

## modtools/reaction-product-trigger

This triggers dfhack commands when reaction products are produced, once per product. Usage:

```

-clear
    unregister all reaction hooks
-reactionName name
    specify the name of the reaction
-command [ commandStrs ]
    specify the command to be run on the target(s)
    special args
        \\WORKER_ID
        \\REACTION
        \\BUILDING_ID
        \\LOCATION
        \\INPUT_ITEMS
        \\OUTPUT_ITEMS
        \\anything -> \anything
        anything -> anything

```

## modtools/reaction-trigger

Triggers dfhack commands when custom reactions complete, regardless of whether it produced anything, once per completion. Arguments:

```
-clear
    unregister all reaction hooks
-reactionName name
    specify the name of the reaction
-syndrome name
    specify the name of the syndrome to be applied to the targets
-allowNonworkerTargets
    allow other units in the same building to be targetted by
    either the script or the syndrome
-allowMultipleTargets
    allow multiple targets to the script or syndrome
    if absent:
        if running a script, only one target will be used
        if applying a syndrome, then only one target will be infected
-resetPolicy policy
    the policy in the case that the syndrome is already present
    policy
        NewInstance (default)
        DoNothing
        ResetDuration
        AddDuration
-command [ commandStrs ]
    specify the command to be run on the target(s)
    special args
        \\WORKER_ID
        \\TARGET_ID
        \\BUILDING_ID
        \\LOCATION
        \\REACTION_NAME
        \\anything -> \anything
        anything -> anything
```

### modtools/reaction-trigger-transition

Prints useful things to the console and a file to help modders transition from `autoSyndrome` to *modtools/reaction-trigger*.

This script is basically an apology for breaking backward compatibility in June 2014, and will be removed eventually.

### modtools/skill-change

Sets or modifies a skill of a unit. Args:

- skill **skillName** set the skill that we're talking about
- mode (**add/set**) are we adding experience/levels or setting them?
- granularity (**experience/level**) direct experience, or experience levels?
- unit **id** id of the target unit
- value **amount** how much to set/add

### modtools/spawn-flow

Creates flows at the specified location.

**Arguments:**

```

-material mat
    specify the material of the flow, if applicable
    examples:
        INORGANIC:IRON
        CREATURE_MAT:DWARF:BRAIN
        PLANT_MAT:MUSHROOM_HELMET_PLUMP:DRINK
-location [ x y z]
    the location to spawn the flow
-flowType type
    specify the flow type
    examples:
        Miasma
        Steam
        Mist
        MaterialDust
        MagmaMist
        Smoke
        Dragonfire
        Fire
        Web
        MaterialGas
        MaterialVapor
        OceanWave
        SeaFoam
-flowSize size
    specify how big the flow is

```

**modtools/syndrome-trigger**

Triggers dfhack commands when syndromes are applied to units.

**Arguments:**

```

-clear
    clear all triggers
-syndrome name
    specify the name of a syndrome
-command [ commandStrs ]
    specify the command to be executed after infection
    args
        \\SYNDROME_ID
        \\UNIT_ID
        \\LOCATION
        \\anything -> \anything
        anything -> anything

```

**modtools/transform-unit**

Transforms a unit into another unit type, possibly permanently. Warning: this will crash arena mode if you view the unit on the same tick that it transforms. If you wait until later, it will be fine.

**Arguments:**

```
-clear
    clear records of normal races
-unit id
    set the target unit
-duration ticks
    how long it should last, or "forever"
-setPrevRace
    make a record of the previous race so that you can
    change it back with -untransform
-keepInventory
    move items back into inventory after transformation
-race raceName
-caste casteName
-suppressAnnouncement
    don't show the Unit has transformed into a Blah! event
-untransform
    turn the unit back into what it was before
```

## List of Authors

The following is a list of people who have contributed to DFHack, in alphabetical order.

If you should be here and aren't, please get in touch on IRC or the forums, or make a pull request!

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Continued on next page		

Table 3.1 – continued from previous page

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Table 3.1 – continued from previous page

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## Changelog

### Contents

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  - *DFHack 0.40.24-r1*
  - *DFHack 0.40.24-r0*
  - *Older Changelogs*

## DFHack 0.43.05-r1

### Internals

- 64-bit support on all platforms
- Several structure fixes to match 64-bit DF's memory layout
- Added `DFHack::Job::removeJob()` function
- New module: `Designations` - handles designation creation (currently for plants only)
- Added `Gui::getSelectedPlant()`
- Added `Units::getMainSocialActivity()`, `Units::getMainSocialEvent()`
- Visual Studio 2015 now required to build on Windows instead of 2010
- GCC 4.8 or newer required to build on Linux and OS X (and now supported on OS X)
- Updated TinyXML from 2.5.3 to 2.6.2
- Added the ability to download files manually before building

## Lua

- Lua has been updated to 5.3 - see <http://www.lua.org/manual/5.3/readme.html> for details
  - Floats are no longer implicitly converted to integers in DFHack API calls
- `df.new()` supports more types: `char`, `intptr_t`, `uintptr_t`, `long`, `unsigned long`
- String representations of vectors and a few other containers now include their lengths
- Added a `tile-material` module
- Added a `Painter:key_string()` method
- Made `dfhack.gui.revealInDwarfmodeMap()` available

## Ruby

- Added support for loading ruby 2.x libraries

## New Plugins

- *dwarfviet* enables animal caretaking
- *generated-creature-renamer*: Renames generated creature IDs for use with graphics packs
- *labormanager* (formerly *autolabor2*): a more advanced alternative to *autolabor*
- *misery*: re-added and updated for the 0.4x series
- *title-folder*: shows DF folder name in window title bar when enabled

## New Scripts

- *adv-rumors*: improves the “Bring up specific incident or rumor” menu in adventure mode
- *fix/tile-occupancy*: Clears bad occupancy flags on the selected tile.
- *install-info*: Logs basic troubleshooting information about the current DFHack installation
- *load-save*: loads a save non-interactively
- *modtools/change-build-menu*: Edit the build mode sidebar menus
- *modtools/if-entity*: Run a command if the current entity matches a given ID
- *season-palette*: Swap color palettes with the changes of the seasons
- *unforbid*: Unforbids all items

## New Tweaks

- *tweak condition-material*: fixes a crash in the work order condition material list
- *tweak hotkey-clear*: adds an option to clear bindings from DF hotkeys

## Fixes

- The DF path on OS X can now contain spaces and `:` characters
- `Buildings::setOwner()` changes now persist properly when saved
- `ls` now lists scripts in folders other than `hack/scripts`, when applicable
- Fixed `plug` output alignment for plugins with long names
- *add-thought*: fixed support for emotion names
- *autochop*:
  - fixed several issues with job creation and removal
  - stopped designating the center tile (unreachable) for large trees
  - stopped options from moving when enabling and disabling burrows
  - fixed display of unnamed burrows
- *devel/find-offsets*: fixed a crash when vtables used by globals aren't available
- *getplants*:
  - fixed several issues with job creation and removal
  - stopped designating the center tile (unreachable) for large trees
- *gui/workflow*: added extra keybinding to work with *gui/extended-status*
- *manipulator*:
  - Fixed crash when selecting a profession from an empty list
  - Custom professions are now sorted alphabetically more reliably
- *modtools/create-item*:
  - made gloves usable by specifying handedness
  - now creates pairs of boots and gloves
- *modtools/create-unit*:
  - stopped permanently overwriting the creature creation menu in arena mode
  - now uses non-English names
  - added `-setUnitToFort` option to make a unit a civ/group member more easily
  - fixed some issues where units would appear in unrevealed areas of the map
- *modtools/item-trigger*: fixed errors with plant growths
- *remotefortressreader*: fixed a crash when serializing the local map
- *ruby*: fixed a crash when unloading the plugin on Windows
- *stonesense*: disabled overlay in STANDARD-based print modes to prevent crashes
- *title-version*: now hidden when loading an arena

## Misc Improvements

- Documented all default keybindings (from `dfhack.init-example`) in the docs for the relevant commands; updates enforced by build system.
- *autounsuspend*: reduced update frequency to address potential performance issues
- *gui/extended-status*: added a feature to queue beds
- *lua* and *gui/gm-editor* now support the same aliases (`scr`, `unit`, etc.)
- *manipulator*: added social activities to job column
- *remotefortressreader*: Added support for
  - world map snow coverage
  - spatters
  - wall info
  - site towers, world buildings
  - surface material
  - building items
  - DF version info
- *title-version*: Added a prerelease indicator
- *workflow*: Re-added `Alt-W` keybindings

## DFHack 0.43.03-r1

### Lua

- Label widgets can now easily register handlers for mouse clicks

## New Features

- *add-thought*: allow syndrome name as `-thought` argument
- *gui/gm-editor*
  - Added ability to insert default types into containers. For primitive types leave the type entry empty, and for references use `*`.
  - Added `shift-esc` binding to fully exit from editor
  - Added `gui/gm-editor toggle` command to toggle editor visibility (saving position)
- *modtools/create-unit*:
  - Added an option to attach units to an existing wild animal population
  - Added an option to attach units to a map feature

## Fixes

- *autofarm*: Can now handle crops that grow for more than a season
- *combine-plants*: Fixed recursion into sub-containers
- *createitem*: Now moves multiple created items to cursor correctly
- *exportlegends*: Improved handling of unknown enum items (fixes many errors)
- *gui/create-item*: Fixed quality when creating multiple items
- *gui/mod-manager*: Fixed error when mods folder doesn't exist
- *modtools/item-trigger*: Fixed handling of items with subtypes
- *reveal*: `revflood` now handles constructed stairs with floors in generated fortresses
- *stockflow*:
  - Can order metal mechanisms
  - Fixed material category of thread-spinning jobs

## Misc Improvements

- The built-in `ls` command now wraps the descriptions of commands
- *catsplosion*: now a lua script instead of a plugin
- *fix/diplomats*: replaces `fixdiplomats`
- *fix/merchants*: replaces `fixmerchants`
- *prefchange*: added a `help` option
- *probe*: now displays raw tiletype names
- Unified script documentation and in-terminal help options

## Removed

- *tweak* manager-quantity: no longer needed

## DFHack 0.42.06-r1

### Internals

- Commands to run on startup can be specified on the command line with +

Example:

```
./dfhack +devel/print-args example  
"Dwarf Fortress.exe" +devel/print-args example
```

- Prevented plugins with active viewscreens from being unloaded and causing a crash
- Additional script search paths can be specified in `dfhack-config/script-paths.txt`



## Lua

- *Building-hacks* now supports `auto_gears` flags. It automatically finds and animates gears in building definition
- Changed how *Eventful* triggers reaction complete. Now it has `onReactionComplete` and `onReactionCompleting`. Second one can be canceled

## New Plugins

- *autogems*: Creates a new Workshop Order setting, automatically cutting rough gems

## New Scripts

- *devel/save-version*: Displays DF version information about the current save
- *modtools/extra-gamelog*: replaces `log-region`, `soundsense-season`, and `soundsense`

## New Features

- *buildingplan*: Support for floodgates, grates, and bars
- *colonies*: new place subcommand and supports any vermin (default honey bees)
- *confirm*: Added a confirmation for retiring locations
- *exportlegends*: Exports more information (poetic/musical/dance forms, written/artifact content, landmasses, extra histfig information, and more)
- *search*: Support for new screens:
  - location occupation assignment
  - civilization animal training knowledge
  - animal trainer assignment
- *tweak*:
  - `tweak block-labors`: Prevents labors that can't be used from being toggled
  - `tweak hide-priority`: Adds an option to hide designation priority indicators
  - `tweak title-start-rename`: Adds a safe rename option to the title screen “Start Playing” menu
- *zone*:
  - Added `unassign` subcommand
  - Added `only` option to `assign` subcommand

## Fixes

- Fixed a crash bug caused by the historical figures DFHack uses to store persistent data.
- More plugins should recognize non-dwarf citizens
- Fixed a possible crash from cloning jobs
- `moveToBuilding()` now sets flags for items that aren't a structural part of the building properly

- *autotrade, stocks*: Made trading work when multiple caravans are present but only some can trade
- *confirm* note-delete: No longer interferes with name entry
- *exportlegends*: Handles entities without specific races, and a few other fixes for things new to v0.42
- *fastdwarf*: Fixed a bug involving teleporting mothers but not the babies they're holding.
- *gaydar*: Fixed text display on OS X/Linux and failure with soul-less creatures
- *manipulator*:
  - allowed editing of non-dwarf citizens
  - stopped ghosts and visitors from being editable
  - fixed applying last custom profession
- *modtools/create-unit*: Stopped making units without civs historical figures
- *modtools/force*:
  - Removed siege option
  - Prevented a crash resulting from a bad civilization option
- *showmood*: Fixed name display on OS X/Linux
- *view-item-info*: Fixed density units

## Misc Improvements

- *autochop*: Can now edit log minimum/maximum directly and remove limit entirely
- *autolabor, autohauler, manipulator*: Added support for new jobs/labors/skills
- *colonies*: now implemented by a script
- *createitem*: Can now create items anywhere without specifying a unit, as long as a unit exists on the map
- *devel/export-dt-ini*: Updated for 0.42.06
- *devel/find-offsets*: Automated several more scans
- *gui/gm-editor*: Now supports finding some items with a numeric ID (with *i*)
- *lua*: Now supports some built-in variables like *gui/gm-editor*, e.g. *unit*, *screen*
- *remotefortressreader*: Can now trigger keyboard events
- *stockflow*: Now offers better control over individual craft jobs
- *weather*: now implemented by a script
- *zone*: colored output

## Removed

- DFusion: legacy script system, obsolete or replaced by better alternatives

## DFHack 0.40.24-r5

### New Features

- *confirm*:
  - Added a `uniform-delete` option for military uniform deletion
  - Added a basic in-game configuration UI

### Fixes

- Fixed a rare crash that could result from running *keybinding* in `onLoadWorld.init`
- Script help that doesn't start with a space is now recognized correctly
- *confirm*: Fixed issues with `haul-delete`, `route-delete`, and `squad-disband` confirmations intercepting keys too aggressively
- *emigration* should work now
- *fix-unit-occupancy*: Significantly optimized - up to 2,000 times faster in large fortresses
- *gui/create-item*: Allow exiting quantity prompt
- *gui/family-affairs*: Fixed an issue where lack of relationships wasn't recognized and other issues
- *modtools/create-unit*: Fixed a possible issue in reclaim fortress mode
- *search*: Fixed a crash on the military screen
- *tweak* max-wheelbarrow: Fixed a minor display issue with large numbers
- *workflow*: Fixed a crash related to job postings (and added a fix for existing, broken jobs)

### Misc Improvements

- Unrecognized command feedback now includes more information about plugins
- *fix/dry-buckets*: replaces the `drybuckets` plugin
- *feature*: now implemented by a script

## DFHack 0.40.24-r4

### Internals

- A method for caching screen output is now available to Lua (and C++)
- Developer plugins can be ignored on startup by setting the `DFHACK_NO_DEV_PLUGINS` environment variable
- The console on Linux and OS X now recognizes keyboard input between prompts
- JSON libraries available (C++ and Lua)
- More DFHack build information used in plugin version checks and available to plugins and lua scripts
- Fixed a rare overflow issue that could cause crashes on Linux and OS X
- Stopped DF window from receiving input when unfocused on OS X
- Fixed issues with keybindings involving `CtrlA` and `CtrlZ`, as well as `AltE/U/N` on OS X

- Multiple contexts can now be specified when adding keybindings
- Keybindings can now use F10-F12 and 0-9
- Plugin system is no longer restricted to plugins that exist on startup
- `dfhack.init` file locations significantly generalized

## Lua

- Scripts can be enabled with the built-in *enable/disable* commands
- A new function, `reqscript()`, is available as a safer alternative to `script_environment()`
- Lua viewscreens can choose not to intercept the OPTIONS keybinding

## New internal commands

- *kill-lua*: Interrupt running Lua scripts
- *type*: Show where a command is implemented

## New plugins

- *confirm*: Adds confirmation dialogs for several potentially dangerous actions
- *fix-unit-occupancy*: Fixes issues with unit occupancy, such as faulty “unit blocking tile” messages ([Bug 3499](#))
- *title-version* (formerly *vshook*): Display DFHack version on title screen

## New scripts

- *armoks-blessing*: Adjust all attributes, personality, age and skills of all dwarves in play
- *brainwash*: brainwash a dwarf (modifying their personality)
- *burial*: sets all unowned coffins to allow burial (“-pets” to allow pets too)
- *deteriorateclothes*: make worn clothes on the ground wear far faster to boost FPS
- *deterioratecorpses*: make body parts wear away far faster to boost FPS
- *deterioratefood*: make food vanish after a few months if not used
- *elevate-mental*: elevate all the mental attributes of a unit
- *elevate-physical*: elevate all the physical attributes of a unit
- *emigration*: stressed dwarves may leave your fortress if they see a chance
- *fix-ster*: changes fertility/sterility of animals or dwarves
- *gui/family-affairs*: investigate and alter romantic relationships
- *make-legendary*: modify skill(s) of a single unit
- *modtools/create-unit*: create new units from nothing
- *modtools/equip-item*: a script to equip items on units
- *points*: set number of points available at embark screen
- *pref-adjust*: Adjust all preferences of all dwarves in play

- *rejuvenate*: make any “old” dwarf 20 years old
- *starvingdead*: make undead weaken after one month on the map, and crumble after six
- *view-item-info*: adds information and customisable descriptions to item viewscreens
- *warn-starving*: check for starving, thirsty, or very drowsy units and pause with warning if any are found

### New tweaks

- *embark-profile-name*: Allows the use of lowercase letters when saving embark profiles
- *kitchen-keys*: Fixes DF kitchen meal keybindings
- *kitchen-prefs-color*: Changes color of enabled items to green in kitchen preferences
- *kitchen-prefs-empty*: Fixes a layout issue with empty kitchen tabs

### Fixes

- Plugins with `vmethod` hooks can now be reloaded on OS X
- Lua's `os.system()` now works on OS X
- Fixed default arguments in Lua gametype detection functions
- Circular lua dependencies (`reqscript/script_environment`) fixed
- Prevented crash in `Items::createItem()`
- *buildingplan*: Now supports hatch covers
- *gui/create-item*: fixed assigning quality to items, made `Esc` work properly
- *gui/gm-editor*: handles lua tables properly
- *help*: now recognizes built-in commands, like `help`
- *manipulator*: fixed crash when selecting custom professions when none are found
- *remotefortressreader*: fixed crash when attempting to send map info when no map was loaded
- *search*: fixed crash in unit list after cancelling a job; fixed crash when disabling stockpile category after searching in a subcategory
- *stocksettings*: now checks/sanitizes filenames when saving
- *stocks*: fixed a crash when right-clicking
- *steam-engine*: fixed a crash on arena load; number keys (e.g. 2/8) take priority over cursor keys when applicable
- *tweak fps-min* fixed
- *tweak farm-plot-select*: Stopped controls from appearing when plots weren't fully built
- *workflow*: Fixed some issues with stuck jobs. Existing stuck jobs must be cancelled and re-added
- *zone*: Fixed a crash when using `zone set` (and a few other potential crashes)

## Misc Improvements

- DFHack documentation:
  - massively reorganised, into files of more readable size
  - added many missing entries
  - indexes, internal links, offline search all documents
  - includes documentation of linked projects (df-structures, third-party scripts)
  - better HTML generation with Sphinx
  - documentation for scripts now located in source files
- *autolabor*:
  - Stopped modification of labors that shouldn't be modified for brokers/diplomats
  - Prioritize skilled dwarves more efficiently
  - Prevent dwarves from running away with tools from previous jobs
- *automaterial*: Fixed several issues with constructions being allowed/disallowed incorrectly when using box-select
- *dwarfmonitor*:
  - widgets' positions, formats, etc. are now customizable
  - weather display now separated from the date display
  - New mouse cursor widget
- *gui/dfstatus*: Can enable/disable individual categories and customize metal bar list
- *full-heal*: `-r` option removes corpses
- *gui/gm-editor*
  - Pointers can now be displaced
  - Added some useful aliases: "item" for the selected item, "screen" for the current screen, etc.
  - Now avoids errors with unrecognized types
- *gui/hack-wish*: renamed to *gui/create-item*
- *keybinding list* accepts a context
- *lever*:
  - Lists lever names
  - `lever pull` can be used to pull the currently-selected lever
- *memview*: Fixed display issue
- *modtools/create-item*: arguments are named more clearly, and you can specify the creator to be the unit with `id df.global.unit_next_id-1` (useful in conjunction with *modtools/create-unit*)
- *nyan*: Can now be stopped with `dfhack-run`
- *plug*: lists all plugins; shows state and number of commands in plugins
- *prospect*: works from within command-prompt
- *quicksave*: Restricted to fortress mode

- *remotefortressreader*: Exposes more information
- *search*:
  - Supports noble suggestion screen (e.g. suggesting a baron)
  - Supports fortress mode loo[k] menu
  - Recognizes ? and ; keys
- *stocks*: can now match beginning and end of item names
- *teleport*: Fixed cursor recognition
- *tidlers*, *twaterlvl*: now implemented by scripts instead of a plugin
- *tweak*:
  - debug output now logged to stderr.log instead of console - makes DFHack start faster
  - farm-plot-select: Fixed issues with selecting undiscovered crops
- *workflow*: Improved handling of plant reactions

## Removed

- *embark-tools* nano: 1x1 embarks are now possible in vanilla 0.40.24

## DFHack 0.40.24-r3

### Internals

- Ruby library now included on OS X - Ruby scripts should work on OS X 10.10
- libstdc++ should work with older versions of OS X
- Added support for *onMapLoad.init* / *onMapUnload.init* scripts
- game type detection functions are now available in the World module
- The DFHACK\_LOG\_MEM\_RANGES environment variable can be used to log information to stderr.log on OS X
- Fixed adventure mode menu names
- Fixed command usage information for some commands

### Lua

- Lua scripts will only be reloaded if necessary
- Added a `df2console()` wrapper, useful for printing DF (CP437-encoded) text to the console in a portable way
- Added a `strerror()` wrapper

### New Internal Commands

- *hide*, *show*: hide and show the console on Windows
- *sc-script*: Allows additional scripts to be run when certain events occur (similar to *onLoad\*.init* scripts)

## New Plugins

- *autohauler*: A hauling-only version of autolabor

## New Scripts

- *modtools/reaction-product-trigger*: triggers callbacks when products are produced (contrast with when reactions complete)

## New Tweaks

- *fps-min*: Fixes the in-game minimum FPS setting
- *shift-8-scroll*: Gives Shift+8 (or \*) priority when scrolling menus, instead of scrolling the map
- *tradereq-pet-gender*: Displays pet genders on the trade request screen

## Fixes

- Fixed game type detection in *3dveins*, *gui/create-item*, *reveal*, *seedwatch*
- `PRELOAD_LIB`: More extensible on Linux
- *add-spatter*, *Eventful*: Fixed crash on world load
- *add-thought*: Now has a proper subthought arg.
- *Building-hacks*: Made buildings produce/consume correct amount of power
- *fix-armory*: compiles and is available again (albeit with issues)
- *gui/gm-editor*: Added search option (accessible with “s”)
- *hack-wish*: Made items stack properly.
- *modtools/skill-change*: Made level granularity work properly.
- *show-unit-syndromes*: should work
- *stockflow*:
  - Fixed error message in Arena mode
  - no longer checks the DF version
  - fixed ballistic arrow head orders
  - convinces the bookkeeper to update records more often
- *zone*: Stopped crash when scrolling cage owner list

## Misc Improvements

- *autolabor*: A negative pool size can be specified to use the most unskilled dwarves
- *Building-hacks*:
  - Added a way to allow building to work even if it consumes more power than is available.
  - Added `setPower/getPower` functions.
- *catsplosion*: Can now trigger pregnancies in (most) other creatures



- *exportlegends*: info and all options export legends\_plus.xml with more data for legends utilities
- *manipulator*:
  - Added ability to edit nicknames/profession names
  - added “Job” as a View Type, in addition to “Profession” and “Squad”
  - added custom profession templates with masking
- *remotefortressreader*: Exposes more information

## DFHack 0.40.24-r2

### Internals

- Lua scripts can set environment variables of each other with `dfhack.run_script_with_env`
- Lua scripts can now call each others internal nonlocal functions with `dfhack.script_environment(scriptName).functionName(arg1, arg2)`
- *Eventful*: Lua reactions no longer require LUA\_HOOK as a prefix; you can register a callback for the completion of any reaction with a name
- Filesystem module now provides file access/modification times and can list directories (normally and recursively)
- Units Module: New functions:

```
isWar
isHunter
isAvailableForAdoption
isOwnCiv
isOwnRace
getRaceName
getRaceNamePlural
getRaceBabyName
getRaceChildName
isBaby
isChild
isAdult
isEggLayer
isGrazer
isMilkable
isTrainableWar
isTrainableHunting
isTamable
isMale
isFemale
isMerchant
isForest
isMarkedForSlaughter
```

- Buildings Module: New Functions:

```
isActivityZone
isPenPasture
isPitPond
isActive
findPenPitAt
```

## Fixes

- `dfhack.run_script` should correctly find save-specific scripts now.
- *add-thought*: updated to properly affect stress.
- *hfs-pit*: should work now
- *autobutcher*: takes gelding into account
- `init.lua` existence checks should be more reliable (notably when using non-English locales)

## Misc Improvements

Multiline commands are now possible inside `dfhack.init` scripts. See `dfhack.init-example` for example usage.

## DFHack 0.40.24-r1

### Internals

CMake shouldn't cache `DFHACK_RELEASE` anymore. People may need to manually update/delete their CMake cache files to get rid of it.

## DFHack 0.40.24-r0

### Internals

- *Events from EventManager*: fixed crash error with `EQUIPMENT_CHANGE` event.
- key modifier state exposed to Lua (ie `Ctrl`, `Alt`, `Shift`)

## Fixes

`dfhack.sh` can now be run from other directories on OS X

## New Plugins

- *blueprint*: export part of your fortress to quickfort `.csv` files

## New Scripts

- *hotkey-notes*: print key, name, and jump position of hotkeys

## Removed

- `needs_porting/*`

## Misc Improvements

Added support for searching more lists

## Older Changelogs

Are kept in a seperate file: HISTORY



## How to contribute to DFHack

### Contents

- *How to contribute to DFHack*
  - *Contributing Code*
    - \* *Code Format*
    - \* *How to get new code into DFHack*
    - \* *Memory research*
  - *Using the library as a developer*
    - \* *DF data structure definitions*
    - \* *Remote access interface*
  - *Documentation Standards*
  - *Other ways to help*

## Contributing Code

Several things should be kept in mind when contributing code to DFHack.

### Code Format

- Four space indents for C++. Never use tabs for indentation in any language.
- LF (Unix style) line terminators

- Avoid trailing whitespace
- UTF-8 encoding
- For C++:
  - Opening and closing braces on their own lines or opening brace at the end of the previous line
  - Braces placed at original indent level if on their own lines
  - #includes should be sorted. C++ libraries first, then dfhack modules, then df structures, then local includes. Within each category they should be sorted alphabetically.

## How to get new code into DFHack

- Submit pull requests to the `develop` branch, not the `master` branch. (The `master` branch always points at the most recent release)
- Use a new branch for each feature or bugfix so that your changes can be merged independently (i.e. not the `master` or `develop` branch of your fork).
- If possible, compile on multiple platforms when changing anything that compiles
- It must pass CI - run `python travis/all.py` to check this.
- Update `NEWS.rst` and `docs/Authors.rst` when applicable.
- Create a GitHub pull request once finished
- Submit ideas and bug reports as [issues on GitHub](#). Posts in the forum thread can easily get missed or forgotten.
- Work on [reported problems](#) will take priority over ideas or suggestions.

## Memory research

If you want to do memory research, you'll need some tools and some knowledge. In general, you'll need a good memory viewer and optionally something to look at machine code without getting crazy :) Using publicly known information and analyzing the game's data is preferred.

Good windows tools include:

- Cheat Engine
- IDA Pro 5.0 (freely available for non-commercial use)

Good linux tools:

- angavrilov's df-structures gui (visit us on IRC for details).
- edb (Evan's Debugger)
- IDA Pro 5.0 running under Wine
- Some of the tools residing in the `legacy dfhack` branch.

## Using the library as a developer

Currently, the most direct way to use the library is to write a script or plugin that can be loaded by it. All the plugins can be found in the 'plugins' folder. There's no in-depth documentation on how to write one yet, but it should be easy enough to copy one and just follow the pattern. `plugins/skeleton/skeleton.cpp` is provided for this purpose.

Other than through plugins, it is possible to use DFHack via remote access interface, or by writing scripts in Lua or Ruby. There are plenty of examples in the scripts folder. The *DFHack Lua API* is quite well documented.

The most important parts of DFHack are the Core, Console, Modules and Plugins.

- Core acts as the centerpiece of DFHack - it acts as a filter between DF and SDL and synchronizes the various plugins with DF.
- Console is a thread-safe console that can be used to invoke commands exported by Plugins.
- Modules actually describe the way to access information in DF's memory. You can get them from the Core. Most modules are split into two parts: high-level and low-level. High-level is mostly method calls, low-level publicly visible pointers to DF's data structures.
- Plugins are the tools that use all the other stuff to make things happen. A plugin can have a list of commands that it exports and an onupdate function that will be called each DF game tick.

Rudimentary API documentation can be built using doxygen (see build options in `CMakeCache.txt` or with `cmake` or `cmake-gui`). The full DFHack documentation is built with *Sphinx*, which runs automatically at compile time.

DFHack consists of variously licensed code, but invariably weak copyleft. The main license is zlib/libpng, some bits are MIT licensed, and some are BSD licensed. See the *Licenses* for more information.

Feel free to add your own extensions and plugins. Contributing back to the DFHack repository is welcome and the right thing to do :)

## DF data structure definitions

DFHack uses information about the game data structures, represented via xml files in the `library/xml/` submodule.

See <https://github.com/DFHack/df-structures>, and the documentation linked in the index.

Data structure layouts are described in files following the `df.*.xml` name pattern. This information is transformed by a perl script into C++ headers describing the structures, and associated metadata for the Lua wrapper. These headers and data are then compiled into the DFHack libraries, thus necessitating a compatibility break every time layouts change; in return it significantly boosts the efficiency and capabilities of DFHack code.

Global object addresses are stored in `symbols.xml`, which is copied to the dfhack release package and loaded as data at runtime.

## Remote access interface

DFHack supports remote access by exchanging Google protobuf messages via a TCP socket. Both the core and plugins can define remotely accessible methods. The `dfhack-run` command uses this interface to invoke ordinary console commands.

Currently the supported set of requests is limited, because the developers don't know what exactly is most useful. *remotefortressreader* provides a fairly comprehensive interface for visualisers such as *Armok Vision*.

## Documentation Standards

DFHack documentation is built with *Sphinx*, and configured automatically through CMake. If you want to build the docs *only*, use this command:

```
sphinx-build . docs/html
```

Whether you're adding new code or just fixing old documentation (and there's plenty), there are a few important standards for completeness and consistent style. Treat this section as a guide rather than iron law, match the surrounding text, and you'll be fine.

Each command should have a short (~54 character) help string, which is shown by the `ls` command. For scripts, this is a comment on the first line (the comment marker and whitespace is stripped). For plugins it's the second argument to `PluginCommand`. Please make this brief but descriptive!

Everything should be documented! If it's not clear *where* a particular thing should be documented, ask on IRC or in the DFHack thread on Bay12 - as well as getting help, you'll be providing valuable feedback that makes it easier for future readers!

Scripts can use a custom autodoc function, based on the Sphinx `include` directive - anything between the tokens is copied into the appropriate scripts documentation page. For Ruby, we follow the built-in docstring convention (`=begin` and `=end`). For Lua, the tokens are `[====[` and `]====]` - ordinary multi-line strings. It is highly encouraged to reuse this string as the in-console documentation by (eg.) printing it when a `-help` argument is given.

The docs **must** have a heading which exactly matches the command, underlined with `=====` to the same length. For example, a lua file would have:

```
local helpstr = [====[

add-thought
=====
Adds a thought or emotion to the selected unit. Can be used by other scripts,
or the gui invoked by running ``add-thought gui`` with a unit selected.

]====]
```

Where the heading for a section is also the name of a command, the spelling and case should exactly match the command to enter in the DFHack command line.

Try to keep lines within 80-100 characters, so it's readable in plain text in the terminal - Sphinx (our documentation system) will make sure paragraphs flow.

If there aren't many options or examples to show, they can go in a paragraph of text. Use double-backticks to put commands in monospaced font, like this:

```
You can use ``cleanowned scattered x`` to dump tattered or abandoned items.
```

If the command takes more than three arguments, format the list as a table called Usage. The table *only* lists arguments, not full commands. Input values are specified in angle brackets. Example:

```
Usage:

:arg1:          A simple argument.
:arg2 <input>:  Does something based on the input value.
:Very long argument:
                Is very specific.
```

To demonstrate usage - useful mainly when the syntax is complicated, list the full command with arguments in monospaced font, then indent the next line and describe the effect:

```
``resume all``
    Resumes all suspended constructions.
```

If it would be helpful to mention another DFHack command, don't just type the name - add a hyperlink! Specify the link target in backticks, and it will be replaced with the corresponding title and linked: eg ``autolabor` =>`



*autolabor*. Link targets should be equivalent to the command described (without file extension), and placed above the heading of that section like this:

```
.. _autolabor:

autolabor
=====
```

Add link targets if you need them, but otherwise plain headings are preferred. Scripts have link targets created automatically.

## Other ways to help

DFHack is a software project, but there's a lot more to it than programming. If you're not comfortable programming, you can help by:

- reporting bugs and incomplete documentation
- improving the documentation
- finding third-party scripts to add
- writing tutorials for newbies

All those things are crucial, and often under-represented. So if that's your thing, go get started!

## Compiling DFHack

You don't need to compile DFHack unless you're developing plugins or working on the core.

For users, modders, and authors of scripts it's better to download and *install the latest release instead*.

### Contents

- *Compiling DFHack*
  - *How to get the code*
  - *Contributing to DFHack*
  - *Build settings*
  - *Linux*
  - *Mac OS X*
  - *Windows*
  - *Building the documentation*
  - *Misc. Notes*

## How to get the code

DFHack doesn't have any kind of system of code snapshots in place, so you will have to get code from the GitHub repository using Git. How to get Git is described under the instructions for each platform.

To get the latest release code (master branch):

```
git clone --recursive https://github.com/DFHack/dfhack
cd dfhack
```

If your version of Git does not support the `--recursive` flag, you will need to omit it and run `git submodule update --init` after entering the `dfhack` directory.

To get the latest development code (develop branch), clone as above and then:

```
git checkout develop
git submodule update
```

Generally, you should only need to clone DFHack once.

### **Important note regarding submodule update and changing branches:**

You must run `git submodule update` every time you change branches, such as when switching between the master and develop branches or vice versa. If a submodule only exists on the newer branch, you also need to run `git submodule update --init`. Failure to do this may result in strange build errors or “not a known DF version” errors.

### **More notes:**

- *Note on building DFHack offline* - read this if your build machine may not have an internet connection!
- *Note on using very old git versions with pre-0.43.03 DFHack versions*

## **Contributing to DFHack**

If you want to get involved with the development, create an account on GitHub, make a clone there and then use that as your remote repository instead.

We’d love that; join us on [IRC](#) (#dfhack channel on freenode) for discussion, and whenever you need help.

(Note: for submodule issues, please see the above instructions first!)

For lots more details on contributing to DFHack, including pull requests, code format, and more, please see [Contributing Code](#).

## **Build settings**

### **Build type**

cmake allows you to pick a build type by changing the `CMAKE_BUILD_TYPE` variable:

```
cmake .. -DCMAKE_BUILD_TYPE:string=BUILD_TYPE
```

Without specifying a build type or ‘None’, cmake uses the `CMAKE_CXX_FLAGS` variable for building.

Valid and useful build types include ‘Release’, ‘Debug’ and ‘RelWithDebInfo’. ‘Debug’ is not available on Windows; use ‘RelWithDebInfo’ instead.

### **Target architecture (32-bit vs. 64-bit)**

Set `DFHACK_BUILD_ARCH` to either 32 or 64 to build a 32-bit or 64-bit version of DFHack (respectively). The default is currently 32, but this may change, so specifying it explicitly is a good idea.

```
cmake .. -DDFHACK_BUILD_ARCH=32
```

*or*

```
cmake .. -DDFHACK_BUILD_ARCH=64
```

Note that the scripts in the “build” folder on Windows will set the architecture automatically.

## Other settings

There are a variety of other settings which you can find in CMakeCache.txt in your build folder or by running `ccmake` (or another CMake GUI). Most DFHack-specific settings begin with `BUILD_` and control which parts of DFHack are built.

## Linux

On Linux, DFHack acts as a library that shadows parts of the SDL API using `LD_PRELOAD`.

## Dependencies

DFHack is meant to be installed into an existing DF folder, so get one ready.

We assume that any Linux platform will have `git` available (though it may need to be installed with your package manager.)

To build DFHack you need GCC version 4.8 or later. GCC 4.8 is easiest to work with due to avoiding `libstdc++` issues (see below), but any version from 4.8 onwards (including 5.x) will work.

Before you can build anything, you’ll also need `cmake`. It is advisable to also get `ccmake` on distributions that split the `cmake` package into multiple parts.

You also need `perl` and the `XML::LibXML` and `XML::LibXSLOT` perl packages (for the code generation parts). You should be able to find them in your distro repositories.

To build `stonesense`, you’ll also need OpenGL headers.

Here are some package install commands for various platforms:

- On Arch linux:
  - For the required Perl modules: `perl-xml-libxml` and `perl-xml-libxslt` (or through `cpan`)

- On Ubuntu:

```
apt-get install gcc cmake git zlib1g-dev libxml-libxml-perl libxml-libxslt-perl
```

- Debian and derived distros should have similar requirements to Ubuntu.

## Multilib dependencies

If you want to compile 32-bit DFHack on 64-bit distributions, you’ll need the multilib development tools and libraries:

- `gcc-multilib` and `g++-multilib`
- If you have installed a non-default version of GCC - for example, GCC 4.8 on a distribution that defaults to 5.x - you may need to add the version number to the multilib packages.

- For example, `gcc-4.8-multilib` and `g++-4.8-multilib` if installing for GCC 4.8 on a system that uses a later GCC version.
- This is definitely required on Ubuntu/Debian, check if using a different distribution.
- `zlib1g-dev:i386` (or a similar i386 zlib-dev package)

Note that installing a 32-bit GCC on 64-bit systems (e.g. `gcc:i386` on Debian) will typically *not* work, as it depends on several other 32-bit libraries that conflict with system libraries. Alternatively, you might be able to use `lxc` to [create a virtual 32-bit environment](#).

## Build

Building is fairly straightforward. Enter the `build` folder (or create an empty folder in the DFHack directory to use instead) and start the build like this:

```
cd build
cmake .. -DCMAKE_BUILD_TYPE:string=Release -DCMAKE_INSTALL_PREFIX=<path to DF>
make install # or make -jX install on multi-core systems to compile with X parallel_
↳processes
```

<path to DF> should be a path to a copy of Dwarf Fortress, of the appropriate version for the DFHack you are building. This will build the library along with the normal set of plugins and install them into your DF folder.

Alternatively, you can use `ccmake` instead of `cmake`:

```
cd build
ccmake ..
make install
```

This will show a curses-based interface that lets you set all of the extra options. You can also use a `cmake`-friendly IDE like KDevelop 4 or the `cmake-gui` program.

## Incompatible libstdc++

When compiling `dfhack` yourself, it builds against your system `libstdc++`. When Dwarf Fortress runs, it uses a `libstdc++` shipped with the binary, which comes from GCC 4.8 and is incompatible with code compiled with newer GCC versions. If you compile DFHack with a GCC version newer than 4.8, you will see an error message such as:

```
./libs/Dwarf_Fortress: /pathToDF/libs/libstdc++.so.6: version
`GLIBCXX_3.4.18' not found (required by ./hack/libdfhack.so)
```

To fix this you can compile with GCC 4.8 or remove the `libstdc++` shipped with DF, which causes DF to use your system `libstdc++` instead:

```
cd /path/to/DF/
rm libs/libstdc++.so.6
```

Note that distributing binaries compiled with newer GCC versions requires end- users to delete `libstdc++` themselves and have a `libstdc++` on their system from the same GCC version or newer. For this reason, distributing anything compiled with GCC versions newer than 4.8 is discouraged. In the future we may start bundling a later `libstdc++` as part of the DFHack package, so as to enable compilation-for-distribution with a GCC newer than 4.8.

## Mac OS X

DFHack functions similarly on OS X and Linux, and the majority of the information above regarding the build process (cmake and make) applies here as well.

DFHack can officially be built on OS X with GCC 4.8. Anything newer than 4.8 will require you to perform extra steps to get DFHack to run (see *Notes for GCC 4.9+ or OS X 10.10+ users*), and your build will likely not be redistributable.

### Notes for GCC 4.9+ or OS X 10.10+ users

If none of these situations apply to you, skip to *Dependencies and system set-up*.

If you have issues building on OS X 10.10 (Yosemite) or above, try defining the following environment variable:

```
export MACOSX_DEPLOYMENT_TARGET=10.9
```

If you build with a GCC version newer than 4.8, DFHack will probably crash immediately on startup, or soon after. To fix this, you will need to replace `hack/libstdc++.6.dylib` with a symlink to the `libstdc++.6.dylib` included in your version of GCC:

```
cd <path to df>/hack && mv libstdc++.6.dylib libstdc++.6.dylib.orig &&
ln -s [PATH_TO_LIBSTDC++] .
```

For example, with GCC 5.2.0, `PATH_TO_LIBSTDC++` would be:

```
/usr/local/Cellar/gcc5/5.2.0/lib/gcc/5/libstdc++.6.dylib # for 64-bit DFHack
/usr/local/Cellar/gcc5/5.2.0/lib/gcc/5/i386/libstdc++.6.dylib # for 32-bit DFHack
```

**Note:** If you build with a version of GCC that requires this, your DFHack build will *not* be redistributable. (Even if you copy the `libstdc++.6.dylib` from your GCC version and distribute that too, it will fail on older OS X versions.) For this reason, if you plan on distributing DFHack, it is highly recommended to use GCC 4.8.

### Dependencies and system set-up

1. Download and unpack a copy of the latest DF
2. Install Xcode from the Mac App Store
3. Install the XCode Command Line Tools by running the following command:

```
xcode-select --install
```

4. Install dependencies

It is recommended to use Homebrew instead of MacPorts, as it is generally cleaner, quicker, and smarter. For example, installing MacPort's GCC will install more than twice as many dependencies as Homebrew's will, and all in both 32-bit and 64-bit variants. Homebrew also doesn't require constant use of `sudo`.

Using [Homebrew](#) (recommended):

```
brew tap homebrew/versions
brew install git
brew install cmake
brew install gcc@4.8
```

Using [MacPorts](#):

```
sudo port install gcc48 +universal cmake +universal git-core +universal
```

Macports will take some time - maybe hours. At some point it may ask you to install a Java environment; let it do so.

## 5. Install Perl dependencies

- Using system Perl

- `sudo cpan`

If this is the first time you've run `cpan`, you will need to go through the setup process. Just stick with the defaults for everything and you'll be fine.

If you are running OS X 10.6 (Snow Leopard) or earlier, good luck! You'll need to open a separate Terminal window and run:

```
sudo ln -s /usr/include/libxml2/libxml /usr/include/libxml
```

- `install XML::LibXML`

- `install XML::LibXSMT`

- In a separate, local Perl install

Rather than using system Perl, you might also want to consider the Perl manager, [Perlbrew](#).

This manages Perl 5 locally under `~/perl5/`, providing an easy way to install Perl and run CPAN against it without `sudo`. It can maintain multiple Perl installs and being local has the benefit of easy migration and insulation from OS issues and upgrades.

See <http://perlbrew.pl/> for more details.

## Building

- Get the DFHack source as per section *How to get the code*, above.

- Set environment variables

Homebrew (if installed elsewhere, replace `/usr/local` with `$(brew --prefix)`):

```
export CC=/usr/local/bin/gcc-4.8
export CXX=/usr/local/bin/g++-4.8
```

Macports:

```
export CC=/opt/local/bin/gcc-mp-4.8
export CXX=/opt/local/bin/g++-mp-4.8
```

Change the version numbers appropriately if you installed a different version of GCC.

- Build dfhack:

```
mkdir build-osx
cd build-osx
cmake .. -DCMAKE_BUILD_TYPE:string=Release -DCMAKE_INSTALL_PREFIX=<path to DF>
make install # or make -j X install on multi-core systems to compile with X
↳parallel processes
```

<path to DF> should be a path to a copy of Dwarf Fortress, of the appropriate version for the DFHack you are building.

## Windows

On Windows, DFHack replaces the SDL library distributed with DF.

### Dependencies

You will need the following:

- Microsoft Visual Studio 2015, with the C++ language
- Git
- CMake
- Perl with XML::LibXML and XML::LibXSLT
  - It is recommended to install StrawberryPerl, which includes both.
- Python (for documentation; optional, except for release builds)

### Microsoft Visual Studio 2015

DFHack has to be compiled with the Microsoft Visual C++ 2015 toolchain; other versions won't work against Dwarf Fortress due to ABI and STL incompatibilities.

At present, the only way to obtain the MSVC C++ 2015 toolchain is to install a full copy of Microsoft Visual Studio 2015. The free Community version is sufficient.

### Additional dependencies: installing with the Chocolatey Package Manager

The remainder of dependencies - Git, CMake, StrawberryPerl, and Python - can be most easily installed using the Chocolatey Package Manager. Chocolatey is a \*nix-style package manager for Windows. It's fast, small (8-20MB on disk) and very capable. Think "apt-get for Windows."

Chocolatey is a recommended way of installing the required dependencies as it's quicker, requires less effort, and will install known-good utilities guaranteed to have the correct setup (especially PATH).

To install Chocolatey and the required dependencies:

- Go to <https://chocolatey.org> in a web browser
- At the top of the page it will give you the install command to copy
  - Copy the first one, which starts `@powershell ...`
  - It won't be repeated here in case it changes in future Chocolatey releases.
- Open an elevated (Admin) `cmd.exe` window
  - On Windows 8 and later this can be easily achieved by:
    - \* right-clicking on the Start Menu, or pressing Win+X.
    - \* choosing "Command Prompt (Admin)"
  - On earlier Windows: find `cmd.exe` in Start Menu, right click and choose Open As Administrator.
- Paste in the Chocolatey install command and hit enter
- Close this `cmd.exe` window and open another Admin `cmd.exe` in the same way

- Run the following command:

```
choco install git cmake.portable strawberryperl -y
```

- Close the Admin `cmd.exe` window; you're done!

You can now use all of these utilities from any normal `cmd.exe` window. You only need Admin/elevated `cmd.exe` for running `choco install` commands; for all other purposes, including compiling DFHack, you should use a normal `cmd.exe` (or, better, an improved terminal like [Cmder](#); details below, under Build.)

**NOTE:** you can run the above `choco install` command even if you already have Git, CMake or StrawberryPerl installed. Chocolatey will inform you if any software is already installed and won't re-install it. In that case, please check the PATHs are correct for that utility as listed in the manual instructions below. Or, better, manually uninstall the version you have already and re-install via Chocolatey, which will ensure the PATH are set up right and will allow Chocolatey to manage that program for you in future.

### Additional dependencies: installing manually

If you prefer to install manually rather than using Chocolatey, details and requirements are as below. If you do install manually, please ensure you have all PATHs set up correctly.

#### Git

Some examples:

- [Git for Windows](#) (command-line and GUI)
- [tortoisegit](#) (GUI and File Explorer integration)

#### CMake

You can get the win32 installer version from [the official site](#). It has the usual installer wizard. Make sure you let it add its binary folder to your binary search PATH so the tool can be later run from anywhere.

#### Perl / Strawberry Perl

For the code generation parts you'll need Perl 5 with XML::LibXML and XML::LibXSLT. [Strawberry Perl](#) is recommended as it includes all of the required packages in a single, easy install.

After install, ensure Perl is in your user's PATH. This can be edited from Control Panel -> System -> Advanced System Settings -> Environment Variables.

The following three directories must be in PATH, in this order:

- <path to perl>\c\bin
- <path to perl>\perl\site\bin
- <path to perl>\perl\bin

Be sure to close and re-open any existing `cmd.exe` windows after updating your PATH.

If you already have a different version of Perl (for example the one from Cygwin), you can run into some trouble. Either remove the other Perl install from PATH, or install XML::LibXML and XML::LibXSLT for it using CPAN.



## Build

There are several different batch files in the `win32` and `win64` subfolders in the `build` folder, along with a script that's used for picking the DF path. Use the subfolder corresponding to the architecture that you want to build for.

First, run `set_df_path.vbs` and point the dialog that pops up at a suitable DF installation which is of the appropriate version for the DFHack you are compiling. The result is the creation of the file `DF_PATH.txt` in the build directory. It contains the full path to the destination directory. You could therefore also create this file manually - or copy in a pre-prepared version - if you prefer.

Next, run one of the scripts with `generate` prefix. These create the MSVC solution file(s):

- `all` will create a solution with everything enabled (and the kitchen sink).
- `gui` will pop up the CMake GUI and let you choose what to build. This is probably what you want most of the time. Set the options you are interested in, then hit configure, then generate. More options can appear after the configure step.
- `minimal` will create a minimal solution with just the bare necessities - the main library and standard plugins.
- `release` will create a solution with everything that should be included in release builds of DFHack. Note that this includes documentation, which requires Python.

Then you can either open the solution with MSVC or use one of the `msbuild` scripts:

### Building/installing from the command line:

In the build directory you will find several `.bat` files:

- Scripts with `build` prefix will only build DFHack.
- Scripts with `install` prefix will build DFHack and install it to the previously selected DF path.
- Scripts with `package` prefix will build and create a `.zip` package of DFHack.

Compiling from the command line is generally the quickest and easiest option. However be aware that due to the limitations of `cmd.exe` - especially in versions of Windows prior to Windows 10 - it can be very hard to see what happens during a build. If you get a failure, you may miss important errors or warnings due to the tiny window size and extremely limited scrollback. For that reason you may prefer to compile in the IDE which will always show all build output.

Alternatively (or additionally), consider installing an improved Windows terminal such as [Cmder](#). Easily installed through Chocolatey with: `choco install cmder -y`.

**Note for Cygwin/msysgit users:** It is also possible to compile DFHack from a Bash command line. This has three potential benefits:

- When you've installed Git and are using its Bash, but haven't added Git to your path:
  - You can load Git's Bash and as long as it can access Perl and CMake, you can use it for compile without adding Git to your system path.
- When you've installed Cygwin and its SSH server:
  - You can now SSH in to your Windows install and compile from a remote terminal; very useful if your Windows installation is a local VM on a \*nix host OS.
- In general: you can use Bash as your compilation terminal, meaning you have a decent sized window, scrollback, etc.
  - Whether you're accessing it locally as with Git's Bash, or remotely through Cygwin's SSH server, this is far superior to using `cmd.exe`.

You don't need to do anything special to compile from Bash. As long as your PATHs are set up correctly, you can run the same generate- and build/install/package- bat files as detailed above.

### Building/installing from the Visual Studio IDE:

After running the CMake generate script you will have a new folder called VC2015 or VC2015\_32, depending on the architecture you specified. Open the file `dfhack.sln` inside that folder. If you have multiple versions of Visual Studio installed, make sure you open with Visual Studio 2015.

The first thing you must then do is change the build type. It defaults to Debug, but this cannot be used on Windows. Debug is not binary-compatible with DF. If you try to use a debug build with DF, you'll only get crashes and for this reason the Windows "debug" scripts actually do RelWithDebInfo builds. After loading the Solution, change the Build Type to either Release or RelWithDebInfo.

Then build the `INSTALL` target listed under `CMakePredefinedTargets`.

### Building the documentation

DFHack documentation, like the file you are reading now, is created as `.rst` files, which are in [reStructuredText \(reST\)](#) format. This is a documentation format that has come from the Python community. It is very similar in concept - and in syntax - to Markdown, as found on GitHub and many other places. However it is more advanced than Markdown, with more features available when compiled to HTML, such as automatic tables of contents, cross-linking, special external links (forum, wiki, etc) and more. The documentation is compiled by a Python tool, [Sphinx](#).

The DFHack build process will compile the documentation but this has been disabled by default. You only need to build the docs if you're changing them, or perhaps if you want a local HTML copy; otherwise, read them easily online at [ReadTheDoc's DFHack hosted documentation](#).

(Note that even if you do want a local copy, it is certainly not necessary to compile the documentation in order to read it. Like Markdown, reST documents are designed to be just as readable in a plain-text editor as they are in HTML format. The main thing you lose in plain text format is hyperlinking.)

### Enabling documentation building

First, make sure you have followed all the necessary steps for your platform as outlined in the rest of this document.

To compile documentation with DFHack, add the following flag to your `cmake` command:

```
-DBUILD_DOCS:bool=ON
```

For example:

```
cmake .. -DCMAKE_BUILD_TYPE:string=Release -DBUILD_DOCS:bool=ON -DCMAKE_INSTALL_
↳PREFIX=<path to DF>
```

Alternatively you can use the CMake GUI which allows options to be changed easily.

On Windows you should either use `generate-msvc-gui.bat` and set the option through the GUI, or else if you want to use an alternate file, such as `generate-msvc-all.bat`, you will need to edit it to add the flag. Or you could just run `cmake` on the command line like in other platforms.

## Required dependencies

In order to build the documentation, you must have Python with Sphinx version 1.3.1 or later. Both Python 2.x and 3.x are supported.

When installing Sphinx from OS package managers, be aware that there is another program called Sphinx, completely unrelated to documentation management. Be sure you are installing the right Sphinx; it may be called `python-sphinx`, for example. To avoid doubt, `pip` can be used instead as detailed below.

## Linux

Most Linux distributions will include Python as standard.

Check your package manager to see if Sphinx 1.3.1 or later is available, but at the time of writing Ubuntu for example only has 1.2.x.

You can instead install Sphinx with the `pip` package manager. This may need to be installed from your OS package manager; this is the case on Ubuntu. On Ubuntu/Debian, use the following to first install `pip`:

```
sudo apt-get install python-pip
```

Once `pip` is available, you can then install the Python Sphinx module with:

```
pip install sphinx
```

If you run this as a normal user it will install a local copy for your user only. Run it with `sudo` if you want a system-wide install. Either is fine for DFHack, however if installing locally do check that `sphinx-build` is in your path. It may be installed in a directory such as `~/local/bin/`, so after `pip` install, find `sphinx-build` and ensure its directory is in your local `$PATH`.

## Mac OS X

OS X has Python 2.7 installed by default, but it does not have the `pip` package manager.

You can install Homebrew's Python 3, which includes `pip`, and then install the latest Sphinx using `pip`:

```
brew install python3
pip3 install sphinx
```

Alternatively, you can simply install Sphinx 1.3.x directly from Homebrew:

```
brew install sphinx-doc
```

This will install Sphinx for OS X's system Python 2.7, without needing `pip`.

Either method works; if you plan to use Python for other purposes, it might best to install Homebrew's Python 3 so that you have the latest Python as well as `pip`. If not, just installing `sphinx-doc` for OS X's system Python 2.7 is fine.

## Windows

Use the Chocolatey package manager to install Python and `pip`, then use `pip` to install Sphinx.

Run the following commands from an elevated (Admin) `cmd.exe`, after installing Chocolatey as outlined in the [Windows section](#):

```
choco install python pip -y
```

Then close that `Admin cmd.exe`, re-open another `Admin cmd.exe`, and run:

```
pip install sphinx
```

## Misc. Notes

### Note on building DFHack offline

As of 0.43.05, DFHack downloads several files during the build process, depending on your target OS and architecture. If your build machine's internet connection is unreliable, or nonexistent, you can download these files in advance.

First, you must locate the files you will need. These can be found in the [dfhack-bin repo](#). Look for the most recent version number *before or equal to* the DF version which you are building for. For example, suppose “0.43.05” and “0.43.07” are listed. You should choose “0.43.05” if you are building for 0.43.05 or 0.43.06, and “0.43.07” if you are building for 0.43.07 or 0.43.08.

Then, download all of the files you need, and save them to `<path to DFHack clone>/CMake/downloads/<any filename>`. The destination filename you choose does not matter, as long as the files end up in the `CMake/downloads` folder. You need to download all of the files for the architecture(s) you are building for. For example, if you are building for 32-bit Linux and 64-bit Windows, download all files starting with `linux32` and `win64`. GitHub should sort files alphabetically, so all the files you need should be next to each other.

It is recommended that you create a build folder and run CMake to verify that you have downloaded everything at this point, assuming your download machine has CMake installed. This involves running a “generate” batch script on Windows, or a command starting with `cmake . .` on Linux and OS X. CMake should automatically locate files that you placed in `CMake/downloads`, and use them instead of attempting to download them.

### Note on using very old git versions with pre-0.43.03 DFHack versions

If you are using git 1.8.0 or older, and cloned DFHack before commit 85a920d (around DFHack v0.43.03-alpha1), you may run into fatal git errors when updating submodules after switching branches. This is due to those versions of git being unable to handle our change from “`scripts/3rdparty/name`” submodules to a single “`scripts`” submodule. This may be fixable by renaming `.git/modules/scripts` to something else and re-running `git submodule update --init` on the branch with the single scripts submodule (and running it again when switching back to the one with multiple submodules, if necessary), but it is usually much simpler to upgrade your git version.

## Development Changelog

### Contents

- *Development Changelog*
  - *DFHack 0.43.05-beta2*
  - *DFHack 0.43.05-beta1*
  - *DFHack 0.43.05-alpha4*
  - *DFHack 0.43.05-alpha3*

## DFHack 0.43.05-beta2

### Fixes

- Fixed Buildings::updateBuildings(), along with building creation/deletion events
- Fixed `plug` output alignment for plugins with long names
- Fixed a crash that happened when a `LUA_PATH` environment variable was set
- *add-thought*: fixed number conversion
- *gui/workflow*: fixed range editing producing the wrong results for certain numbers
- *modtools/create-unit*: now uses non-English names
- *modtools/item-trigger*: fixed errors with plant growths
- *remotefortressreader*: fixed a crash when serializing the local map
- *stockflow*: fixed an issue with non-integer manager order limits
- *title-folder*: fixed compatibility issues with certain SDL libraries on macOS

### Structures

- Added some missing renderer VTable addresses on macOS
- `entity.resources.organic`: identified parchment
- `entity_sell_category`: added Parchment and CupsMugsGoblets
- `ui_advmode_menu`: added Build
- `ui_unit_view_mode`: added PrefOccupation
- `unit_skill`: identified `natural_skill_lvl` (was `unk_1c`)
- `viewscreen_jobmanagementst`: identified `max_workshops`
- `viewscreen_overallstatusst`: made `visible_pages` an enum
- `viewscreen_pricest`: identified fields
- `viewscreen_workquota_conditionst`: gave some fields unk names

### API Changes

- Allowed the Lua API to accept integer-like floats and strings when expecting an integer
- Lua: `New Painter:key_string()` method
- Lua: Added `dfhack.getArchitecture()` and `dfhack.getArchitectureName()`

### Additions/Removals:

- Added *adv-rumors* script: improves the “Bring up specific incident or rumor” menu in adventure mode
- Added *install-info* script for basic troubleshooting
- Added *tweak condition-material*: fixes a crash in the work order condition material list
- Added *tweak hotkey-clear*: adds an option to clear bindings from DF hotkeys

- *autofarm*: reverted local biome detection (from 0.43.05-alpha3)

## Other Changes

- Added a DOWNLOAD\_RUBY CMake option, to allow use of a system/external ruby library
- Added the ability to download files manually before building
- *gui/extended-status*: added a feature to queue beds
- *remotefortressreader*: added building items, DF version info
- *stonesense*: Added support for 64-bit macOS and Linux

## DFHack 0.43.05-beta1

### Fixes

- Fixed various crashes on 64-bit Windows related to DFHack screens, notably *manipulator*
- Fixed addresses of next\_id globals on 64-bit Linux (fixes an *automaterial*/box-select crash)
- *ls* now lists scripts in folders other than `hack/scripts`, when applicable
- *modtools/create-unit*: stopped permanently overwriting the creature creation menu in arena mode
- *season-palette*: fixed an issue where only part of the screen was redrawn after changing the color scheme
- *title-version*: now hidden when loading an arena

### Structures

- `file_compressorst`: fixed field sizes on x64
- `historical_entity`: fixed alignment on x64
- `ui_sidebar_menus.command_line`: fixed field sizes on x64
- `viewscreen_choose_start_sitest`: added 3 missing fields, renamed `in_embark_only_warning`
- `viewscreen_layer_arena_creaturest`: identified more fields
- `world.math`: identified
- `world.murky_pools`: identified

### Additions/Removals

- *generated-creature-renamer*: Renames generated creature IDs for use with graphics packs

## Other Changes

- *title-version*: Added a prerelease indicator

## DFHack 0.43.05-alpha4

### Fixes

- Fixed an issue with uninitialized bitfields that was causing several issues (disappearing buildings in *building-plan*'s planning mode, strange behavior in the extended *stocks* screen, and likely other problems). This issue was introduced in 0.43.05-alpha3.
- *stockflow*: Fixed an “integer expected” error

### Structures

- Located several globals on 64-bit Linux: `flows`, `timed_events`, `ui_advmode`, `ui_building_assign_type`, `ui_building_assign_is_marked`, `ui_building_assign_units`, `ui_building_assign_items`, and `ui_look_list`. This fixes *search*, *zone*, and *force*, among others.
- `ui_sidebar_menus`: Fixed some x64 alignment issues

### Additions/Removals

- Added *fix/tile-occupancy*: Clears bad occupancy flags on the selected tile. Useful for fixing blocked tiles introduced by the above buildingplan issue.
- Added a Lua `tile-material` module

### Other Changes

- *labormanager*: Add support for shell crafts
- *manipulator*: Custom professions are now sorted alphabetically more reliably

## DFHack 0.43.05-alpha3

### Fixes

- *add-thought*: fixed support for emotion names
- *autofarm*: Made surface farms detect local biome
- *devel/export-dt-ini*: fixed `squad_schedule_entry` size
- *labormanager*:
  - Now accounts for unit attributes
  - Made instrument-building jobs work (constructed instruments)
  - Fixed deconstructing constructed instruments
  - Fixed jobs in bowyer's shops
  - Fixed trap component jobs
  - Fixed multi-material construction jobs
  - Fixed deconstruction of buildings containing items
  - Fixed interference caused by “store item in vehicle” jobs

- *manipulator*: Fixed crash when selecting a profession from an empty list
- *ruby*:
  - Fixed crash on Win64 due to truncated global addresses
  - Fixed compilation on Win64
  - Use correct raw string length with encodings

## Structures

- Changed many `comment` XML attributes with version numbers to use `new` since attribute instead
- `activity_event_conflictst.sides`: named many fields
- `building_def.build_key`: fixed size on 64-bit Linux and OS X
- `historical_kills`:
  - `unk_30` -> `killed_underground_region`
  - `unk_40` -> `killed_region`
- `historical_kills.killed_undead`: removed skeletal flag
- `ui_advmode`: aligned enough so that it doesn't crash (64-bit OS X/Linux)
- `ui_advmode.show_menu`: changed from bool to enum
- `unit_personality.emotions.flags`: now a bitfield

## API Changes

- Added `DFHack::Job::removeJob()` function
- C++: Removed bitfield constructors that take an initial value. These kept bitfields from being used in unions. Set `bitfield.whole` directly instead.
- Lua: `bitfield.whole` now returns an integer, not a decimal

## Additions/Removals

- Removed source for `treefarm` plugin (wasn't built)
- Added *modtools/change-build-menu*: Edit the build mode sidebar menus
- Added *modtools/if-entity*: Run a command if the current entity matches a given ID
- Added *season-palette*: Swap color palettes with the changes of the seasons

## Other changes

- Changed minimum GCC version to 4.8 on OS X and Linux (earlier versions wouldn't have worked on Linux anyway)
- Updated TinyXML from 2.5.3 to 2.6.2



## DFHack Lua API

DFHack has extensive support for the [Lua](#) scripting language, providing access to:

1. Raw data structures used by the game.
2. Many C++ functions for high-level access to these structures, and interaction with dfhack itself.
3. Some functions exported by C++ plugins.

Lua code can be used both for writing scripts, which are treated by DFHack command line prompt almost as native C++ commands, and invoked by plugins written in C++.

This document describes native API available to Lua in detail. It does not describe all of the utility functions implemented by Lua files located in `hack/lua/*` (`library/lua/*` in the git repo).

### Contents

- *DFHack Lua API*
  - *DF data structure wrapper*
    - \* *Typed object references*
    - \* *Named types*
    - \* *Global functions*
    - \* *Recursive table assignment*
  - *DFHack API*
    - \* *Native utilities*
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    - \* *Luasocket*

- *Scripts*
  - \* *Enabling and disabling scripts*
  - \* *Save init script*

## DF data structure wrapper

- *Typed object references*
  - *Primitive references*
  - *Struct references*
  - *Container references*
  - *Bitfield references*
- *Named types*
- *Global functions*
- *Recursive table assignment*

Data structures of the game are defined in XML files located in `library/xml` (and [online](#), and automatically exported to lua code as a tree of objects and functions under the `df` global, which also broadly maps to the `df` namespace in the headers generated for C++.

**Warning:** The wrapper provides almost raw access to the memory of the game, so mistakes in manipulating objects are as likely to crash the game as equivalent plain C++ code would be.

eg. NULL pointer access is safely detected, but dangling pointers aren't.

Objects managed by the wrapper can be broadly classified into the following groups:

1. Typed object pointers (references).

References represent objects in DF memory with a known type.

In addition to fields and methods defined by the wrapped type, every reference has some built-in properties and methods.

2. Untyped pointers

Represented as `lightuserdata`.

In assignment to a pointer NULL can be represented either as `nil`, or a NULL `lightuserdata`; reading a NULL pointer field returns `nil`.

3. Named types

Objects in the `df` tree that represent identity of struct, class, enum and bitfield types. They host nested named types, static methods, builtin properties & methods, and, for enums and bitfields, the bi-directional mapping between key names and values.

4. The `global` object

`df.global` corresponds to the `df::global` namespace, and behaves as a mix between a named type and a reference, containing both nested types and fields corresponding to global symbols.

In addition to the `global` object and top-level types the `df` global also contains a few global builtin utility functions.

## Typed object references

The underlying primitive lua object is userdata with a metatable. Every structured field access produces a new userdata instance.

All typed objects have the following built-in features:

- `ref1 == ref2, tostring(ref)`

References implement equality by type & pointer value, and string conversion.

- `pairs(ref)`

Returns an iterator for the sequence of actual C++ field names and values. Fields are enumerated in memory order. Methods and lua wrapper properties are not included in the iteration.

**Warning:** a few of the data structures (like `ui_look_list`) contain unions with pointers to different types with vtables. Using `pairs` on such structs is an almost sure way to crash with an access violation.

- `ref._kind`

Returns one of: `primitive`, `struct`, `container`, or `bitfield`, as appropriate for the referenced object.

- `ref._type`

Returns the named type object or a string that represents the referenced object type.

- `ref:sizeof()`

Returns *size*, *address*

- `ref:new()`

Allocates a new instance of the same type, and copies data from the current object.

- `ref:delete()`

Destroys the object with the C++ `delete` operator. If destructor is not available, returns *false*.

**Warning:** the lua reference object remains as a dangling pointer, like a raw C++ pointer would.

- `ref:assign(object)`

Assigns data from object to ref. Object must either be another ref of a compatible type, or a lua table; in the latter case special recursive assignment rules are applied.

- `ref:_displace(index[, step])`

Returns a new reference with the pointer adjusted by `index*step`. Step defaults to the natural object size.

## Primitive references

References of the `_kind` 'primitive' are used for objects that don't fit any of the other reference types. Such references can only appear as a value of a pointer field, or as a result of calling the `_field()` method.

They behave as structs with one field value of the right type.

To make working with numeric buffers easier, they also allow numeric indices. Note that other than excluding negative values no bound checking is performed, since buffer length is not available. Index 0 is equivalent to the `value` field.

## Struct references

Struct references are used for class and struct objects.

They implement the following features:

- `ref.field, ref[field] = value`

Valid fields of the structure may be accessed by subscript.

Primitive typed fields, i.e. numbers & strings, are converted to/from matching lua values. The value of a pointer is a reference to the target, or `nil`/NULL. Complex types are represented by a reference to the field within the structure; unless recursive lua table assignment is used, such fields can only be read.

---

**Note:** In case of inheritance, *superclass* fields have precedence over the subclass, but fields shadowed in this way can still be accessed as `ref['subclasstype.field']`.

This shadowing order is necessary because vtable-based classes are automatically exposed in their exact type, and the reverse rule would make access to superclass fields unreliable.

---

- `ref._field(field)`

Returns a reference to a valid field. That is, unlike regular subscript, it returns a reference to the field within the structure even for primitive typed fields and pointers.

- `ref:vmethod(args...)`

Named virtual methods are also exposed, subject to the same shadowing rules.

- `pairs(ref)`

Enumerates all real fields (but not methods) in memory order, which is the same as declaration order.

## Container references

Containers represent vectors and arrays, possibly resizable.

A container field can associate an enum to the container reference, which allows accessing elements using string keys instead of numerical indices.

Note that two-dimensional arrays in C++ (ie pointers to pointers) are exposed to lua as one-dimensional. The best way to handle this is probably `array[x].value:_displace(y)`.

Implemented features:

- `ref._enum`

If the container has an associated enum, returns the matching named type object.

- `#ref`

Returns the *length* of the container.

- `ref[index]`

Accesses the container element, using either a 0-based numerical index, or, if an enum is associated, a valid enum key string.

Accessing an invalid index is an error, but some container types may return a default value, or auto-resize instead for convenience. Currently this relaxed mode is implemented by `df-flagarray` aka `BitArray`.

- `ref._field(index)`

Like with structs, returns a pointer to the array element, if possible. Flag and bit arrays cannot return such pointer, so it fails with an error.

- `pairs(ref), ipairs(ref)`

If the container has no associated enum, both behave identically, iterating over numerical indices in order. Otherwise, `ipairs` still uses numbers, while `pairs` tries to substitute enum keys whenever possible.

- `ref:resize(new_size)`

Resizes the container if supported, or fails with an error.

- `ref:insert(index, item)`

Inserts a new item at the specified index. To add at the end, use `#ref`, or just `'#'` as index.

- `ref:erase(index)`

Removes the element at the given valid index.

## Bitfield references

Bitfields behave like special fixed-size containers. Consider them to be something in between structs and fixed-size vectors.

The `_enum` property points to the bitfield type. Numerical indices correspond to the shift value, and if a subfield occupies multiple bits, the `ipairs` order would have a gap.

Since currently there is no API to allocate a bitfield object fully in GC-managed lua heap, consider using the lua table assignment feature outlined below in order to pass bitfield values to dfhack API functions that need them, e.g. `matinfo:matches{metal=true}`.

## Named types

Named types are exposed in the `df` tree with names identical to the C++ version, except for the `::` vs `.` difference.

All types and the global object have the following features:

- `type._kind`

Evaluates to one of `struct-type`, `class-type`, `enum-type`, `bitfield-type` or `global`.

- `type._identity`

Contains a `lightuserdata` pointing to the underlying `DFHack::type_instance` object.

Types excluding the global object also support:

- `type:sizeof()`

Returns the size of an object of the type.

- `type:new()`

Creates a new instance of an object of the type.

- `type:is_instance(object)`

Returns true if object is same or subclass type, or a reference to an object of same or subclass type. It is permissible to pass `nil`, `NULL` or non-wrapper value as object; in this case the method returns `nil`.

In addition to this, enum and bitfield types contain a bi-directional mapping between key strings and values, and also `map_first_item` and `_last_item` to the min and max values.

Struct and class types with instance-vector attribute in the xml have a `type.find(key)` function that wraps the find method provided in C++.

## Global functions

The `df` table itself contains the following functions and values:

- `NULL, df.NULL`

Contains the `NULL` `lightuserdata`.

- `df.isnull(obj)`

Evaluates to true if `obj` is `nil` or `NULL`; false otherwise.

- `df.isvalid(obj[, allow_null])`

For supported objects returns one of `type`, `voidptr`, `ref`.

If `allow_null` is true, and `obj` is `nil` or `NULL`, returns `null`.

Otherwise returns `nil`.

- `df.sizeof(obj)`

For types and refs identical to `obj:sizeof()`. For `lightuserdata` returns `nil, address`

- `df.new(obj), df.delete(obj), df.assign(obj, obj2)`

Equivalent to using the matching methods of `obj`.

- `df._displace(obj, index[, step])`

For refs equivalent to the method, but also works with `lightuserdata` (step is mandatory then).

- `df.is_instance(type, obj)`

Equivalent to the method, but also allows a reference as proxy for its type.

- `df.new(p_type[, count])`

Allocate a new instance, or an array of built-in types. The `p_type` argument is a string from the following list: `string`, `int8_t`, `uint8_t`, `int16_t`, `uint16_t`, `int32_t`, `uint32_t`, `int64_t`, `uint64_t`, `bool`, `float`, `double`. All of these except `string` can be used with the `count` argument to allocate an array.

- `df.reinterpret_cast(type, ptr)`

Converts `ptr` to a ref of specified type. The type may be anything acceptable to `df.is_instance`. `Ptr` may be `nil`, a ref, a `lightuserdata`, or a number.

Returns `nil` if `NULL`, or a ref.

## Recursive table assignment

Recursive assignment is invoked when a lua table is assigned to a C++ object or field, i.e. one of:

- `ref:assign{...}`

- `ref.field = {...}`

The general mode of operation is that all fields of the table are assigned to the fields of the target structure, roughly emulating the following code:

```
function rec_assign(ref,table)
  for key,value in pairs(table) do
    ref[key] = value
  end
end
```

Since assigning a table to a field using `=` invokes the same process, it is recursive.

There are however some variations to this process depending on the type of the field being assigned to:

1. If the table contains an `assign` field, it is applied first, using the `ref:assign(value)` method. It is never assigned as a usual field.
2. When a table is assigned to a non-NULL pointer field using the `ref.field = {...}` syntax, it is applied to the target of the pointer instead.

If the pointer is NULL, the table is checked for a new field:

- (a) If it is `nil` or `false`, assignment fails with an error.
- (b) If it is `true`, the pointer is initialized with a newly allocated object of the declared target type of the pointer.
- (c) Otherwise, `table.new` must be a named type, or an object of a type compatible with the pointer. The pointer is initialized with the result of calling `table.new:new()`.

After this auto-vivification process, assignment proceeds as if the pointer wasn't NULL.

Obviously, the new field inside the table is always skipped during the actual per-field assignment processing.

3. If the target of the assignment is a container, a separate rule set is used:
  - (a) If the table contains neither `assign` nor `resize` fields, it is interpreted as an ordinary *1-based* lua array. The container is resized to the `#`-size of the table, and elements are assigned in numeric order:

```
ref:resize(#table);
for i=1,#table do ref[i-1] = table[i] end
```

- (b) Otherwise, `resize` must be `true`, `false`, or an explicit number. If it is not `false`, the container is resized. After that the usual struct-like 'pairs' assignment is performed.

In case `resize` is `true`, the size is computed by scanning the table for the largest numeric key.

This means that in order to reassign only one element of a container using this system, it is necessary to use:

```
{ resize=false, [idx]=value }
```

Since `nil` inside a table is indistinguishable from missing key, it is necessary to use `df.NULL` as a null pointer value.

This system is intended as a way to define a nested object tree using pure lua data structures, and then materialize it in C++ memory in one go. Note that if pointer auto-vivification is used, an error in the middle of the recursive walk would not destroy any objects allocated in this way, so the user should be prepared to catch the error and do the necessary cleanup.

## DFHack API

- *Native utilities*
  - *Input & Output*
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  - *Miscellaneous*
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  - *Persistent configuration storage*
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- *C++ function wrappers*
  - *Gui module*
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  - *Filesystem module*
  - *Internal API*
- *Core interpreter context*
  - *Event type*

DFHack utility functions are placed in the `dfhack` global tree.

## Native utilities

### Input & Output

- `dfhack.print(args...)`

Output tab-separated args as standard lua print would do, but without a newline.
- `print(args...), dfhack.println(args...)`

A replacement of the standard library print function that works with DFHack output infrastructure.



- `dfhack.printerr(args...)`  
Same as `println`; intended for errors. Uses red color and logs to `stderr.log`.
- `dfhack.color([color])`  
Sets the current output color. If color is *nil* or *-1*, resets to default. Returns the previous color value.
- `dfhack.is_interactive()`  
Checks if the thread can access the interactive console and returns *true* or *false*.
- `dfhack.lineedit([prompt[, history_filename]])`  
If the thread owns the interactive console, shows a prompt and returns the entered string. Otherwise returns *nil*, *error*.  
  
Depending on the context, this function may actually yield the running coroutine and let the C++ code release the core suspend lock. Using an explicit `dfhack.with_suspend` will prevent this, forcing the function to block on input with lock held.
- `dfhack.interpreter([prompt[, history_filename[, env]])`  
Starts an interactive lua interpreter, using the specified prompt string, global environment and command-line history file.  
  
If the interactive console is not accessible, returns *nil*, *error*.

## Exception handling

- `dfhack.error(msg[, level[, verbose]])`  
Throws a dfhack exception object with location and stack trace. The verbose parameter controls whether the trace is printed by default.
- `qerror(msg[, level])`  
Calls `dfhack.error()` with `verbose` being *false*. Intended to be used for user-caused errors in scripts, where stack traces are not desirable.
- `dfhack.pcall(f[, args...])`  
Invokes `f` via `xpcall`, using an error function that attaches a stack trace to the error. The same function is used by `SafeCall` in C++, and `dfhack safecall`.
- `safecall(f[, args...], dfhack.safecall(f[, args...]))`  
Just like `pcall`, but also prints the error using `printerr` before returning. Intended as a convenience function.
- `dfhack.saferesume(coroutine[, args...])`  
Compares to `coroutine.resume` like `dfhack.safecall` vs `pcall`.
- `dfhack.exception`  
Metatable of error objects used by dfhack. The objects have the following properties:  
**err.where** The location prefix string, or *nil*.  
**err.message** The base message string.  
**err.stacktrace** The stack trace string, or *nil*.  
**err.cause** A different exception object, or *nil*.  
**err.thread** The coroutine that has thrown the exception.

**err.verbose** Boolean, or *nil*; specifies if where and stacktrace should be printed.

**tostring(err), or err:tostring([verbose])** Converts the exception to string.

- `dfhack.exception.verbose`

The default value of the `verbose` argument of `err:tostring()`.

## Miscellaneous

- `dfhack.VERSION`

DFHack version string constant.

- `dfhack.curry(func, args...), or curry(func, args...)`

Returns a closure that invokes the function with `args` combined both from the `curry` call and the closure call itself. I.e. `curry(func, a, b)(c, d)` equals `func(a, b, c, d)`.

## Locking and finalization

- `dfhack.with_suspend(f[, args...])`

Calls `f` with arguments after grabbing the DF core suspend lock. Suspending is necessary for accessing a consistent state of DF memory.

Returned values and errors are propagated through after releasing the lock. It is safe to nest suspends.

Every thread is allowed only one suspend per DF frame, so it is best to group operations together in one big critical section. A plugin can choose to run all lua code inside a C++-side suspend lock.

- `dfhack.call_with_finalizer(num_cleanup_args, always, cleanup_fn[, cleanup_args...], fn[, args...])`

Invokes `fn` with `args`, and after it returns or throws an error calls `cleanup_fn` with `cleanup_args`. Any return values from `fn` are propagated, and errors are re-thrown.

The `num_cleanup_args` integer specifies the number of `cleanup_args`, and the `always` boolean specifies if cleanup should be called in any case, or only in case of an error.

- `dfhack.with_finalize(cleanup_fn, fn[, args...])`

Calls `fn` with arguments, then finalizes with `cleanup_fn`. Implemented using `call_with_finalizer(0, true, ...)`.

- `dfhack.with_onerror(cleanup_fn, fn[, args...])`

Calls `fn` with arguments, then finalizes with `cleanup_fn` on any thrown error. Implemented using `call_with_finalizer(0, false, ...)`.

- `dfhack.with_temp_object(obj, fn[, args...])`

Calls `fn(obj, args...)`, then finalizes with `obj:delete()`.

## Persistent configuration storage

This api is intended for storing configuration options in the world itself. It probably should be restricted to data that is world-dependent.

Entries are identified by a string `key`, but it is also possible to manage multiple entries with the same key; their identity is determined by `entry_id`. Every entry has a mutable string value, and an array of 7 mutable `ints`.

- `dfhack.persistent.get(key), entry:get()`

Retrieves a persistent config record with the given string key, or refreshes an already retrieved entry. If there are multiple entries with the same key, it is undefined which one is retrieved by the first version of the call.

Returns entry, or *nil* if not found.

- `dfhack.persistent.delete(key), entry:delete()`

Removes an existing entry. Returns *true* if succeeded.

- `dfhack.persistent.get_all(key[, match_prefix])`

Retrieves all entries with the same key, or starting with key. Calling `get_all('', true)` will match all entries.

If none found, returns *nil*; otherwise returns an array of entries.

- `dfhack.persistent.save({key=str1, ...}[, new]), entry:save([new])`

Saves changes in an entry, or creates a new one. Passing *true* as *new* forces creation of a new entry even if one already exists; otherwise the existing one is simply updated. Returns *entry*, *did\_create\_new*

Since the data is hidden in data structures owned by the DF world, and automatically stored in the save game, these save and retrieval functions can just copy values in memory without doing any actual I/O. However, currently every entry has a 180+-byte dead-weight overhead.

It is also possible to associate one bit per map tile with an entry, using these two methods:

- `entry:getTilemask(block[, create])`

Retrieves the tile bitmask associated with this entry in the given map block. If *create* is *true*, an empty mask is created if none exists; otherwise the function returns *nil*, which must be assumed to be the same as an all-zero mask.

- `entry:deleteTilemask(block)`

Deletes the associated tile mask from the given map block.

Note that these masks are only saved in fortress mode, and also that deleting the persistent entry will **NOT** delete the associated masks.

## Material info lookup

A material info record has fields:

- `type, index, material`

DF material code pair, and a reference to the material object.

- `mode`

One of 'builtin', 'inorganic', 'plant', 'creature'.

- `inorganic, plant, creature`

If the material is of the matching type, contains a reference to the raw object.

- `figure`

For a specific creature material contains a ref to the historical figure.

Functions:

- `dfhack.matinfo.decode(type, index)`  
Looks up material info for the given number pair; if not found, returns *nil*.
- `....decode(matinfo), ....decode(item), ....decode(obj)`  
Uses `matinfo.type/matinfo.index`, `item` getter vmethods, or `obj.mat_type/obj.mat_index` to get the code pair.
- `dfhack.matinfo.find(token[, token...])`  
Looks up material by a token string, or a pre-split string token sequence.
- `dfhack.matinfo.getToken(...), info:getToken()`  
Applies `decode` and constructs a string token.
- `info:toString([temperature[, named]])`  
Returns the human-readable name at the given temperature.
- `info:getCraftClass()`  
Returns the classification used for craft skills.
- `info:matches(obj)`  
Checks if the material matches `job_material_category` or `job_item`. Accept `dfhack_material_category` auto-assign table.

## Random number generation

- `dfhack.random.new([seed[, perturb_count]])`  
Creates a new random number generator object. Without any arguments, the object is initialized using current time. Otherwise, the seed must be either a non-negative integer, or a list of such integers. The second argument may specify the number of additional randomization steps performed to improve the initial state.
- `rng:init([seed[, perturb_count]])`  
Re-initializes an already existing random number generator object.
- `rng:random([limit])`  
Returns a random integer. If `limit` is specified, the value is in the range `[0, limit)`; otherwise it uses the whole 32-bit unsigned integer range.
- `rng:drandom()`  
Returns a random floating-point number in the range `[0,1)`.
- `rng:drandom0()`  
Returns a random floating-point number in the range `(0,1)`.
- `rng:drandom1()`  
Returns a random floating-point number in the range `[0,1]`.
- `rng:unitrandom()`  
Returns a random floating-point number in the range `[-1,1]`.
- `rng:unitvector([size])`  
Returns multiple values that form a random vector of length 1, uniformly distributed over the corresponding sphere surface. The default size is 3.

- `fn = rng:perlin([dim]); fn(x[,y[,z]])`

Returns a closure that computes a classical Perlin noise function of dimension *dim*, initialized from this random generator. Dimension may be 1, 2 or 3 (default).

## C++ function wrappers

Thin wrappers around C++ functions, similar to the ones for virtual methods. One notable difference is that these explicit wrappers allow argument count adjustment according to the usual lua rules, so trailing false/nil arguments can be omitted.

- `dfhack.getOSType()`  
Returns the OS type string from `symbols.xml`.
- `dfhack.getDFVersion()`  
Returns the DF version string from `symbols.xml`.
- `dfhack.getDFHackVersion()`
- `dfhack.getDFHackRelease()`
- `dfhack.getCompiledDFVersion()`
- `dfhack.getGitDescription()`
- `dfhack.getGitCommit()`
- `dfhack.isRelease()`  
Return information about the DFHack build in use.

---

**Note:** `getCompiledDFVersion()` returns the DF version specified at compile time, while `getDFVersion()` returns the version and typically the OS as well. These do not necessarily match - for example, DFHack 0.34.11-r5 worked with DF 0.34.10 and 0.34.11, so the former function would always return 0.34.11 while the latter would return v0.34.10 <platform> or v0.34.11 <platform>.

---

- `dfhack.getDfPath()`  
Returns the DF directory path.
- `dfhack.getHackPath()`  
Returns the dfhack directory path, i.e. "`.../df/hack/`".
- `dfhack.getSavePath()`  
Returns the path to the current save directory, or *nil* if no save loaded.
- `dfhack.getTickCount()`  
Returns the tick count in ms, exactly as DF ui uses.
- `dfhack.isWorldLoaded()`  
Checks if the world is loaded.
- `dfhack.isMapLoaded()`  
Checks if the world and map are loaded.
- `dfhack.TranslateName(name[,in_english,only_last_name])`  
Convert a language\_name or only the last name part to string.

- `dfhack.df2utf(string)`  
Convert a string from DF's CP437 encoding to UTF-8.
- `dfhack.df2console()`  
Convert a string from DF's CP437 encoding to the correct encoding for the DFHack console.
- `dfhack.utf2df(string)`  
Convert a string from UTF-8 to DF's CP437 encoding.

**Note:** When printing CP437-encoded text to the console (for example, names returned from `TranslateName()`), use `print(dfhack.df2console(text))` to ensure proper display on all platforms.

## Gui module

- `dfhack.gui.getCurViewscreen([skip_dismissed])`  
Returns the topmost viewscreen. If `skip_dismissed` is *true*, ignores screens already marked to be removed.
- `dfhack.gui.getFocusString(viewscreen)`  
Returns a string representation of the current focus position in the ui. The string has a "screen/foo/bar/baz..." format.
- `dfhack.gui.getCurFocus([skip_dismissed])`  
Returns the focus string of the current viewscreen.
- `dfhack.gui.getViewscreenByType(type [, depth])`  
Returns the topmost viewscreen out of the top `depth` viewscreens with the specified type (e.g. `df.viewscreen_tittest`), or *nil* if none match. If `depth` is not specified or is less than 1, all viewscreens are checked.
- `dfhack.gui.getSelectedWorkshopJob([silent])`  
When a job is selected in `q` mode, returns the job, else prints error unless `silent` and returns *nil*.
- `dfhack.gui.getSelectedJob([silent])`  
Returns the job selected in a workshop or unit/jobs screen.
- `dfhack.gui.getSelectedUnit([silent])`  
Returns the unit selected via `v`, `k`, unit/jobs, or a full-screen item view of a cage or suchlike.
- `dfhack.gui.getSelectedItem([silent])`  
Returns the item selected via `v` -> inventory, `k`, `t`, or a full-screen item view of a container. Note that in the last case, the highlighted *contained item* is returned, not the container itself.
- `dfhack.gui.getSelectedBuilding([silent])`  
Returns the building selected via `q`, `t`, `k` or `i`.
- `dfhack.gui.getSelectedPlant([silent])`  
Returns the plant selected via `k`.
- `dfhack.gui.writeToGamelog(text)`  
Writes a string to `gamelog.txt` without doing an announcement.

- `dfhack.gui.makeAnnouncement (type, flags, pos, text, color[, is_bright])`

Adds an announcement with given `announcement_type`, `text`, `color`, and `brightness`. The `is_bright` boolean actually seems to invert the brightness.

The announcement is written to `gamelog.txt`. The `announcement_flags` argument provides a custom set of `announcements.txt` options, which specify if the message should actually be displayed in the announcement list, and whether to recenter or show a popup.

Returns the index of the new announcement in `df.global.world.status.reports`, or `-1`.

- `dfhack.gui.addCombatReport (unit, slot, report_index)`

Adds the report with the given index (returned by `makeAnnouncement`) to the specified group of the given unit. Returns *true* on success.

- `dfhack.gui.addCombatReportAuto (unit, flags, report_index)`

Adds the report with the given index to the appropriate group(s) of the given unit, as requested by the flags.

- `dfhack.gui.showAnnouncement (text, color[, is_bright])`

Adds a regular announcement with given `text`, `color`, and `brightness`. The `is_bright` boolean actually seems to invert the brightness.

- `dfhack.gui.showZoomAnnouncement (type, pos, text, color[, is_bright])`

Like above, but also specifies a position you can zoom to from the announcement menu.

- `dfhack.gui.showPopupAnnouncement (text, color[, is_bright])`

Pops up a titan-style modal announcement window.

- `dfhack.gui.showAutoAnnouncement (type, pos, text, color[, is_bright, unit1, unit2])`

Uses the `type` to look up options from `announcements.txt`, and calls the above operations accordingly. The units are used to call `addCombatReportAuto`.

## Job module

- `dfhack.job.cloneJobStruct (job)`

Creates a deep copy of the given job.

- `dfhack.job.printJobDetails (job)`

Prints info about the job.

- `dfhack.job.printItemDetails (jobitem, idx)`

Prints info about the job item.

- `dfhack.job.getGeneralRef (job, type)`

Searches for a `general_ref` with the given type.

- `dfhack.job.getSpecificRef (job, type)`

Searches for a `specific_ref` with the given type.

- `dfhack.job.getHolder (job)`

Returns the building holding the job.

- `dfhack.job.getWorker(job)`  
Returns the unit performing the job.
- `dfhack.job.setJobCooldown(building, worker, timeout)`  
Prevent the worker from taking jobs at the specified workshop for the specified time. This doesn't decrease the timeout in any circumstances.
- `dfhack.job.removeWorker(job, timeout)`  
Removes the worker from the specified workshop job, and sets the cooldown. Returns *true* on success.
- `dfhack.job.checkBuildingsNow()`  
Instructs the game to check buildings for jobs next frame and assign workers.
- `dfhack.job.checkDesignationsNow()`  
Instructs the game to check designations for jobs next frame and assign workers.
- `dfhack.job.is_equal(job1, job2)`  
Compares important fields in the job and nested item structures.
- `dfhack.job.is_item_equal(job_item1, job_item2)`  
Compares important fields in the job item structures.
- `dfhack.job.linkIntoWorld(job, new_id)`  
Adds job into `df.global.job_list`, and if `new_id` is true, then also sets its id and increases `df.global.job_next_id`.
- `dfhack.job.listNewlyCreated(first_id)`  
Returns the current value of `df.global.job_next_id`, and if there are any jobs with `first_id <= id < job_next_id`, a lua list containing them.
- `dfhack.job.isSuitableItem(job_item, item_type, item_subtype)`  
Does basic sanity checks to verify if the suggested item type matches the flags in the job item.
- `dfhack.job.isSuitableMaterial(job_item, mat_type, mat_index)`  
Likewise, if replacing material.
- `dfhack.job.getName(job)`  
Returns the job's description, as seen in the Units and Jobs screens.

## Units module

- `dfhack.units.getPosition(unit)`  
Returns true *x,y,z* of the unit, or *nil* if invalid; may be not equal to `unit.pos` if caged.
- `dfhack.units.getGeneralRef(unit, type)`  
Searches for a `general_ref` with the given type.
- `dfhack.units.getSpecificRef(unit, type)`  
Searches for a `specific_ref` with the given type.
- `dfhack.units.getContainer(unit)`  
Returns the container (cage) item or *nil*.



- `dfhack.units.setNickname(unit, nick)`  
Sets the unit's nickname properly.
- `dfhack.units.getVisibleName(unit)`  
Returns the `language_name` object visible in game, accounting for false identities.
- `dfhack.units.getIdentity(unit)`  
Returns the false identity of the unit if it has one, or *nil*.
- `dfhack.units.getNemesis(unit)`  
Returns the nemesis record of the unit if it has one, or *nil*.
- `dfhack.units.isHidingCurse(unit)`  
Checks if the unit hides improved attributes from its curse.
- `dfhack.units.getPhysicalAttrValue(unit, attr_type)`
- `dfhack.units.getMentalAttrValue(unit, attr_type)`  
Computes the effective attribute value, including curse effect.
- `dfhack.units.isCrazed(unit)`
- `dfhack.units.isOpposedToLife(unit)`
- `dfhack.units.hasExtravision(unit)`
- `dfhack.units.isBloodsucker(unit)`  
Simple checks of caste attributes that can be modified by curses.
- `dfhack.units.getMiscTrait(unit, type[, create])`  
Finds (or creates if requested) a misc trait object with the given id.
- `dfhack.units.isDead(unit)`  
The unit is completely dead and passive, or a ghost.
- `dfhack.units.isAlive(unit)`  
The unit isn't dead or undead.
- `dfhack.units.isSane(unit)`  
The unit is capable of rational action, i.e. not dead, insane, zombie, or active werewolf.
- `dfhack.units.isDwarf(unit)`  
The unit is of the correct race of the fortress.
- `dfhack.units.isCitizen(unit)`  
The unit is an alive sane citizen of the fortress; wraps the same checks the game uses to decide game-over by extinction.
- `dfhack.units.getAge(unit[, true_age])`  
Returns the age of the unit in years as a floating-point value. If `true_age` is true, ignores false identities.
- `dfhack.units.getNominalSkill(unit, skill[, use_rust])`  
Retrieves the nominal skill level for the given unit. If `use_rust` is *true*, subtracts the rust penalty.

- `dfhack.units.getEffectiveSkill(unit, skill)`  
Computes the effective rating for the given skill, taking into account exhaustion, pain etc.
- `dfhack.units.getExperience(unit, skill[, total])`  
Returns the experience value for the given skill. If `total` is true, adds experience implied by the current rating.
- `dfhack.units.computeMovementSpeed(unit)`  
Computes number of frames \* 100 it takes the unit to move in its current state of mind and body.
- `dfhack.units.computeSlowdownFactor(unit)`  
Meandering and floundering in liquid introduces additional slowdown. It is random, but the function computes and returns the expected mean factor as a float.
- `dfhack.units.getNoblePositions(unit)`  
Returns a list of tables describing noble position assignments, or *nil*. Every table has fields `entity`, `assignment` and `position`.
- `dfhack.units.getProfessionName(unit[, ignore_noble, plural])`  
Retrieves the profession name using custom profession, noble assignments or raws. The `ignore_noble` boolean disables the use of noble positions.
- `dfhack.units.getCasteProfessionName(race, caste, prof_id[, plural])`  
Retrieves the profession name for the given race/caste using raws.
- `dfhack.units.getProfessionColor(unit[, ignore_noble])`  
Retrieves the color associated with the profession, using noble assignments or raws. The `ignore_noble` boolean disables the use of noble positions.
- `dfhack.units.getCasteProfessionColor(race, caste, prof_id)`  
Retrieves the profession color for the given race/caste using raws.

## Items module

- `dfhack.items.getPosition(item)`  
Returns true *x,y,z* of the item, or *nil* if invalid; may be not equal to `item.pos` if in inventory.
- `dfhack.items.getDescription(item, type[, decorate])`  
Returns the string description of the item, as produced by the `getItemDescription` method. If `decorate` is true, also adds markings for quality and improvements.
- `dfhack.items.getGeneralRef(item, type)`  
Searches for a `general_ref` with the given type.
- `dfhack.items.getSpecificRef(item, type)`  
Searches for a `specific_ref` with the given type.
- `dfhack.items.getOwner(item)`  
Returns the owner unit or *nil*.
- `dfhack.items.setOwner(item, unit)`  
Replaces the owner of the item. If `unit` is *nil*, removes ownership. Returns *false* in case of error.

- `dfhack.items.getContainer(item)`  
Returns the container item or *nil*.
- `dfhack.items.getContainedItems(item)`  
Returns a list of items contained in this one.
- `dfhack.items.getHolderBuilding(item)`  
Returns the holder building or *nil*.
- `dfhack.items.getHolderUnit(item)`  
Returns the holder unit or *nil*.
- `dfhack.items.moveToGround(item, pos)`  
Move the item to the ground at position. Returns *false* if impossible.
- `dfhack.items.moveToContainer(item, container)`  
Move the item to the container. Returns *false* if impossible.
- `dfhack.items.moveToBuilding(item, building[, use_mode[, force_in_building]])`  
Move the item to the building. Returns *false* if impossible.  
  
`use_mode` defaults to 0. If set to 2, the item will be treated as part of the building.  
  
If `force_in_building` is true, the item will be considered to be stored by the building (used for items temporarily used in traps in vanilla DF)
- `dfhack.items.moveToInventory(item, unit, use_mode, body_part)`  
Move the item to the unit inventory. Returns *false* if impossible.
- `dfhack.items.remove(item[, no_uncat])`  
Removes the item, and marks it for garbage collection unless `no_uncat` is true.
- `dfhack.items.makeProjectile(item)`  
Turns the item into a projectile, and returns the new object, or *nil* if impossible.
- `dfhack.items.isCasteMaterial(item_type)`  
Returns *true* if this item type uses a creature/caste pair as its material.
- `dfhack.items.getSubtypeCount(item_type)`  
Returns the number of raw-defined subtypes of the given item type, or *-1* if not applicable.
- `dfhack.items.getSubtypeDef(item_type, subtype)`  
Returns the raw definition for the given item type and subtype, or *nil* if invalid.
- `dfhack.items.getItemBaseValue(item_type, subtype, material, mat_index)`  
Calculates the base value for an item of the specified type and material.
- `dfhack.items.getValue(item)`  
Calculates the Basic Value of an item, as seen in the View Item screen.

## Maps module

- `dfhack.maps.getSize()`  
Returns map size in blocks: *x*, *y*, *z*
- `dfhack.maps.getTileSize()`  
Returns map size in tiles: *x*, *y*, *z*
- `dfhack.maps.getBlock(x, y, z)`  
Returns a map block object for given *x,y,z* in local block coordinates.
- `dfhack.maps.isValidTilePos(coords)`, or `isValidTilePos(x, y, z)`  
Checks if the given *df::coord* or *x,y,z* in local tile coordinates are valid.
- `dfhack.maps.getTileBlock(coords)`, or `getTileBlock(x, y, z)`  
Returns a map block object for given *df::coord* or *x,y,z* in local tile coordinates.
- `dfhack.maps.ensureTileBlock(coords)`, or `ensureTileBlock(x, y, z)`  
Like `getTileBlock`, but if the block is not allocated, try creating it.
- `dfhack.maps.getTileType(coords)`, or `getTileType(x, y, z)`  
Returns the tile type at the given coordinates, or *nil* if invalid.
- `dfhack.maps.getTileFlags(coords)`, or `getTileFlags(x, y, z)`  
Returns designation and occupancy references for the given coordinates, or *nil*, *nil* if invalid.
- `dfhack.maps.getRegionBiome(region_coord2d)`, or `getRegionBiome(x, y)`  
Returns the biome info struct for the given global map region.
- `dfhack.maps.enableBlockUpdates(block[, flow, temperature])`  
Enables updates for liquid flow or temperature, unless already active.
- `dfhack.maps.spawnFlow(pos, type, mat_type, mat_index, dimension)`  
Spawns a new flow (i.e. steam/mist/dust/etc) at the given pos, and with the given parameters. Returns it, or *nil* if unsuccessful.
- `dfhack.maps.getGlobalInitFeature(index)`  
Returns the global feature object with the given index.
- `dfhack.maps.getLocalInitFeature(region_coord2d, index)`  
Returns the local feature object with the given region coords and index.
- `dfhack.maps.getTileBiomeRgn(coords)`, or `getTileBiomeRgn(x, y, z)`  
Returns *x*, *y* for use with `getRegionBiome`.
- `dfhack.maps.canWalkBetween(pos1, pos2)`  
Checks if a dwarf may be able to walk between the two tiles, using a pathfinding cache maintained by the game.

---

**Note:** This cache is only updated when the game is unpaused, and thus can get out of date if doors are forbidden or unforbidden, or tools like *liquids* or *tiletypes* are used. It also cannot possibly take into account anything that depends on the actual units, like burrows, or the presence of invaders.

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- `dfhack.maps.hasTileAssignment(tilemask)`  
Checks if the `tile_bitmask` object is not *nil* and contains any set bits; returns *true* or *false*.
- `dfhack.maps.getTileAssignment(tilemask, x, y)`  
Checks if the `tile_bitmask` object is not *nil* and has the relevant bit set; returns *true* or *false*.
- `dfhack.maps.setTileAssignment(tilemask, x, y, enable)`  
Sets the relevant bit in the `tile_bitmask` object to the *enable* argument.
- `dfhack.maps.resetTileAssignment(tilemask[, enable])`  
Sets all bits in the mask to the *enable* argument.

## Burrows module

- `dfhack.burrows.findByName(name)`  
Returns the burrow pointer or *nil*.
- `dfhack.burrows.clearUnits(burrow)`  
Removes all units from the burrow.
- `dfhack.burrows.isAssignedUnit(burrow, unit)`  
Checks if the unit is in the burrow.
- `dfhack.burrows.setAssignedUnit(burrow, unit, enable)`  
Adds or removes the unit from the burrow.
- `dfhack.burrows.clearTiles(burrow)`  
Removes all tiles from the burrow.
- `dfhack.burrows.listBlocks(burrow)`  
Returns a table of map block pointers.
- `dfhack.burrows.isAssignedTile(burrow, tile_coord)`  
Checks if the tile is in burrow.
- `dfhack.burrows.setAssignedTile(burrow, tile_coord, enable)`  
Adds or removes the tile from the burrow. Returns *false* if invalid coords.
- `dfhack.burrows.isAssignedBlockTile(burrow, block, x, y)`  
Checks if the tile within the block is in burrow.
- `dfhack.burrows.setAssignedBlockTile(burrow, block, x, y, enable)`  
Adds or removes the tile from the burrow. Returns *false* if invalid coords.

## Buildings module

### General

- `dfhack.buildings.getGeneralRef(building, type)`  
Searches for a `general_ref` with the given type.

- `dfhack.buildings.getSpecificRef(building, type)`  
Searches for a `specific_ref` with the given `type`.
- `dfhack.buildings.setOwner(item, unit)`  
Replaces the owner of the building. If `unit` is *nil*, removes ownership. Returns *false* in case of error.
- `dfhack.buildings.getSize(building)`  
Returns *width*, *height*, *centerx*, *centery*.
- `dfhack.buildings.findAtTile(pos)`, or `findAtTile(x, y, z)`  
Scans the buildings for the one located at the given tile. Does not work on civzones. Warning: linear scan if the map tile indicates there are buildings at it.
- `dfhack.buildings.findCivzonesAt(pos)`, or `findCivzonesAt(x, y, z)`  
Scans civzones, and returns a lua sequence of those that touch the given tile, or *nil* if none.
- `dfhack.buildings.getCorrectSize(width, height, type, subtype, custom, direction)`  
Computes correct dimensions for the specified building type and orientation, using width and height for flexible dimensions. Returns *is\_flexible*, *width*, *height*, *center\_x*, *center\_y*.
- `dfhack.buildings.checkFreeTiles(pos, size[, extents, change_extents, allow_occupied])`  
Checks if the rectangle defined by `pos` and `size`, and possibly `extents`, can be used for placing a building. If `change_extents` is true, bad tiles are removed from `extents`. If `allow_occupied`, the occupancy test is skipped.
- `dfhack.buildings.countExtentTiles(extents, defval)`  
Returns the number of tiles included by `extents`, or `defval`.
- `dfhack.buildings.containsTile(building, x, y[, room])`  
Checks if the building contains the specified tile, either directly, or as room.
- `dfhack.buildings.hasSupport(pos, size)`  
Checks if a bridge constructed at specified position would have support from terrain, and thus won't collapse if retracted.
- `dfhack.buildings.getStockpileContents(stockpile)`  
Returns a list of items stored on the given stockpile. Ignores empty bins, barrels, and wheelbarrows assigned as storage and transport for that stockpile.

## Low-level

Low-level building creation functions:

- `dfhack.buildings.allocInstance(pos, type, subtype, custom)`  
Creates a new building instance of given type, subtype and custom type, at specified position. Returns the object, or *nil* in case of an error.
- `dfhack.buildings.setSize(building, width, height, direction)`  
Configures an object returned by `allocInstance`, using specified parameters wherever appropriate. If the building has fixed size along any dimension, the corresponding input parameter will be ignored. Returns *false*

if the building cannot be placed, or *true*, *width*, *height*, *rect\_area*, *true\_area*. Returned width and height are the final values used by the building; *true\_area* is less than *rect\_area* if any tiles were removed from designation.

- `dfhack.buildings.constructAbstract (building)`

Links a fully configured object created by `allocInstance` into the world. The object must be an abstract building, i.e. a stockpile or civzone. Returns *true*, or *false* if impossible.

- `dfhack.buildings.constructWithItems (building, items)`

Links a fully configured object created by `allocInstance` into the world for construction, using a list of specific items as material. Returns *true*, or *false* if impossible.

- `dfhack.buildings.constructWithFilters (building, job_items)`

Links a fully configured object created by `allocInstance` into the world for construction, using a list of `job_item` filters as inputs. Returns *true*, or *false* if impossible. Filter objects are claimed and possibly destroyed in any case. Use a negative `quantity` field value to auto-compute the amount from the size of the building.

- `dfhack.buildings.deconstruct (building)`

Destroys the building, or queues a deconstruction job. Returns *true* if the building was destroyed and deallocated immediately.

## High-level

More high-level functions are implemented in lua and can be loaded by `require('dfhack.buildings')`. See `hack/lua/dfhack/buildings.lua`.

Among them are:

- `dfhack.buildings.getFiltersByType (argtable, type, subtype, custom)`

Returns a sequence of lua structures, describing input item filters suitable for the specified building type, or *nil* if unknown or invalid. The returned sequence is suitable for use as the `job_items` argument of `constructWithFilters`. Uses tables defined in `buildings.lua`.

`Argtable` members `material` (the default name), `bucket`, `barrel`, `chain`, `mechanism`, `screw`, `pipe`, `anvil`, `weapon` are used to augment the basic attributes with more detailed information if the building has input items with the matching name (see the tables for naming details). Note that it is impossible to *override* any properties this way, only supply those that are not mentioned otherwise; one exception is that `flags2.non_economic` is automatically cleared if an explicit material is specified.

- `dfhack.buildings.constructBuilding {...}`

Creates a building in one call, using options contained in the argument table. Returns the building, or *nil*, *error*.

---

**Note:** Despite the name, unless the building is abstract, the function creates it in an ‘unconstructed’ stage, with a queued in-game job that will actually construct it. I.e. the function replicates programmatically what can be done through the construct building menu in the game ui, except that it does less environment constraint checking.

---

The following options can be used:

- `pos = coordinates`, or `x = ...`, `y = ...`, `z = ...`

Mandatory. Specifies the left upper corner of the building.

- `type = df.building_type.FOO`, `subtype = ...`, `custom = ...`

Mandatory. Specifies the type of the building. Obviously, subtype and custom are only expected if the type requires them.

- `fields = { ... }`

Initializes fields of the building object after creation with `df.assign`.

- `width = ..., height = ..., direction = ...`

Sets size and orientation of the building. If it is fixed-size, specified dimensions are ignored.

- `full_rectangle = true`

For buildings like stockpiles or farm plots that can normally accomodate individual tile exclusion, forces an error if any tiles within the specified width\*height are obstructed.

- `items = { item, item ... }, or filters = { {...}, {...}}...`

Specifies explicit items or item filters to use in construction. It is the job of the user to ensure they are correct for the building type.

- `abstract = true`

Specifies that the building is abstract and does not require construction. Required for stockpiles and civ-zones; an error otherwise.

- `material = {...}, mechanism = {...}, ...`

If none of `items`, `filter`, or `abstract` is used, the function uses `getFiltersByType` to compute the input item filters, and passes the argument table through. If no filters can be determined this way, `constructBuilding` throws an error.

## Constructions module

- `dfhack.constructions.designateNew(pos, type, item_type, mat_index)`

Designates a new construction at given position. If there already is a planned but not completed construction there, changes its type. Returns *true*, or *false* if obstructed. Note that designated constructions are technically buildings.

- `dfhack.constructions.designateRemove(pos)`, or `designateRemove(x, y, z)`

If there is a construction or a planned construction at the specified coordinates, designates it for removal, or instantly cancels the planned one. Returns *true*, *was\_only\_planned* if removed; or *false* if none found.

## Screen API

The screen module implements support for drawing to the tiled screen of the game. Note that drawing only has any effect when done from callbacks, so it can only be feasibly used in the core context.

Basic painting functions:

- `dfhack.screen.getWindowSize()`

Returns *width*, *height* of the screen.

- `dfhack.screen.getMousePos()`

Returns *x*, *y* of the tile the mouse is over.

- `dfhack.screen.inGraphicsMode()`

Checks if [GRAPHICS:YES] was specified in init.



- `dfhack.screen.paintTile(pen, x, y[, char, tile])`  
Paints a tile using given parameters. See below for a description of `pen`.  
Returns *false* if coordinates out of bounds, or other error.
- `dfhack.screen.readTile(x, y)`  
Retrieves the contents of the specified tile from the screen buffers. Returns a `pen` object, or *nil* if invalid or `TrueType`.
- `dfhack.screen.paintString(pen, x, y, text)`  
Paints the string starting at `x,y`. Uses the string characters in sequence to override the `ch` field of `pen`.  
Returns *true* if painting at least one character succeeded.
- `dfhack.screen.fillRect(pen, x1, y1, x2, y2)`  
Fills the rectangle specified by the coordinates with the given `pen`. Returns *true* if painting at least one character succeeded.
- `dfhack.screen.findGraphicsTile(pagename, x, y)`  
Finds a tile from a graphics set (i.e. the raws used for creatures), if in graphics mode and loaded.  
Returns: *tile*, *tile\_grayscale*, or *nil* if not found. The values can then be used for the *tile* field of *pen* structures.
- `dfhack.screen.clear()`  
Fills the screen with blank background.
- `dfhack.screen.invalidate()`  
Requests repaint of the screen by setting a flag. Unlike other functions in this section, this may be used at any time.
- `dfhack.screen.getKeyDisplay(key)`  
Returns the string that should be used to represent the given logical keybinding on the screen in texts like “press Key to ...”.
- `dfhack.screen.keyToChar(key)`  
Returns the integer character code of the string input character represented by the given logical keybinding, or *nil* if not a string input key.
- `dfhack.screen.charToKey(charcode)`  
Returns the keybinding representing the given string input character, or *nil* if impossible.

The “`pen`” argument used by functions above may be represented by a table with the following possible fields:

**ch** Provides the ordinary tile character, as either a 1-character string or a number. Can be overridden with the `char` function parameter.

**fg** Foreground color for the ordinary tile. Defaults to `COLOR_GREY (7)`.

**bg** Background color for the ordinary tile. Defaults to `COLOR_BLACK (0)`.

**bold** Bright/bold text flag. If *nil*, computed based on `(fg & 8)`; `fg` is masked to 3 bits. Otherwise should be *true/false*.

**tile** Graphical tile id. Ignored unless `[GRAPHICS:YES]` was in `init.txt`.

**tile\_color = true** Specifies that the tile should be shaded with *fg/bg*.

**tile\_fg, tile\_bg** If specified, overrides *tile\_color* and supplies shading colors directly.

Alternatively, it may be a pre-parsed native object with the following API:

- `dfhack.pen.make(base[, pen_or_fg, bg, bold])`

Creates a new pre-parsed pen by combining its arguments according to the following rules:

1. The `base` argument may be a pen object, a pen table as specified above, or a single color value. In the single value case, it is split into `fg` and `bold` properties, and others are initialized to 0. This argument will be converted to a pre-parsed object and returned if there are no other arguments.
2. If the `pen_or_fg` argument is specified as a table or object, it completely replaces the `base`, and is returned instead of it.
3. Otherwise, the non-nil subset of the optional arguments is used to update the `fg`, `bg` and `bold` properties of the `base`. If the `bold` flag is *nil*, but `pen_or_fg` is a number, `bold` is deduced from it like in the simple base case.

This function always returns a new pre-parsed pen, or *nil*.

- `dfhack.pen.parse(base[, pen_or_fg, bg, bold])`

Exactly like the above function, but returns `base` or `pen_or_fg` directly if they are already a pre-parsed native object.

- `pen.property, pen.property = value, pairs(pen)`

Pre-parsed pens support reading and setting their properties, but don't behave exactly like a simple table would; for instance, assigning to `pen.tile_color` also resets `pen.tile_fg` and `pen.tile_bg` to *nil*.

In order to actually be able to paint to the screen, it is necessary to create and register a viewscreen (basically a modal dialog) with the game.

**Warning:** As a matter of policy, in order to avoid user confusion, all interface screens added by dfhack should bear the “DFHack” signature.

Screens are managed with the following functions:

- `dfhack.screen.show(screen[, below])`

Displays the given screen, possibly placing it below a different one. The screen must not be already shown. Returns *true* if success.

- `dfhack.screen.dismiss(screen[, to_first])`

Marks the screen to be removed when the game enters its event loop. If `to_first` is *true*, all screens up to the first one will be deleted.

- `dfhack.screen.isDismissed(screen)`

Checks if the screen is already marked for removal.

Apart from a native viewscreen object, these functions accept a table as a screen. In this case, `show` creates a new native viewscreen that delegates all processing to methods stored in that table.

---

**Note:** Lua-implemented screens are only supported in the core context.

---

Supported callbacks and fields are:

- `screen._native`

Initialized by `show` with a reference to the backing viewscreen object, and removed again when the object is deleted.

- `function screen:onShow()`  
Called by `dfhack.screen.show` if successful.
- `function screen:onDismiss()`  
Called by `dfhack.screen.dismiss` if successful.
- `function screen:onDestroy()`  
Called from the destructor when the viewscreen is deleted.
- `function screen:onResize(w, h)`  
Called before `onRender` or `onIdle` when the window size has changed.
- `function screen:onRender()`  
Called when the viewscreen should paint itself. This is the only context where the above painting functions work correctly.  
  
If omitted, the screen is cleared; otherwise it should do that itself. In order to make a see-through dialog, call `self._native.parent:render()`.
- `function screen:onIdle()`  
Called every frame when the screen is on top of the stack.
- `function screen:onHelp()`  
Called when the help keybinding is activated (usually '?').
- `function screen:onInput(keys)`  
Called when keyboard or mouse events are available. If any keys are pressed, the `keys` argument is a table mapping them to *true*. Note that this refers to logical keybindings computed from real keys via options; if multiple interpretations exist, the table will contain multiple keys.  
  
The table also may contain special keys:  
  - `_STRING` Maps to an integer in range 0-255. Duplicates a separate “`STRING_A???`” code for convenience.
  - `_MOUSE_L`, `_MOUSE_R` If the left or right mouse button is being pressed.
  - `_MOUSE_L_DOWN`, `_MOUSE_R_DOWN` If the left or right mouse button was just pressed.  
If this method is omitted, the screen is dismissed on receipt of the `LEAVESCREEN` key.
- `function screen:onGetSelectedUnit()`
- `function screen:onGetSelectedItem()`
- `function screen:onGetSelectedJob()`
- `function screen:onGetSelectedBuilding()`  
  
Implement these to provide a return value for the matching `dfhack.gui.getSelected...` function.

## PenArray class

Screens that require significant computation in their `onRender()` method can use a `dfhack.penarray` instance to cache their output.

- `dfhack.penarray.new(w, h)`  
  
Creates a new `penarray` instance with an internal buffer of `w * h` tiles. These dimensions currently cannot be changed after a `penarray` is instantiated.

- `penarray:clear()`  
Clears the internal buffer, similar to `dfhack.screen.clear()`.
- `penarray:get_dims()`  
Returns the x and y dimensions of the internal buffer.
- `penarray:get_tile(x, y)`  
Returns a pen corresponding to the tile at (x, y) in the internal buffer. Note that indices are 0-based.
- `penarray:set_tile(x, y, pen)`  
Sets the tile at (x, y) in the internal buffer to the pen given.
- `penarray:draw(x, y, w, h, bufferx, buffery)`  
Draws the contents of the internal buffer, beginning at (bufferx, buffery) and spanning w columns and h rows, to the screen starting at (x, y). Any invalid screen and buffer coordinates are skipped.  
bufferx and buffery default to 0.

## Filesystem module

Most of these functions return `true` on success and `false` on failure, unless otherwise noted.

- `dfhack.filesystem.exists(path)`  
Returns `true` if path exists.
- `dfhack.filesystem.isfile(path)`  
Returns `true` if path exists and is a file.
- `dfhack.filesystem.isdir(path)`  
Returns `true` if path exists and is a directory.
- `dfhack.filesystem.getcwd()`  
Returns the current working directory. To retrieve the DF path, use `dfhack.getDFPath()` instead.
- `dfhack.filesystem.chdir(path)`  
Changes the current directory to path. Use with caution.
- `dfhack.filesystem.mkdir(path)`  
Creates a new directory. Returns `false` if unsuccessful, including if path already exists.
- `dfhack.filesystem.rmdir(path)`  
Removes a directory. Only works if the directory is already empty.
- `dfhack.filesystem.mtime(path)`  
Returns the modification time (in seconds) of the file or directory specified by path, or -1 if path does not exist. This depends on the system clock and should only be used locally.
- `dfhack.filesystem.atime(path)`
- `dfhack.filesystem.ctime(path)`  
Return values vary across operating systems - return the `st_atime` and `st_ctime` fields of a C++ stat struct, respectively.

- `dfhack.filesystem.listdir(path)`

Lists files/directories in a directory. Returns {} if path does not exist.

- `dfhack.filesystem.listdir_recursive(path [, depth = 10])`

Lists all files/directories in a directory and its subdirectories. All directories are listed before their contents. Returns a table with subtables of the format:

```
{path: 'path to file', isdir: true|false}
```

Note that `listdir()` returns only the base name of each directory entry, while `listdir_recursive()` returns the initial path and all components following it for each entry.

## Internal API

These functions are intended for the use by dfhack developers, and are only documented here for completeness:

- `dfhack.internal.scripts`

The table used by `dfhack.run_script()` to give every script its own global environment, persistent between calls to the script.

- `dfhack.internal.getPE()`

Returns the PE timestamp of the DF executable (only on Windows)

- `dfhack.internal.getMd5()`

Returns the MD5 of the DF executable (only on OS X and Linux)

- `dfhack.internal.getAddress(name)`

Returns the global address name, or *nil*.

- `dfhack.internal.setAddress(name, value)`

Sets the global address name. Returns the value of `getAddress` before the change.

- `dfhack.internal.getVTable(name)`

Returns the pre-extracted vtable address name, or *nil*.

- `dfhack.internal.getImageBase()`

Returns the mmap base of the executable.

- `dfhack.internal.getRebaseDelta()`

Returns the ASLR rebase offset of the DF executable.

- `dfhack.internal.adjustOffset(offset[, to_file])`

Returns the re-aligned offset, or *nil* if invalid. If `to_file` is true, the offset is adjusted from memory to file. This function returns the original value everywhere except windows.

- `dfhack.internal.getMemRanges()`

Returns a sequence of tables describing virtual memory ranges of the process.

- `dfhack.internal.patchMemory(dest, src, count)`

Like `memmove` below, but works even if `dest` is read-only memory, e.g. code. If destination overlaps a completely invalid memory region, or another error occurs, returns false.

- `dfhack.internal.patchBytes(write_table[, verify_table])`

The first argument must be a lua table, which is interpreted as a mapping from memory addresses to byte values that should be stored there. The second argument may be a similar table of values that need to be checked before writing anything.

The function takes care to either apply all of `write_table`, or none of it. An empty `write_table` with a nonempty `verify_table` can be used to reasonably safely check if the memory contains certain values.

Returns *true* if successful, or *nil, error\_msg, address* if not.

- `dfhack.internal.memmove(dest, src, count)`

Wraps the standard `memmove` function. Accepts both numbers and refs as pointers.

- `dfhack.internal.memcmp(ptr1, ptr2, count)`

Wraps the standard `memcmp` function.

- `dfhack.internal.memscan(haystack, count, step, needle, nsize)`

Searches for `needle` of `nsize` bytes in `haystack`, using `count` steps of `step` bytes. Returns: *step\_idx, sum\_idx, found\_ptr*, or *nil* if not found.

- `dfhack.internal.diffscan(old_data, new_data, start_idx, end_idx, eltsize[, oldval, newval, delta])`

Searches for differences between buffers at `ptr1` and `ptr2`, as integers of size `eltsize`. The `oldval`, `newval` or `delta` arguments may be used to specify additional constraints. Returns: *found\_index*, or *nil* if end reached.

- `dfhack.internal.getDir(path)`

Lists files/directories in a directory. Returns: *file\_names* or empty table if not found. Identical to `dfhack.filesystem.listdir(path)`.

- `dfhack.internal.strerror(errno)`

Wraps `strerror()` - returns a string describing a platform-specific error code

- `dfhack.internal.addScriptPath(path, search_before)`

Adds `path` to the list of paths searched for scripts (both in Lua and Ruby). If `search_before` is passed and *true*, the path will be searched before the default paths (e.g. `raw/scripts`, `hack/scripts`); otherwise, it will be searched after.

Returns *true* if successful or *false* otherwise (e.g. if the path does not exist or has already been registered).

- `dfhack.internal.removeScriptPath(path)`

Removes `path` from the script search paths and returns *true* if successful.

- `dfhack.internal.getScriptPaths()`

Returns the list of script paths in the order they are searched, including defaults. (This can change if a world is loaded.)

- `dfhack.internal.findScript(name)`

Searches script paths for the script `name` and returns the path of the first file found, or *nil* on failure.

---

**Note:** This requires an extension to be specified (`.lua` or `.rb`) - use `dfhack.findScript()` to include the `.lua` extension automatically.

---

## Core interpreter context

While plugins can create any number of interpreter instances, there is one special context managed by dfhack core. It is the only context that can receive events from DF and plugins.

Core context specific functions:

- `dfhack.is_core_context`  
Boolean value; *true* in the core context.
- `dfhack.timeout(time, mode, callback)`  
Arranges for the callback to be called once the specified period of time passes. The `mode` argument specifies the unit of time used, and may be one of 'frames' (raw FPS), 'ticks' (unpaused FPS), 'days', 'months', 'years' (in-game time). All timers other than 'frames' are cancelled when the world is unloaded, and cannot be queued until it is loaded again. Returns the timer id, or *nil* if unsuccessful due to world being unloaded.
- `dfhack.timeout_active(id[, new_callback])`  
Returns the active callback with the given id, or *nil* if inactive or nil id. If called with 2 arguments, replaces the current callback with the given value, if still active. Using `timeout_active(id, nil)` cancels the timer.
- `dfhack.onStateChange.foo = function(code)`  
Event. Receives the same codes as `plugin_onstatechange` in C++.

## Event type

An event is a native object transparently wrapping a lua table, and implementing a `__call` metamethod. When it is invoked, it loops through the table with `next` and calls all contained values. This is intended as an extensible way to add listeners.

This type itself is available in any context, but only the core context has the actual events defined by C++ code.

Features:

- `dfhack.event.new()`  
Creates a new instance of an event.
- `event[key] = function`  
Sets the function as one of the listeners. Assign *nil* to remove it.

---

**Note:** The `df.NULL` key is reserved for the use by the C++ owner of the event; it is an error to try setting it.

---

- `#event`  
Returns the number of non-nil listeners.
- `pairs(event)`  
Iterates over all listeners in the table.
- `event(args...)`  
Invokes all listeners contained in the event in an arbitrary order using `dfhack.safeCALL`.

## Lua Modules

- *Global environment*
- *utils*
- *dumper*
- *class*

DFHack sets up the lua interpreter so that the built-in `require` function can be used to load shared lua code from `hack/lua/`. The `dfhack` namespace reference itself may be obtained via `require('dfhack')`, although it is initially created as a global by C++ bootstrap code.

The following module management functions are provided:

- `mkmodule(name)`

Creates an environment table for the module. Intended to be used as:

```
local _ENV = mkmodule('foo')
...
return _ENV
```

If called the second time, returns the same table; thus providing reload support.

- `reload(name)`

Reloads a previously `require`-d module “*name*” from the file. Intended as a help for module development.

- `dfhack.BASE_G`

This variable contains the root global environment table, which is used as a base for all module and script environments. Its contents should be kept limited to the standard Lua library and API described in this document.

## Global environment

A number of variables and functions are provided in the base global environment by the mandatory init file `dfhack.lua`:

- Color constants

These are applicable both for `dfhack.color()` and color fields in DF functions or structures:

```
COLOR_RESET, COLOR_BLACK, COLOR_BLUE, COLOR_GREEN, COLOR_CYAN,
COLOR_RED, COLOR_MAGENTA, COLOR_BROWN, COLOR_GREY, COLOR_DARKGREY,
COLOR_LIGHTBLUE, COLOR_LIGHTGREEN, COLOR_LIGHTCYAN, COLOR_LIGHTRED,
COLOR_LIGHTMAGENTA, COLOR_YELLOW, COLOR_WHITE
```

- `dfhack.onStateChange` event codes

Available only in the core context, as is the event itself:

```
SC_WORLD_LOADED, SC_WORLD_UNLOADED, SC_MAP_LOADED, SC_MAP_UNLOADED,
SC_VIEWSCREEN_CHANGED, SC_CORE_INITIALIZED
```

- Functions already described above

`safecall`, `qerror`, `mkmodule`, `reload`

- Miscellaneous constants



**NEWLINE, COMMA, PERIOD** evaluate to the relevant character strings.

**DEFAULT\_NIL** is an unspecified unique token used by the class module below.

- `printall(obj)`  
If the argument is a lua table or DF object reference, prints all fields.
- `copyall(obj)`  
Returns a shallow copy of the table or reference as a lua table.
- `pos2xyz(obj)`  
The object must have fields `x`, `y` and `z`. Returns them as 3 values. If `obj` is *nil*, or `x` is -30000 (the usual marker for undefined coordinates), returns *nil*.
- `xyz2pos(x, y, z)`  
Returns a table with `x`, `y` and `z` as fields.
- `same_xyz(a, b)`  
Checks if `a` and `b` have the same `x`, `y` and `z` fields.
- `get_path_xyz(path, i)`  
Returns `path.x[i]`, `path.y[i]`, `path.z[i]`.
- `pos2xy(obj)`, `xy2pos(x, y)`, `same_xy(a, b)`, `get_path_xy(a, b)`  
Same as above, but for 2D coordinates.
- `safe_index(obj, index...)`  
Walks a sequence of dereferences, which may be represented by numbers or strings. Returns *nil* if any of `obj` or indices is *nil*, or a numeric index is out of array bounds.

## utils

- `utils.compare(a, b)`  
Comparator function; returns *-1* if `a < b`, *1* if `a > b`, *0* otherwise.
- `utils.compare_name(a, b)`  
Comparator for names; compares empty string last.
- `utils.is_container(obj)`  
Checks if `obj` is a container ref.
- `utils.make_index_sequence(start, end)`  
Returns a lua sequence of numbers in `start..end`.
- `utils.make_sort_order(data, ordering)`  
Computes a sorted permutation of objects in `data`, as a table of integer indices into the data sequence. Uses `data.n` as input length if present.  
  
The ordering argument is a sequence of ordering specs, represented as lua tables with following possible fields:  
  
**ord.key = function(value)** Computes comparison key from input data value. Not called on *nil*. If omitted, the comparison key is the value itself.  
  
**ord.key\_table = function(data)** Computes a key table from the data table in one go.

**ord.compare** = *function(a,b)* Comparison function. Defaults to `utils.compare` above. Called on non-nil keys; nil sorts last.

**ord.nil\_first** = *true/false* If true, nil keys are sorted first instead of last.

**ord.reverse** = *true/false* If true, sort non-nil keys in descending order.

For every comparison during sorting the specs are applied in order until an unambiguous decision is reached. Sorting is stable.

Example of sorting a sequence by field foo:

```
local spec = { key = function(v) return v.foo end }
local order = utils.make_sort_order(data, { spec })
local output = {}
for i = 1, #order do output[i] = data[order[i]] end
```

Separating the actual reordering of the sequence in this way enables applying the same permutation to multiple arrays. This function is used by the sort plugin.

- `for link,item in utils.listpairs(list)`

Iterates a df-list structure, for example `df.global.world.job_list`.

- `utils.assign(tgt, src)`

Does a recursive assignment of `src` into `tgt`. Uses `df.assign` if `tgt` is a native object ref; otherwise recurses into lua tables.

- `utils.clone(obj, deep)`

Performs a shallow, or semi-deep copy of the object as a lua table tree. The deep mode recurses into lua tables and subobjects, except pointers to other heap objects. Null pointers are represented as `df.NULL`. Zero-based native containers are converted to 1-based lua sequences.

- `utils.clone_with_default(obj, default, force)`

Copies the object, using the default lua table tree as a guide to which values should be skipped as uninteresting. The `force` argument makes it always return a non-*nil* value.

- `utils.parse_bitfield_int(value, type_ref)`

Given an int `value`, and a bitfield type in the df tree, it returns a lua table mapping the enabled bit keys to *true*, unless `value` is 0, in which case it returns *nil*.

- `utils.list_bitfield_flags(bitfield[, list])`

Adds all enabled bitfield keys to `list` or a newly-allocated empty sequence, and returns it. The `bitfield` argument may be *nil*.

- `utils.sort_vector(vector, field, cmpfun)`

Sorts a native vector or lua sequence using the comparator function. If `field` is not *nil*, applies the comparator to the field instead of the whole object.

- `utils.linear_index(vector, key[, field])`

Searches for `key` in the vector, and returns *index*, *found\_value*, or *nil* if none found.

- `utils.binsearch(vector, key, field, cmpfun, min, max)`

Does a binary search in a native vector or lua sequence for `key`, using `cmpfun` and `field` like `sort_vector`. If `min` and `max` are specified, they are used as the search subrange bounds.

If found, returns *item*, *true*, *idx*. Otherwise returns *nil*, *false*, *insert\_idx*, where *insert\_idx* is the correct insertion point.

- `utils.insert_sorted(vector, item, field, cmpfun)`

Does a binary search, and inserts item if not found. Returns *did\_insert*, *vector[idx]*, *idx*.

- `utils.insert_or_update(vector, item, field, cmpfun)`

Like `insert_sorted`, but also assigns the item into the vector cell if insertion didn't happen.

As an example, you can use this to set skill values:

```
utils.insert_or_update(soul.skills, {new=true, id=..., rating=...}, 'id')
```

(For an explanation of `new=true`, see [Recursive table assignment](#))

- `utils.erase_sorted_key(vector, key, field, cmpfun)`

Removes the item with the given key from the list. Returns: *did\_erase*, *vector[idx]*, *idx*.

- `utils.erase_sorted(vector, item, field, cmpfun)`

Exactly like `erase_sorted_key`, but if `field` is specified, takes the key from `item[field]`.

- `utils.call_with_string(obj, methodname, ...)`

Allocates a temporary string object, calls `obj:method(tmp, ...)`, and returns the value written into the temporary after deleting it.

- `utils.getBuildingName(building)`

Returns the string description of the given building.

- `utils.getBuildingCenter(building)`

Returns an x/y/z table pointing at the building center.

- `utils.split_string(string, delimiter)`

Splits the string by the given delimiter, and returns a sequence of results.

- `utils.prompt_yes_no(prompt, default)`

Presents a yes/no prompt to the user. If `default` is not *nil*, allows just pressing Enter to submit the default choice. If the user enters 'abort', throws an error.

- `utils.prompt_input(prompt, checkfun, quit_str)`

Presents a prompt to input data, until a valid string is entered. Once `checkfun(input)` returns *true*, ..., passes the values through. If the user enters the `quit_str` (defaults to '~~~'), throws an error.

- `utils.check_number(text)`

A `prompt_input` checkfun that verifies a number input.

## dumper

A third-party lua table dumper module from <http://lua-users.org/wiki/DataDumper>. Defines one function:

- `dumper.DataDumper(value, varname, fastmode, ident, indent_step)`

Returns `value` converted to a string. The `indent_step` argument specifies the indentation step size in spaces. For the other arguments see the original documentation link above.

## class

Implements a trivial single-inheritance class system.

- `Foo = defclass(Foo[, ParentClass])`

Defines or updates class `Foo`. The `Foo = defclass(Foo)` syntax is needed so that when the module or script is reloaded, the class identity will be preserved through the preservation of global variable values.

The `defclass` function is defined as a stub in the global namespace, and using it will auto-load the class module.

- `Class.super`

This class field is set by `defclass` to the parent class, and allows a readable `Class.super.method(self, ...)` syntax for calling superclass methods.

- `Class.ATTRS { foo = xxx, bar = yyy }`

Declares certain instance fields to be attributes, i.e. auto-initialized from fields in the table used as the constructor argument. If omitted, they are initialized with the default values specified in this declaration.

If the default value should be *nil*, use `ATTRS { foo = DEFAULT_NIL }`.

Declaring an attribute is mostly the same as defining your `init` method like this:

```
function Class.init(args)
  self.attr1 = args.attr1 or default1
  self.attr2 = args.attr2 or default2
  ...
end
```

The main difference is that attributes are processed as a separate initialization step, before any `init` methods are called. They also make the direct relation between instance fields and constructor arguments more explicit.

- `new_obj = Class{ foo = arg, bar = arg, ... }`

Calling the class as a function creates and initializes a new instance. Initialization happens in this order:

1. An empty instance table is created, and its metatable set.
2. The `preinit` methods are called via `invoke_before` (see below) with the table used as argument to the class. These methods are intended for validating and tweaking that argument table.
3. Declared `ATTRS` are initialized from the argument table or their default values.
4. The `init` methods are called via `invoke_after` with the argument table. This is the main constructor method.
5. The `postinit` methods are called via `invoke_after` with the argument table. Place code that should be called after the object is fully constructed here.

Predefined instance methods:

- `instance:assign{ foo = xxx }`

Assigns all values in the input table to the matching instance fields.

- `instance:callback(method_name, [args...])`

Returns a closure that invokes the specified method of the class, properly passing in `self`, and optionally a number of initial arguments too. The arguments given to the closure are appended to these.

- `instance:cb_getfield(field_name)`

Returns a closure that returns the specified field of the object when called.

- `instance:cb_setfield(field_name)`

Returns a closure that sets the specified field to its argument when called.

- `instance:invoke_before(method_name, args...)`

Navigates the inheritance chain of the instance starting from the most specific class, and invokes the specified method with the arguments if it is defined in that specific class. Equivalent to the following definition in every class:

```
function Class:invoke_before(method, ...)
  if rawget(Class, method) then
    rawget(Class, method)(self, ...)
  end
  Class.super:invoke_before(method, ...)
end
```

- `instance:invoke_after(method_name, args...)`

Like `invoke_before`, only the method is called after the recursive call to `super`, i.e. invocations happen in the parent to child order.

These two methods are inspired by the Common Lisp `before` and `after` methods, and are intended for implementing similar protocols for certain things. The class library itself uses them for constructors.

To avoid confusion, these methods cannot be redefined.

## In-game UI Library

- *gui*
  - *Misc*
  - *ViewRect class*
  - *Painter class*
  - *View class*
  - *Screen class*
  - *FramedScreen class*
- *gui.widgets*
  - *Widget class*
  - *Panel class*
  - *Pages class*
  - *EditField class*
  - *Label class*
  - *List class*
  - *FilteredList class*

A number of lua modules with names starting with `gui` are dedicated to wrapping the natives of the `dfhack`. `screen` module in a way that is easy to use. This allows relatively easily and naturally creating dialogs that integrate in the main game UI window.

These modules make extensive use of the `class` module, and define things ranging from the basic `Painter`, `View` and `Screen` classes, to fully functional predefined dialogs.

## gui

This module defines the most important classes and functions for implementing interfaces. This documents those of them that are considered stable.

## Misc

- `USE_GRAPHICS`

Contains the value of `dfhack.screen.inGraphicsMode()`, which cannot be changed without restarting the game and thus is constant during the session.

- `CLEAR_PEN`

The black pen used to clear the screen.

- `simulateInput(screen, keys...)`

This function wraps an undocumented native function that passes a set of keycodes to a screen, and is the official way to do that.

Every argument after the initial screen may be *nil*, a numeric keycode, a string keycode, a sequence of numeric or string keycodes, or a mapping of keycodes to *true* or *false*. For instance, it is possible to use the table passed as argument to `onInput`.

- `mkdims_xy(x1, y1, x2, y2)`

Returns a table containing the arguments as fields, and also `width` and `height` that contains the rectangle dimensions.

- `mkdims_wh(x1, y1, width, height)`

Returns the same kind of table as `mkdims_xy`, only this time it computes `x2` and `y2`.

- `is_in_rect(rect, x, y)`

Checks if the given point is within a rectangle, represented by a table produced by one of the `mkdims` functions.

- `blink_visible(delay)`

Returns *true* or *false*, with the value switching to the opposite every `delay` msec. This is intended for rendering blinking interface objects.

- `getKeyDisplay(keycode)`

Wraps `dfhack.screen.getKeyDisplay` in order to allow using strings for the keycode argument.

## ViewRect class

This class represents an on-screen rectangle with an associated independent clip area rectangle. It is the base of the `Painter` class, and is used by `Views` to track their client area.

- `ViewRect{ rect = ..., clip_rect = ..., view_rect = ..., clip_view = ... }`

The constructor has the following arguments:

**rect** The `mkdims` rectangle in screen coordinates of the logical viewport. Defaults to the whole screen.

**clip\_rect** The clip rectangle in screen coordinates. Defaults to `rect`.

**view\_rect** A `ViewRect` object to copy from; overrides both `rect` and `clip_rect`.

**clip\_view** A `ViewRect` object to intersect the specified clip area with.

- `rect:isDefunct()`

Returns *true* if the clip area is empty, i.e. no painting is possible.

- `rect:inClipGlobalXY(x, y)`

Checks if these global coordinates are within the clip rectangle.

- `rect:inClipLocalXY(x, y)`

Checks if these coordinates (specified relative to `x1, y1`) are within the clip rectangle.

- `rect:localXY(x, y)`

Converts a pair of global coordinates to local; returns *x\_local, y\_local*.

- `rect:globalXY(x, y)`

Converts a pair of local coordinates to global; returns *x\_global, y\_global*.

- `rect:viewport(x, y, w, h)` or `rect:viewport(subrect)`

Returns a `ViewRect` representing a sub-rectangle of the current one. The arguments are specified in local coordinates; the `subrect` argument must be a `mkdims` table. The returned object consists of the exact specified rectangle, and a clip area produced by intersecting it with the clip area of the original object.

## Painter class

The painting natives in `dfhack.screen` apply to the whole screen, are completely stateless and don't implement clipping.

The `Painter` class inherits from `ViewRect` to provide clipping and local coordinates, and tracks current cursor position and current pen.

- `Painter{ ..., pen = ..., key_pen = ... }`

In addition to `ViewRect` arguments, `Painter` accepts a suggestion of the initial value for the main pen, and the keybinding pen. They default to `COLOR_GREY` and `COLOR_LIGHTGREEN` otherwise.

There are also some convenience functions that wrap this constructor:

- `Painter.new(rect, pen)`
- `Painter.new_view(view_rect, pen)`
- `Painter.new_xy(x1, y1, x2, y2, pen)`
- `Painter.new_wh(x1, y1, width, height, pen)`

- `painter:isValidPos()`

Checks if the current cursor position is within the clip area.

- `painter:viewport(x, y, w, h)`

Like the superclass method, but returns a `Painter` object.

- `painter:cursor()`

Returns the current cursor *x, y* in local coordinates.

- `painter:seek(x, y)`  
Sets the current cursor position, and returns *self*. Either of the arguments may be *nil* to keep the current value.
- `painter:advance(dx, dy)`  
Adds the given offsets to the cursor position, and returns *self*. Either of the arguments may be *nil* to keep the current value.
- `painter:newline([dx])`  
Advances the cursor to the start of the next line plus the given x offset, and returns *self*.
- `painter:pen(...)`  
Sets the current pen to `dfhack.pen.parse(old_pen, ...)`, and returns *self*.
- `painter:key_pen(...)`  
Sets the current keybinding pen to `dfhack.pen.parse(old_pen, ...)`, and returns *self*.
- `painter:clear()`  
Fills the whole clip rectangle with `CLEAR_PEN`, and returns *self*.
- `painter:fill(x1, y1, x2, y2[, ...])` or `painter:fill(rect[, ...])`  
Fills the specified local coordinate rectangle with `dfhack.pen.parse(cur_pen, ...)`, and returns *self*.
- `painter:char([char[, ...]])`  
Paints one character using `char` and `dfhack.pen.parse(cur_pen, ...)`; returns *self*. The `char` argument, if not *nil*, is used to override the `ch` property of the pen.
- `painter:tile([char, tile[, ...]])`  
Like above, but also allows overriding the `tile` property on ad-hoc basis.
- `painter:string(text[, ...])`  
Paints the string with `dfhack.pen.parse(cur_pen, ...)`; returns *self*.
- `painter:key(keycode[, ...])`  
Paints the description of the keycode using `dfhack.pen.parse(cur_key_pen, ...)`; returns *self*.

As noted above, all painting methods return *self*, in order to allow chaining them like this:

```
painter:pen(foo):seek(x,y):char(1):advance(1):string('bar')...
```

## View class

This class is the common abstract base of both the stand-alone screens and common widgets to be used inside them. It defines the basic layout, rendering and event handling framework.

The class defines the following attributes:

- visible** Specifies that the view should be painted.
- active** Specifies that the view should receive events, if also visible.
- view\_id** Specifies an identifier to easily identify the view among subviews. This is reserved for implementation of top-level views, and should not be used by widgets for their internal subviews.

It also always has the following fields:



**subviews** Contains a table of all subviews. The sequence part of the table is used for iteration. In addition, subviews are also indexed under their *view\_id*, if any; see `addviews()` below.

These fields are computed by the layout process:

**frame\_parent\_rect** The ViewRect representing the client area of the parent view.

**frame\_rect** The `mkdims` rect of the outer frame in parent-local coordinates.

**frame\_body** The ViewRect representing the body part of the View's own frame.

The class has the following methods:

- `view:addviews(list)`

Adds the views in the list to the `subviews` sequence. If any of the views in the list have `view_id` attributes that don't conflict with existing keys in `subviews`, also stores them under the string keys. Finally, copies any non-conflicting string keys from the `subviews` tables of the listed views.

Thus, doing something like this:

```
self:addviews{
  Panel{
    view_id = 'panel',
    subviews = {
      Label{ view_id = 'label' }
    }
  }
}
```

Would make the label accessible as both `self.subviews.label` and `self.subviews.panel.subviews.label`.

- `view:getWindowSize()`

Returns the dimensions of the `frame_body` rectangle.

- `view:getMousePos()`

Returns the mouse *x,y* in coordinates local to the `frame_body` rectangle if it is within its clip area, or nothing otherwise.

- `view:updateLayout([parent_rect])`

Recomputes layout of the view and its subviews. If no argument is given, re-uses the previous parent rect. The process goes as follows:

1. Calls `preUpdateLayout(parent_rect)` via `invoke_before`.
2. Uses `computeFrame(parent_rect)` to compute the desired frame.
3. Calls `postComputeFrame(frame_body)` via `invoke_after`.
4. Calls `updateSubviewLayout(frame_body)` to update children.
5. Calls `postUpdateLayout(frame_body)` via `invoke_after`.

- `view:computeFrame(parent_rect)` (for overriding)

Called by `updateLayout` in order to compute the frame rectangle(s). Should return the `mkdims` rectangle for the outer frame, and optionally also for the body frame. If only one rectangle is returned, it is used for both frames, and the margin becomes zero.

- `view:updateSubviewLayout(frame_body)`

Calls `updateLayout` on all children.

- `view:render(painter)`

Given the parent's painter, renders the view via the following process:

1. Calls `onRenderFrame(painter, frame_rect)` to paint the outer frame.
2. Creates a new painter using the `frame_body` rect.
3. Calls `onRenderBody(new_painter)` to paint the client area.
4. Calls `renderSubviews(new_painter)` to paint visible children.

- `view:renderSubviews(painter)`

Calls `render` on all visible subviews in the order they appear in the `subviews` sequence.

- `view:onRenderFrame(painter, rect)` (*for overriding*)

Called by `render` to paint the outer frame; by default does nothing.

- `view:onRenderBody(painter)` (*for overriding*)

Called by `render` to paint the client area; by default does nothing.

- `view:onInput(keys)` (*for overriding*)

Override this to handle events. By default directly calls `inputToSubviews`. Return a true value from this method to signal that the event has been handled and should not be passed on to more views.

- `view:inputToSubviews(keys)`

Calls `onInput` on all visible active subviews, iterating the `subviews` sequence in *reverse order*, so that topmost subviews get events first. Returns *true* if any of the subviews handled the event.

## Screen class

This is a `View` subclass intended for use as a stand-alone dialog or screen. It adds the following methods:

- `screen:isShown()`

Returns *true* if the screen is currently in the game engine's display stack.

- `screen:isDismissed()`

Returns *true* if the screen is dismissed.

- `screen:isActive()`

Returns *true* if the screen is shown and not dismissed.

- `screen:invalidate()`

Requests a repaint. Note that currently using it is not necessary, because repaints are constantly requested automatically, due to issues with native screens happening otherwise.

- `screen:renderParent()`

Asks the parent native screen to render itself, or clears the screen if impossible.

- `screen:sendInputToParent(...)`

Uses `simulateInput` to send keypresses to the native parent screen.

- `screen:show([parent])`

Adds the screen to the display stack with the given screen as the parent; if parent is not specified, places this one on topmost. Before calling `dfhack.screen.show`, calls `self:onAboutToShow(parent)`.

- `screen:onAboutToShow(parent)` (*for overriding*)  
Called when `dfhack.screen.show` is about to be called.
- `screen:onShow()`  
Called by `dfhack.screen.show` once the screen is successfully shown.
- `screen:dismiss()`  
Dismisses the screen. A dismissed screen does not receive any more events or paint requests, but may remain in the display stack for a short time until the game removes it.
- `screen:onDismiss()` (*for overriding*)  
Called by `dfhack.screen.dismiss()`.
- `screen:onDestroy()` (*for overriding*)  
Called by the native code when the screen is fully destroyed and removed from the display stack. Place code that absolutely must be called whenever the screen is removed by any means here.
- `screen:onResize`, `screen:onRender`  
Defined as callbacks for native code.

### FramedScreen class

A Screen subclass that paints a visible frame around its body. Most dialogs should inherit from this class.

A framed screen has the following attributes:

- frame\_style** A table that defines a set of pens to draw various parts of the frame.
- frame\_title** A string to display in the middle of the top of the frame.
- frame\_width** Desired width of the client area. If *nil*, the screen will occupy the whole width.
- frame\_height** Likewise, for height.
- frame\_inset** The gap between the frame and the client area. Defaults to 0.
- frame\_background** The pen to fill in the frame with. Defaults to `CLEAR_PEN`.

There are the following predefined frame style tables:

- `GREY_FRAME`  
A plain grey-colored frame.
- `BOUNDARY_FRAME`  
The same frame as used by the usual full-screen DF views, like `dwarfmode`.
- `GREY_LINE_FRAME`  
A frame consisting of grey lines, similar to the one used by titan announcements.

### gui.widgets

This module implements some basic widgets based on the View infrastructure.

## Widget class

Base of all the widgets. Inherits from View and has the following attributes:

- `frame = {...}`

Specifies the constraints on the outer frame of the widget. If omitted, the widget will occupy the whole parent rectangle.

The frame is specified as a table with the following possible fields:

- l** gap between the left edges of the frame and the parent.
- t** gap between the top edges of the frame and the parent.
- r** gap between the right edges of the frame and the parent.
- b** gap between the bottom edges of the frame and the parent.
- w** maximum width of the frame.
- h** maximum height of the frame.
- xalign** X alignment of the frame.
- yalign** Y alignment of the frame.

First the `l`, `t`, `r`, `b` fields restrict the available area for placing the frame. If `w` and `h` are not specified or larger than the computed area, it becomes the frame. Otherwise the smaller frame is placed within the area based on the `xalign`/`yalign` fields. If the align hints are omitted, they are assumed to be 0, 1, or 0.5 based on which of the `l`/`r`/`t`/`b` fields are set.

- `frame_inset = {...}`

Specifies the gap between the outer frame, and the client area. The attribute may be a simple integer value to specify a uniform inset, or a table with the following fields:

- l** left margin.
- t** top margin.
- r** right margin.
- b** bottom margin.
- x** left/right margin, if `l` and/or `r` are omitted.
- y** top/bottom margin, if `t` and/or `b` are omitted.

- `frame_background = pen`

The pen to fill the outer frame with. Defaults to no fill.

## Panel class

Inherits from Widget, and intended for grouping a number of subviews.

Has attributes:

- `subviews = {}`

Used to initialize the subview list in the constructor.

- `on_render = function(painter)`

Called from `onRenderBody`.

## Pages class

Subclass of Panel; keeps exactly one child visible.

- `Pages{ ..., selected = ... }`  
Specifies which child to select initially; defaults to the first one.
- `pages:getSelected()`  
Returns the selected *index*, *child*.
- `pages:setSelected(index)`  
Selects the specified child, hiding the previous selected one. It is permitted to use the subview object, or its `view_id` as index.

## EditField class

Subclass of Widget; implements a simple edit field.

Attributes:

- text** The current contents of the field.
- text\_pen** The pen to draw the text with.
- on\_char** Input validation callback; used as `on_char(new_char, text)`. If it returns false, the character is ignored.
- on\_change** Change notification callback; used as `on_change(new_text, old_text)`.
- on\_submit** Enter key callback; if set the field will handle the key and call `on_submit(text)`.

## Label class

This Widget subclass implements flowing semi-static text.

It has the following attributes:

- text\_pen** Specifies the pen for active text.
- text\_dpen** Specifies the pen for disabled text.
- text\_hpen** Specifies the pen for text hovered over by the mouse, if a click handler is registered.
- disabled** Boolean or a callback; if true, the label is disabled.
- enabled** Boolean or a callback; if false, the label is disabled.
- auto\_height** Sets `self.frame.h` from the text height.
- auto\_width** Sets `self.frame.w` from the text width.
- on\_click** A callback called when the label is clicked (optional)
- on\_rclick** A callback called when the label is right-clicked (optional)

The text itself is represented as a complex structure, and passed to the object via the `text` argument of the constructor, or via the `setText` method, as one of:

- A simple string, possibly containing newlines.
- A sequence of tokens.

Every token in the sequence in turn may be either a string, possibly containing newlines, or a table with the following possible fields:

- `token.text = ...`  
Specifies the main text content of a token, and may be a string, or a callback returning a string.
- `token.gap = ...`  
Specifies the number of character positions to advance on the line before rendering the token.
- `token.tile = pen`  
Specifies a pen to paint as one tile before the main part of the token.
- `token.width = ...`  
If specified either as a value or a callback, the text field is padded or truncated to the specified number.
- `token.pad_char = '?'`  
If specified together with `width`, the padding area is filled with this character instead of just being skipped over.
- `token.key = '...'`  
Specifies the keycode associated with the token. The string description of the key binding is added to the text content of the token.
- `token.key_sep = '...'`  
Specifies the separator to place between the keybinding label produced by `token.key`, and the main text of the token. If the separator is `()`, the token is formatted as `text.. ' (...binding..) '`. Otherwise it is simply `binding..sep..text`.
- `token.enabled, token.disabled`  
Same as the attributes of the label itself, but applies only to the token.
- `token.pen, token.dpen`  
Specify the pen and disabled pen to be used for the token's text. The field may be either the pen itself, or a callback that returns it.
- `token.on_activate`  
If this field is not nil, and `token.key` is set, the token will actually respond to that key binding unless disabled, and call this callback. Eventually this may be extended with mouse click support.
- `token.id`  
Specifies a unique identifier for the token.
- `token.line, token.x1, token.x2`  
Reserved for internal use.

The Label widget implements the following methods:

- `label:setText(new_text)`  
Replaces the text currently contained in the widget.
- `label:itemById(id)`  
Finds a token by its `id` field.

- `label:getTextHeight()`  
Computes the height of the text.
- `label:getTextWidth()`  
Computes the width of the text.

## List class

The List widget implements a simple list with paging.

It has the following attributes:

- text\_pen** Specifies the pen for deselected list entries.
- cursor\_pen** Specifies the pen for the selected entry.
- inactive\_pen** If specified, used for the cursor when the widget is not active.
- icon\_pen** Default pen for icons.
- on\_select** Selection change callback; called as `on_select(index, choice)`. This is also called with *nil* arguments if `setChoices` is called with an empty list.
- on\_submit** Enter key callback; if specified, the list reacts to the key and calls it as `on_submit(index, choice)`.
- on\_submit2** Shift-Enter key callback; if specified, the list reacts to the key and calls it as `on_submit2(index, choice)`.
- row\_height** Height of every row in text lines.
- icon\_width** If not *nil*, the specified number of character columns are reserved to the left of the list item for the icons.
- scroll\_keys** Specifies which keys the list should react to as a table.

Every list item may be specified either as a string, or as a lua table with the following fields:

- text** Specifies the label text in the same format as the Label text.
- caption, [1]** Deprecated legacy aliases for **text**.
- text\_\*** Reserved for internal use.
- key** Specifies a keybinding that acts as a shortcut for the specified item.
- icon** Specifies an icon string, or a pen to paint a single character. May be a callback.
- icon\_pen** When the icon is a string, used to paint it.

The list supports the following methods:

- `List{ ..., choices = ..., selected = ... }`  
Same as calling `setChoices` after construction.
- `list:setChoices(choices[, selected])`  
Replaces the list of choices, possibly also setting the currently selected index.
- `list:setSelected(selected)`  
Sets the currently selected index. Returns the index after validation.

- `list:choices()`  
Returns the list of choices.
- `list:selected()`  
Returns the selected *index*, *choice*, or nothing if the list is empty.
- `list:contentWidth()`  
Returns the minimal width to draw all choices without clipping.
- `list:contentHeight()`  
Returns the minimal width to draw all choices without scrolling.
- `list:submit()`  
Call the `on_submit` callback, as if the Enter key was handled.
- `list:submit2()`  
Call the `on_submit2` callback, as if the Shift-Enter key was handled.

### FilteredList class

This widget combines List, EditField and Label into a combo-box like construction that allows filtering the list by subwords of its items.

In addition to passing through all attributes supported by List, it supports:

- edit\_pen** If specified, used instead of `cursor_pen` for the edit field.
- edit\_below** If true, the edit field is placed below the list instead of above.
- not\_found\_label** Specifies the text of the label shown when no items match the filter.

The list choices may include the following attributes:

- search\_key** If specified, used instead of **text** to match against the filter.

The widget implements:

- `list:setChoices(choices[, selected])`  
Resets the filter, and passes through to the inner list.
- `list:choices()`  
Returns the list of *all* choices.
- `list:getFilter()`  
Returns the current filter string, and the *filtered* list of choices.
- `list:setFilter(filter[, pos])`  
Sets the new filter string, filters the list, and selects the item at index `pos` in the *unfiltered* list if possible.
- `list:canSubmit()`  
Checks if there are currently any choices in the filtered list.
- `list:selected()`, `list:contentWidth()`, `list:contentHeight()`,  
`list:submit()`  
Same as with an ordinary list.



## Plugins

- *burrows*
- *sort*
- *Eventful*
  - *List of events*
  - *Events from EventManager*
  - *Functions*
  - *Examples*
- *Building-hacks*
  - *Functions*
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- *Luasocket*
  - *Socket class*
  - *Client class*
  - *Server class*
  - *Tcp class*

DFHack plugins may export native functions and events to lua contexts. They are automatically imported by `mkmodule('plugins.<name>')`; this means that a lua module file is still necessary for `require` to read.

The following plugins have lua support.

### burrows

Implements extended burrow manipulations.

Events:

- `onBurrowRename.foo = function(burrow)`  
Emitted when a burrow might have been renamed either through the game UI, or `renameBurrow()`.
- `onDigComplete.foo = function(job_type, pos, old_tiletype, new_tiletype, worker)`  
Emitted when a tile might have been dug out. Only tracked if the auto-growing burrows feature is enabled.

Native functions:

- `renameBurrow(burrow, name)`  
Renames the burrow, emitting `onBurrowRename` and updating auto-grow state properly.
- `findByName(burrow, name)`  
Finds a burrow by name, using the same rules as the plugin command line interface. Namely, trailing '+' characters marking auto-grow burrows are ignored.

- `copyUnits(target, source, enable)`

Applies units from `source` burrow to `target`. The `enable` parameter specifies if they are to be added or removed.

- `copyTiles(target, source, enable)`

Applies tiles from `source` burrow to `target`. The `enable` parameter specifies if they are to be added or removed.

- `setTilesByKeyword(target, keyword, enable)`

Adds or removes tiles matching a predefined keyword. The keyword set is the same as used by the command line.

The lua module file also re-exports functions from `dfhack.burrows`.

## **sort**

Does not export any native functions as of now. Instead, it calls lua code to perform the actual ordering of list items.

## **Eventful**

This plugin exports some events to lua thus allowing to run lua functions on DF world events.

## **List of events**

1. `onReactionComplete(reaction, reaction_product, unit, input_items, input_reagents, output_items, call_native)`

Auto activates if detects reactions starting with `LUA_HOOK_`. Is called when reaction finishes.

2. `onItemContaminateWound(item, unit, wound, number1, number2)`

Is called when item tries to contaminate wound (e.g. stuck in).

3. `onProjItemCheckMovement(projectile)`

Is called when projectile moves.

4. `onProjItemCheckImpact(projectile, somebool)`

Is called when projectile hits something.

5. `onProjUnitCheckMovement(projectile)`

Is called when projectile moves.

6. `onProjUnitCheckImpact(projectile, somebool)`

Is called when projectile hits something.

7. `onWorkshopFillSidebarMenu(workshop, callnative)`

Is called when viewing a workshop in 'q' mode, to populate reactions, useful for custom viewscreens for shops.

8. `postWorkshopFillSidebarMenu(workshop)`

Is called after calling (or not) native `fillSidebarMenu()`. Useful for job button tweaking (e.g. adding custom reactions)

## Events from EventManager

These events are straight from EventManager module. Each of them first needs to be enabled. See functions for more info. If you register a listener before the game is loaded, be aware that no events will be triggered immediately after loading, so you might need to add another event listener for when the game first loads in some cases.

1. `onBuildingCreatedDestroyed (building_id)`  
Gets called when building is created or destroyed.
2. `onConstructionCreatedDestroyed (building_id)`  
Gets called when construction is created or destroyed.
3. `onJobInitiated (job)`  
Gets called when job is issued.
4. `onJobCompleted (job)`  
Gets called when job is finished. The job that is passed to this function is a copy. Requires a frequency of 0 in order to distinguish between workshop jobs that were cancelled by the user and workshop jobs that completed successfully.
5. `onUnitDeath (unit_id)`  
Gets called on unit death.
6. `onItemCreated (item_id)`  
Gets called when item is created (except due to traders, migrants, invaders and spider webs).
7. `onSyndrome (unit_id, syndrome_index)`  
Gets called when new syndrome appears on a unit.
8. `onInvasion (invasion_id)`  
Gets called when new invasion happens.
9. `onInventoryChange (unit_id, item_id, old_equip, new_equip)`  
Gets called when someone picks up an item, puts one down, or changes the way they are holding it. If an item is picked up, `old_equip` will be null. If an item is dropped, `new_equip` will be null. If an item is re-equipped in a new way, then neither will be null. You absolutely must NOT alter either `old_equip` or `new_equip` or you might break other plugins.
10. `onReport (reportId)`  
Gets called when a report happens. This happens more often than you probably think, even if it doesn't show up in the announcements.
11. `onUnitAttack (attackerId, defenderId, woundId)`  
Called when a unit wounds another with a weapon. Is NOT called if blocked, dodged, deflected, or parried.
12. `onUnload ()`  
A convenience event in case you don't want to register for every `onStateChange` event.
13. `onInteraction (attackVerb, defendVerb, attackerId, defenderId, attackReportId, defendReportId)`  
Called when a unit uses an interaction on another.

## Functions

1. `registerReaction (reaction_name, callback)`

Simplified way of using `onReactionComplete`; the callback is function (same params as event).

2. `removeNative (shop_name)`

Removes native choice list from the building.

3. `addReactionToShop (reaction_name, shop_name)`

Add a custom reaction to the building.

4. `enableEvent (evType, frequency)`

Enable event checking for EventManager events. For event types use `eventType` table. Note that different types of events require different frequencies to be effective. The frequency is how many ticks EventManager will wait before checking if that type of event has happened. If multiple scripts or plugins use the same event type, the smallest frequency is the one that is used, so you might get events triggered more often than the frequency you use here.

5. `registerSidebar (shop_name, callback)`

Enable callback when sidebar for `shop_name` is drawn. Usefull for custom workshop views e.g. using `gui.dwarfmode` lib. Also accepts a class instead of function as callback. Best used with `gui.dwarfmode` class `WorkshopOverlay`.

## Examples

Spawn dragon breath on each item attempt to contaminate wound:

```
b=require "plugins.eventful"
b.onItemContaminateWound.one=function(item,unit,un_wound,x,y)
    local flw=dfhack.maps.spawnFlow(unit.pos,6,0,0,50000)
end
```

Reaction complete example:

```
b=require "plugins.eventful"

b.registerReaction("LUA_HOOK_LAY_BOMB",function(reaction,unit,in_items,in_reag,out_
→items,call_native)
    local pos=copyall(unit.pos)
    -- spawn dragonbreath after 100 ticks
    dfhack.timeout(100,"ticks",function() dfhack.maps.spawnFlow(pos,6,0,0,50000) end)
    --do not call real item creation code
    call_native.value=false
end)
```

Grenade example:

```
b=require "plugins.eventful"
b.onProjItemCheckImpact.one=function(projectile)
    -- you can check if projectile.item e.g. has correct material
    dfhack.maps.spawnFlow(projectile.cur_pos,6,0,0,50000)
end
```

Integrated tannery:

```
b=require "plugins.eventful"
b.addReactionToShop("TAN_A_HIDE", "LEATHERWORKS")
```

## Building-hacks

This plugin overwrites some methods in workshop df class so that mechanical workshops are possible. Although plugin export a function it's recommended to use lua decorated function.

## Functions

`registerBuilding(table)` where table must contain name, as a workshop raw name, the rest are optional:

**name** custom workshop id e.g. SOAPMAKER

---

**Note:** this is the only mandatory field.

---

**fix\_impassible** if true make impassible tiles impassible to liquids too

**consume** how much machine power is needed to work. Disables reactions if not supplied enough and `needs_power==1`

**produce** how much machine power is produced.

**needs\_power** if produced in network < consumed stop working, default true

**gears** a table or {x=?, y=?} of connection points for machines.

**action** a table of number (how much ticks to skip) and a function which gets called on shop update

**animate** a table of frames which can be a table of:

1. tables of 4 numbers {tile, fore, back, bright} OR
2. empty table (tile not modified) OR
3. {x=<number> y=<number> + 4 numbers like in first case}, this generates full frame useful for animations that change little (1-2 tiles)

**canBeRoomSubset** a flag if this building can be counted in room. 1 means it can, 0 means it can't and -1 default building behaviour

**auto\_gears** a flag that automatically fills up gears and animate. It looks over building definition for gear icons and maps them.

Animate table also might contain:

**frameLength** how many ticks does one frame take OR

**isMechanical** a bool that says to try to match to mechanical system (i.e. how gears are turning)

`getPower(building)` returns two number - produced and consumed power if building can be modified and returns nothing otherwise

`setPower(building, produced, consumed)` sets current production and consumption for a building.

## Examples

Simple mechanical workshop:

```
require('plugins.building-hacks').registerBuilding{name="BONE_GRINDER",
  consume=15,
  gears={x=0,y=0}, --connection point
  animate={
    isMechanical=true, --animate the same conn. point as vanilla gear
    frames={
      {{x=0,y=0,42,7,0,0}}, --first frame, 1 changed tile
      {{x=0,y=0,15,7,0,0}} -- second frame, same
    }
  }
}
```

Or with auto\_gears:

```
require('plugins.building-hacks').registerBuilding{name="BONE_GRINDER",
  consume=15,
  auto_gears=true
}
```

## Luasocket

A way to access csocket from lua. The usage is made similar to luasocket in vanilla lua distributions. Currently only subset of functions exist and only tcp mode is implemented.

### Socket class

This is a base class for `client` and `server` sockets. You can not create it - it's like a virtual base class in c++.

- `socket:close()`  
Closes the connection.
- `socket:setTimeout(sec,msec)`  
Sets the operation timeout for this socket. It's possible to set timeout to 0. Then it performs like a non-blocking socket.

### Client class

Client is a connection socket to a server. You can get this object either from `tcp:connect(address,port)` or from `server:accept()`. It's a subclass of `socket`.

- `client:receive(pattern)`  
Receives data. Pattern is one of:
  - **\*l** read one line (default, if pattern is *nil*)
  - **<number>** read specified number of bytes
  - **\*a** read all available data
- `client:send(data)`  
Sends data. Data is a string.

## Server class

Server is a socket that is waiting for clients. You can get this object from `tcp:bind(address, port)`.

- `server:accept()`

Accepts an incoming connection if it exists. Returns a `client` object representing that socket.

## Tcp class

A class with all the tcp functionality.

- `tcp:bind(address, port)`

Starts listening on that port for incoming connections. Returns `server` object.

- `tcp:connect(address, port)`

Tries connecting to that address and port. Returns `client` object.

## Scripts

- *Enabling and disabling scripts*
- *Save init script*

Any files with the `.lua` extension placed into `hack/scripts/*` are automatically used by the DFHack core as commands. The matching command name consists of the name of the file without the extension. First DFHack searches for the script in the `<save_folder>/raw/scripts/` folder. If it is not found there, it searches in the `<DF>/raw/scripts/` folder. If it is not there, it searches in `<DF>/hack/scripts/`. If it is not there, it gives up.

If the first line of the script is a one-line comment, it is used by the built-in `ls` and `help` commands. Such a comment is required for every script in the official DFHack repository.

---

**Note:** Scripts placed in subdirectories still can be accessed, but do not clutter the `ls` command list (unless `ls -a`; thus it is preferred for obscure developer-oriented scripts and scripts used by tools. When calling such scripts, always use `'/'` as the separator for directories, e.g. `devel/lua-example`).

---

Scripts are re-read from disk if they have changed since the last time they were read. Global variable values persist in memory between calls, unless the file has changed. Every script gets its own separate environment for global variables.

Arguments are passed in to the scripts via the `...` built-in quasi-variable; when the script is called by the DFHack core, they are all guaranteed to be non-nil strings.

DFHack core invokes the scripts in the *core context* (see above); however it is possible to call them from any lua code (including from other scripts) in any context, via the same function the core uses:

- `dfhack.run_script(name[, args...])`

Run a lua script in `hack/scripts/`, as if it was started from dfhack command-line. The `name` argument should be the name stem, as would be used on the command line.

Note that this function lets errors propagate to the caller.

- `dfhack.script_environment(name)`

Run an Lua script and return its environment. This command allows you to use scripts like modules for increased portability. It is highly recommended that if you are a modder you put your custom modules in `raw/scripts` and use `script_environment` instead of `require` so that saves with your mod installed will be self-contained and can be transferred to people who do have DFHack but do not have your mod installed.

You can say `dfhack.script_environment('add-thought').addEmotionToUnit([arguments go here])` and it will have the desired effect. It will call the script in question with the global `moduleMode` set to `true` so that the script can return early. This is useful because if the script is called from the console it should deal with its console arguments and if it is called by `script_environment` it should only create its global functions and return. You can also access global variables with, for example `print(dfhack.script_environment('add-thought').validArgs)`

The function `script_environment` is fast enough that it is recommended that you not store its result in a nonlocal variable, because your script might need to load a different version of that script if the save is unloaded and a save with a different mod that overrides the same script with a slightly different functionality is loaded. This will not be an issue in most cases.

This function also permits circular dependencies of scripts.

- `dfhack.reqscript(name)` or `reqscript(name)`

Nearly identical to `script_environment()` but requires scripts being loaded to include a line similar to:

```
--@ module = true
```

This is intended to only allow scripts that take appropriate action when used as a module to be loaded.

## Enabling and disabling scripts

Scripts can choose to recognize the built-in `enable` and `disable` commands by including the following line anywhere in their file:

```
--@ enable = true
```

When the `enable` and `disable` commands are invoked, a `dfhack_flags` table will be passed to the script with the following fields set:

- `enable`: Always true if the script is being enabled *or* disabled
- `enable_state`: True if the script is being enabled, false otherwise

## Save init script

If a save directory contains a file called `raw/init.lua`, it is automatically loaded and executed every time the save is loaded. The same applies to any files called `raw/init.d/*.lua`. Every such script can define the following functions to be called by DFHack:

- `function onStateChange(op) ... end`

Automatically called from the regular `onStateChange` event as long as the save is still loaded. This avoids the need to install a hook into the global `dfhack.onStateChange` table, with associated cleanup concerns.

- `function onUnload() ... end`

Called when the save containing the script is unloaded. This function should clean up any global hooks installed by the script. Note that when this is called, the world is already completely unloaded.

Within the init script, the path to the save directory is available as `SAVE_PATH`.



## Data Structure Definition Syntax

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This document documents the XML syntax used to define DF data structures for use in dfhack.

## General Background

Originally dfhack used a file called `Memory.xml` to describe data structures of the game. It explicitly listed addresses of known global variables, and offsets within structures to fields, not unlike the ini files used by Dwarf Therapist.

This format is a good choice when only a small number of fields and objects need to be accessed, and allows a program to work with many different versions of DF, provided that the relevant fields and objects work in the same way.

However, as the number of known fields and objects grow, maintaining the explicit offset lists quickly becomes difficult and error prone. Also, even when almost all fields of a structure become known, the format fails to represent and exploit their relative position, which in practice is actually more stable than the specific offset values.

This format instead represents data structure layout purely via listing all fields in the correct order, exactly like a structure definition does in the C++ language itself; in fact, these XML definitions are translated into C++ headers in a mostly straightforward way (the more tricky bits are things like correctly processing circular references, or generating metadata for lua). There is still a file with numeric data, but it only contains absolute addresses of global objects.

As a downside, dfhack now needs to be recompiled every time layout of some data structure changes; on the other hand, accessing DF structures from C++ plugins now has no overhead compared with DF's own code. Also, practice shows that the more fields are known in a structure, the easier it is to spot what exactly has changed, and fix the exact area.

## XML file format

All XML files use `<data-definition>` as their root tag.

They should be indented using 4 spaces per level, without tabs.

Unless noted otherwise, all non-root tags allow using a *comment* attribute, or a `<comment>...</comment>` sub-tag. It may be used to include a comment string that can be used by tools processing the xml.

Excluding content of tags like `<comment>` or `<code-helper>`, all plain text inside tag bodies is ignored and may be freely used instead of XML comments.

**NOTE:** Using XML tags and/or attributes not defined in this document is not allowed.

## Enum type definition

Global enum types are defined as follows:

```
<enum-type type-name='name' [base-type='int32_t']>
  <enum-item [name='key1'] [value='0']/>
  <enum-item [name='key2'] [value='1']/>
  ...
</enum-type>
```

Every enum has an integer base type, which defaults to `int32_t` if omitted.

Like in C++, enum items may either explicitly specify an integer value, or rely on auto-increment behavior.

**NOTE:** Due to a codegen limitation, specifying value on any item other than the first one prevents using the attribute feature described below.

As in most cases, the *name* attribute may be omitted if unknown; the code generator would produce a random identifier to satisfy C++ language requirements.

## Enum item attributes

The XML syntax allows associating attributes with enum items, thus embedding lookup tables for use in C++ or lua code.

Every attribute must be declared at the top level of the enum:

```
<enum-attr name='attr'
    [type-name='primitive-or-enum']
    [default-value='...']
    [use-key-name='true/false']
    [is-list='true/false']/>
```

The declaration allows specifying a numeric, or other enum type for the attribute, overriding the default `const char*` string type.

An explicit default value may also be specified; otherwise the attribute defaults to `NULL` or `0`. If `use-key-name` is *true*, the corresponding `enum-item`'s *name* is used as the default value.

Alternatively, an attribute may be declared to be a list, instead of a scalar. In this case, the default is an empty list.

**NOTE:** Attribute name `'key'` is reserved for a built-in string attribute representing the enum item key.

For every declared attribute, every `enum-item` tag may contain an attribute value definition:

```
<enum-item name='key'>
    <item-attr name='attr' value='...'/>
    ...
</enum-item>
```

For list attributes, multiple `item-attr` entries may be used to define the list contents.

## Bitfield type definition

Global bitfield types are defined as follows:

```
<bitfield-type type-name='name' [base-type='uint32_t']>
    <flag-bit [name='bit1'] [count='1'] [type-name='enum']/>
    <flag-bit [name='bit2'] [count='1'] [type-name='enum']/>
    ...
</bitfield-type>
```

Like enums, bitfields have an integer base type, which defaults to `uint32_t`. The total number of bits in the bitfield must not exceed the base type size.

A bitfield item may be defined to occupy multiple bits via the *count* attribute. It also may have an enum type; due to compiler limitations, the base-type of the enum must be exactly the same as the bitfield itself.

## Structure type definition

Structures without virtual methods are defined as follows:

```
<struct-type type-name='name'
  [is-union='true/false']
  [inherits-from='struct_type']
  [instance-vector='expr']
  [key-field='identifier']>
  ...
  fields
  ...
</struct-type>
```

The *instance-vector* attribute may be used to specify a global vector that canonically contains all instances of the structure. Code generation uses it to produce a `find` static method. If *key-field* is specified, this method uses binary search by the referred field; otherwise it just indexes the vector with its integer argument.

## Common field properties

All fields support the following attributes:

**name** Specifies the identifier naming the field.

This attribute may be omitted, in which case the code generator produces a random identifier. As follows from the word random, such identifiers aren't stable, and shouldn't be used to access the field.

**init-value** Specifies the value that should be assigned to the field by the constructor. By default the following values are used:

- For enums: the first element of the enum.
- For signed integer fields with `ref-target` or `refers-to`: -1.
- For other numeric fields, pointers and bitfields: 0.

**offset, size, alignment** Specifies the offset, size and alignment in bytes.

**WARNING:** Although allowed for any field by the XML syntax, and supported by the lisp GUI tool, code generation will fail with these attributes except in cases specifically shown below.

With the above caveat, `size` and `alignment` may also be used on the `struct-type` tag itself.

## Primitive fields

Primitive fields can be classified as following:

1. Unmarked area:

```
<padding name='id' size='bytes' [alignment='1/2/4'] .../>
```

This tag defines an area of raw bytes with unknown contents.

2. Numbers:

```
<int32_t name='id'.../>
```

Supported number types are: `int8_t`, `uint8_t`, `int16_t`, `uint16_t`, `int32_t`, `uint32_t`, `int64_t`, `uint64_t`, `s-float` (single float), `d-float` (double float).

3. Boolean:

```
<bool name='id'.../>
```

#### 4. String:

```
<static-string name='id' size='bytes'.../>
<ptr-string name='id'.../>
<stl-string name='id'.../>
```

These tags correspond to `char[bytes]`, `char*`, and `std::string`.

#### 4. File Stream:

```
<stl-fstream name='id'/>
```

This is not really a primitive type, but classified as such since it is treated as a predefined opaque object (a-la padding).

Primitives support the following attributes:

`refers-to='expr'`

Specifies a GUI hyperlink to an object returned by an arbitrary expression.

The expression receives the value of the field as `$`, and the reference to the field as `$$`.

`ref-target='type'`

Specifies a hyperlink to an instance of *type*, identified by the value of the field. The instance is retrieved via *instance-vector* and *key-field*, or a `<code-helper name='find-instance'>` in the target type definition.

`aux-value='expr'`

Specifies an additional value for use in the *find-instance* code helper.

Unlike *refers-to*, the expression receives the **reference** to the field as `$`, and a reference to the containing structure as `$$`; i.e. the arguments are shifted one step toward parent. This is because the value of the field is already implicitly passed to *find-instance*.

The *find-instance* helper receives the field value as `$`, and `aux-value` as `$$`.

## Substructure fields

Nested structures are defined via the `compound` tag:

```
<compound name='id' type-name='struct_type'/>

<compound [name='id'] [is-union='true/false'] [key-field='id']>
  ...
  field
  ...
</compound>
```

As seen above, a nested structure may either use a global type defined elsewhere, or define an ad-hoc structure in-place. In the in-place case, omitting *name* has a special meaning of defining an anonymous nested struct or union.

## Enum fields

Fields of enum types are defined as follows:

```
<enum name='id' type-name='enum_type' [base-type='int32_t'] />

<enum name='id' [base-type='int32_t']>
  <enum-item name='key1' .../>
  ...
</enum>
```

Like with substructures, enums may be either referenced globals, or ad-hoc definitions.

In the former case, when *base-type* of the field and the enum differ, a special wrapper is added to coerce the size, or, if impossible, the enum type is completely replaced with the *base-type*. The net effect is that the field *always* has the expected size and alignment.

If no *base-type* is specified on the field, the one in the global type definition has complete precedence. This is not recommended.

## Nested bitfields

Ad-hoc bitfields are defined as follows:

```
<bitfield name='id' [base-type='uint32_t']>
  <flag-bit name='key1' .../>
  ...
</bitfield>
```

In order to reference a global type, use `<compound>`.

## Container fields

A number of tags fall under the ‘container’ abstraction. The common element is that the fields they define reference objects of another type. This includes things like pointers, arrays or vectors.

### Abstract container

The basic syntactic property of a container is that it requires exactly one nested field tag in order to specify the contained item:

```
<container>
  <field .../>
</container>
```

**NOTE:** The `container` tag is used here as a placeholder for any real tag following the container syntax.

For convenience, the following automatic rewrite rules are applied:

1. The `type-name` attribute:

```
<container type-name='foo' .../>
```

is rewritten into:

```
<container ...>
  <compound type-name='foo' .../>
</container>
```

or, if *foo* is a primitive type:

```
<container ...>
  <foo .../>
</container>
```

## 2. The pointer-type attribute:

```
<container pointer-type='foo' .../>
```

is rewritten into:

```
<container ...>
  <pointer type-name='foo' .../>
</container>
```

## 3. Multiple nested fields:

```
<container ...>
  <field1 .../>
  <field2 .../>
</container>
```

are aggregated together:

```
<container ...>
  <compound ...>
    <field1 .../>
    <field2 .../>
  </compound>
</container>
```

## 4. If no item is specified, padding is assumed:

```
<container>
  <padding size='4' />
</container>
```

**NOTE:** These rules are mutually exclusive, and it is an error to specify both of the attributes (unless it is `type-name='pointer'`), or combine nested fields with any of them.

When the above rewrites are applied and result in creation of a new tag, the following attributes are copied to it from the container tag, if applicable: `key-field`, `refers-to`, `ref-target`, `aux-value`. They otherwise have no effect on the container itself.

This means that:

```
<container pointer-type='int32_t' ref-target='foo' />
```

eventually rewrites to:

```
<container pointer-type='int32_t' ref-target='foo'>
  <pointer type-name='int32_t' ref-target='foo'>
    <int32_t ref-target='foo' />
  </pointer>
</container>
```

```
</pointer>
</container>
```

Abstract containers allow the following attributes:

`has-bad-pointers='true'`

Tells the GUI tool to ignore this field in some of its memory scans, because this container may contain invalid pointers, which can confuse the analysis code.

## Pointer fields

As seen above, the `pointer` tag is a subtype of abstract container.

If the pointer refers to an array of objects, instead of one instance, the `is-array` attribute should be used:

`<pointer type-name='foo' is-array='true'/>`

Currently this attribute is ignored by C++ code generation, but the GUI tool properly displays such fields as arrays.

## Abstract sequence

Containers that actually contain a sequence of objects support these additional attributes:

`index-refers-to='expr'`

Specifies a GUI hyperlink from any item in the container to the object returned by the expression.

The expression receives the index of the item in the container as `$`, and a reference to the container as `$$`.

`index-enum='enum_type'`

Associates an enum with the indices of the container. The GUI tries to use enum item names instead of numbers when displaying the items, and lua may allow using strings as indices.

## Standard containers

`<static-array name='id' count='123' .../>`

Defines a simple C++ array of the specified length.

`<stl-vector name='id'.../>`

Defines an `std::vector<item>` field.

`<stl-deque name='id'.../>`

Defines an `std::deque<item>` field.

`<stl-set name='id'.../>`

Defines an `std::set<item>` field.

`<stl-bit-vector name='id'.../>`

Defines an `std::vector<bool>` field.

STL defines `vector<bool>` as a special type that actually contains bits. These XML definitions use a separate tag for it; `<stl-vector type-name='bool'/>` is rendered into C++ as `vector<char>`.



## DF-specific containers

These are defined in df-code.lisp:

```
<df-flagarray name='id' index-enum='enum' />
```

Defines a BitArray<enum> field.

```
<df-static-flagarray name='id' index-enum='enum' count='numbytes' />
```

Defines a StaticBitArray<numbytes,enum> field.

```
<df-array name='id' .../>
```

Defines a DfArray<item> field.

```
<df-linked-list name='id' type-name='foo_link' />
```

Defines an ad-hoc DF-style linked list. In C++ actually equivalent to:

```
<compound type-name='foo_link' />
```

but allows the GUI to display it as a list.

## Class type definition

In the context of these XML definitions, class denotes types with virtual methods:

```
<class-type type-name='name'
  [inherits-from='class_type']
  [original-name='vtable_name']
  ...>
  ...
  fields
  ...
  <virtual-methods>
    ...
    vmethods
    ...
  </virtual-methods>
</class-type>
```

Classes are generally the same as <struct-type>, including support for *instance-vector*. Unlike <struct-type> however, they don't allow *is-union='true'*.

There may only be one table of virtual methods per class-type. In subclasses it should only contain items added to the table of the superclass.

## Virtual method definition

Virtual method definitions are placed within the <virtual-methods> section of a class type. No other tag may be placed within that section, including *comment*.

A virtual destructor is defined as follows:

```
<vmethod is-destructor='true' />
```

Ordinary virtual methods use the following syntax:

```
<vmethod [name='id'] [ret-type='type']>
  [<ret-type .../>]
  <field1.../>
  <field2.../>
  ...
</vmethod>
```

The return type may be specified either as an attribute, or via a `ret-type` sub-tag. The subtag syntax follows the abstract container model outlined above. The attribute is exactly equivalent to `<ret-type type-name='type' />` as subtag. If the return type is completely omitted, it is taken to be void.

Ordinary field definition tags within the `vmethod` tag are treated as method parameters.

If the *name* attribute is omitted, the `vmethod` is named randomly and made protected, so that calling it is impossible. This is the intended way of providing placeholders for completely unknown slots in the `vtable`.

## Global object definition

Global objects are global pointers that are initialized from `symbols.xml` at runtime. Therefore, the tag itself is identical in syntax to `<pointer>`, except that it doesn't allow *is-array*:

```
<global-object name='id' type-name='...' />

<global-object name='id'>
  <field.../>
</global-object>
```

C++ generation places them in the `df::global` namespace.

The *offset* attribute of the `global-object` tag represents the absolute address. As noted above, it may only be used in files intended for the GUI.

## Symbol table definition

Symbol tables are defined in `symbols.xml` and loaded at runtime. They define locations of global objects and virtual tables.

The definition syntax is as follows:

```
<symbol-table name='...' os-type='...'>
  <md5-hash value='...' />
  <binary-timestamp value='0x...' />
  ...

  <global-address name='...' [value='0x...'] />
  ...

  <vtable-address name='...' [value='0x...'] />
  ...
</symbol-table>
```

The *name* attribute specifies an unique name of the symbol table. *os-type* specifies the applicable OS type, and must be one of `windows`, `linux`, `darwin`.

The `<md5-hash>` tag specifies the MD5 hash that is used to match the executable on Linux and OS/X. It will be ignored if used in a windows symbol table. Likewise, `<binary-timestamp>` is valid only for matching EXE files.

A symbol table may contain multiple tags in order to match several executables; this is especially useful with MD5 hashes, which change with patching.

Global object addresses are specified with `<global-address>` tags. Virtual method table addresses may be pre-initialized with `<vtable-address>` tags.

It is allowed to specify addresses for objects and vtables that are otherwise not defined. Obviously, such values can only be used by directly quering the `VersionInfo` object in `dfhack`.

## Lisp Integration

This XML file format was designed together with the `cl-linux-debug` Lisp tool, and has a number of aspects that closely integrate with its internals.

For instance, when loaded by that tool, all XML tags are converted directly into instances of classes that exactly match the name of the tag, and when the documentation above mentions expressions, that refers to Lisp expressions within the context of that library.

## Reference expressions

In order to facilitate compact representation for long chains of dereferences that are commonly required when dealing with the data structures, `cl-linux-debug` defines a reader macro (i.e. basically a parser plugin) that adds a custom syntax for them. This syntax is triggered by special characters `$` and `@`.

Expressions written in that syntax expand into nested chains of calls to two generic functions named `$` and `@`, which implement correspondingly r-value and l-value dereference of their first argument using the second.

## Dereference syntax

The reader macro understands the following syntactic patterns:

- `@, $, $$, $$$, ...`

Lone `@` and sequences of `$` are parsed just as the ordinary lisp parser would. This allows referring to the `$` and `@` functions, and using sequences of `$` characters as implicit argument names.

- `$foo`

A case-sensitive identifier preceeded by the `$` character is interned in the `cl-linux-debug.field-names` package as-is, and returned as the parsing result. The identifier may consist of letters, numbers, and `-` or `_` characters.

The symbol is exported from its package and defined as a symbol macro expanding to `'$foo`, and thus behaves as a case-sensitive keyword (which however can be used as a lexical variable name). All field & type names and other identifiers in the XML definitions are loaded into memory as such symbols.

- `$foo:bar`

This expands into `'($foo . $bar)`; such pairs of identifiers are used in some special contexts.

- `$foo.bar, @foo.bar`

These expressions expand to correspondingly `($ foo '$bar)` and `(@ foo '$bar)`, representing thus r-value or l-value dereference of variable `foo` with literal key `$bar`.

The name `foo` may only contain characters listed above, but is otherwise separated and parsed with the regular lisp parser.

- `$foo.*`, `$foo[*]`, `$foo.@`, `$foo[@]`, `@foo.*` ...

These expand to `($ foo '*)`, `($ foo '@)` etc, thus effectively being a special case of dereference via a literal field name.

- `$foo[expr]`, `@foo[expr]`

These expressions expand to correspondingly `($ foo expr)` and `(@ foo expr)`, and are useful for accessing array elements.

- `$foo.xxx[yyy].zzz`

When dereference clauses are chained, they expand into nested calls to `$` and `@`, with the outermost depending on the first character, and all the inner ones being `@`.

This example expands to: `($ (@ (@ foo '$xxx) yyy) '$zzz)`.

- `@$$foo.bar`, `$$$foo.bar`

When the expression contains multiple initial `$` characters, all but the first one are prepended to the initial variable name.

These examples expand to `(@ $$foo '$bar)` and `($ $$$foo '$bar)`

**NOTE:** Only the `$` character may be used in this way; `$$$@foo.bar` is invalid.

- `$.foo`, `@$[bar]`, ...

If the expression contains no initial identifier, the initial `$` sequence is used as one instead (after replacing `@` with `$` if necessary).

These examples expand to: `($ $ '$foo)`, `(@ $$ bar)`.

**NOTE:** Unlike the previous syntax pattern, this one uses *all* of the initial `$` and `@` characters.

- `$(func arg arg...).bar`

If one initial `$` or `@` is immediately followed by parentheses, the contents of said parentheses are parsed as ordinary lisp code and used instead of the initial variable.

The example expands to: `($ (func arg arg...) '$bar)`

- `@$(foo bar baz)`

If an initial `@` is followed by one or more `$` characters and then parentheses, it is parsed as a lambda expression (anonymous function) with one argument consisting of those `$` characters.

This example expands to: `(lambda ($) (foo bar baz))`

**NOTE:** it is an error to use multiple initial `$` characters without `@` like this: `$$$ (...)` ...

## Basic properties

As described above, dereference is actually implemented by two generic functions, `@` and `$`, which implement l-value and r-value dereference.

They are defined as such:

```
(defgeneric @ (obj key))
(defgeneric $ (obj key))
(defgeneric (setf $) (obj key))
```

Generally, l-value dereference returns an object that can be dereferenced further. R-value dereference with the same arguments may return the same object as l-value, or a simple scalar value, depending on the context.

Perhaps oppositely to the used terms, only the r-value dereference function may be used as the *syntactic* target of assignment; this is because you can't actually change the (conceptual) address of an object, only its contents; and l-value dereference returns an address. I.e. in C++ you can write `*a = ...`, but can't do `&a = ...`.

Any of the dereference functions may return a list to represent multiple possible values. Array objects often define `(@foo '*')` to return all of the elements.

If either the `obj` or `key` argument of any of the functions is a list (including *NIL* as empty list), the functions loop over the list, and return a concatenation of the resulting return value lists. This allows using `$array.*.field` to get a list of all values of a field within array elements.

`($ obj t)` is defined as the *natural* value of an object; e.g. if `obj` is a reference to a numeric field, this will be its value. By default it is equal to the object itself. `($ obj key)` for any other key would fall back to `($ (@ obj key) t)` if no special handler for `$` with that key and object was defined.

## Reference objects

The `cl-linux-debug` library represents typed pointers to objects in memory as objects of the `memory-object-ref` type.

Along with the expected address and type of the pointer, these objects also retain a history of dereferences that have led to this particular pointer, and define virtual fields to access this information. This history is similar to what the Back button in a browser uses.

All references by default have the following properties:

- `@ref.value`  
By default returns `ref` itself. May be hidden by struct fields and index-enum keys.
- `@ref[integer]`  
Returns a reference to `address + size*int`, i.e. offsets the pointer.
- `@ref.*`  
Returns a list of contained collection elements. By default empty.
- `@ref.@`  
Returns a list of subfields. By default empty.
- `@ref._parent`  
Returns the previous reference in the “back” chain.
- `@ref._global`  
Returns the nearest reference in the “back” chain that has a globally named type, i.e. one defined by a `struct-type`, `class-type` etc, and not by any nested substructures. This may return the `ref` itself.
- `@ref._upglobal`  
Exactly equivalent to `@ref._parent._global`.
- `$ref._address`  
Returns the numeric address embedded in the `ref`.
- `$ref._size`  
Returns the size of the object pointed to.

- `$ref._key`

Returns the key that was used to get this ref from the parent. This is not guaranteed to be precisely accurate, but e.g. for array elements this will be the array index.

- `$ref._type`

For globally named types, returns their type name.

## Primitive types

Primitive types define the following methods:

- `$ref[t]`

The natural value of a primitive field is the scalar non-reference value it contains.

**NOTE:** When you write `$struct.field`, it will evaluate via `($ @struct.field t)`.

- `@ref.refers-to`, `@ref.ref-target`

If the field has the relevant attributes, they can be dereferenced to retrieve the target objects.

## Enums

Enum fields return their value as symbols, and allow access to attributes:

- `$ref[t]`

Returns the symbol matching the value, unless there is none. May be assigned both as symbol or number.

- `$ref.attribute`

If the enum has an attribute with that name, retrieves its value for the current value of the field.

## Pointers

- `$ref[t]`, `@ref[t]`, `$ref._target`, `@ref._target`

These all return the value of the pointer, i.e. a reference to the target object.

- `($ ref key) -> ($ (@ ref t) key)`

- `(@ ref key) -> (@ (@ ref t) key)`

All dereferences not explicitly supported are delegated to the target object. This means that for most properties pointers are completely transparent; notable exceptions are pointers to pointers, and pointers to primitive fields where you have to use e.g. `$struct.ptrfield.value`.

## Compounds

- `@ref.field`, `@ref._fields.field`

Returns a reference to the given field.

- `@ref.*`, `@ref.@`

Returns a list of references to all fields. Note that if the object is both an implicit compound and a sequence, `@ref.*` will return the sequence items as described below.

## Sequences

- `@ref[int]`  
Returns a reference to the Nth item of the sequence.
- `@ref[symbol]`  
If the sequence has an `index-enum`, its items can be accessed by symbolic names.
- `@ref.*`  
Returns a list of all items of the sequence.
- `@ref._items`  
Returns the items of the sequence as a special lazy object, intended to optimize some things in the GUI.
- `@ref.index-refers-to[int]`  
If the sequence has the relevant attribute, returns the target for the given index.
- `$ref.count`  
Returns the number of items in the sequence.
- `$ref.has-items`  
Checks if the sequence has any items, and returns T or NIL.

## Code helpers

The `<code-helper>` tag may be used to add lisp code fragments to the objects defined in the xml. The `refers-to`, `index-refers-to` and `ref-target` tags are also converted to code helpers internally, and you can use e.g. `<code-helper name='refers-to'>...</code-helper>` instead of the attribute if your expression is too long for it.

There are two features that can only be implemented via explicit `<code-helper>` tags:

- `<code-helper name='describe'> ... </code-helper>`

This specifies a piece of code that is called to supply additional informational items for the rightmost column of the table in the GUI tool. The code should return a string, or a list of strings.

As with `refers-to`, the code receives the value of the object as `$`, and the reference to the object in `$$` (i.e. `$` is equal to `$$[t]`).

The `(describe-obj object)` function can be used to call the same describe mechanism on another object, e.g.:

```
<code-helper name='describe'> (describe-obj $.name) </code-helper>
```

- `<code-helper name='find-instance'> ... </code-helper>`

If the `instance-vector` and `key-field` attributes are not descriptive enough to specify how to find an instance of the object by id, you can explicitly define this helper to be used by `ref-target` links elsewhere.

It receives the value of the `ref-target` bearing field as `$`, and its `aux-value` as `$$`.

Other than via `ref-target`, you can invoke this mechanism explicitly using the `(find-instance class key aux-key)` function, even from a `find-instance` helper for another type:

```
<code-helper name='find-instance'>$(find-instance $art_image_chunk $$).images[$]</code-helper>
```

This finds an instance of the `art_image_chunk` type using the aux-value `$$`, and then returns an element of its `images` sub-array using the main value `$`.

## Examples

- `@global.*`

The global variable 'global' contains a special compound that contains all known global objects. This expression retrieves a list of refs to all of them.

Using `$global.*` would return values for the primitive ones instead of refs, and is not that useful.

- `$global.world.units.all[0].id`

This expression is syntactically parsed into the following sequence:

```
tmp = global
tmp = @tmp.world ; the world global ref
tmp = @tmp.units ; the units field ref
tmp = @tmp.all   ; the all vector ref
tmp = @tmp[0]    ; the first unit object pointer ref
$tmp.id
```

The only non-trivial step here is the last one. The last value of `tmp` is a reference to a pointer, and as described above, it delegates anything it does not directly understand to its target, adding an implicit step at runtime:

```
unit = @tmp._target
$unit.id
```

A unit object does not define `$unit.id` directly either, so the final step falls back to:

```
idref = @unit.id
($ idref t)
```

which retrieves a reference to the `id` field, and then evaluates its natural value.

The result is that the expression returns the `id` value of the first unit in the vector as would be naturally expected.

Using `@global.world.units.all[0].id` would have used `@tmp.id` as the last step, which would have skipped the `($ idref t)` call and returned a reference to the field.

- A simple `index-refers-to` example:

```
<stl-vector name='created_weapons' type-name='int32_t'
            index-refers-to='$global.world.raws.itemdefs.weapons[$]'/>
```

This is used to define a vector with counts of created weapons.

When it is displayed in the GUI, the tool evaluates the `index-refers-to` expression for every vector element, giving it the *element index* as `$`, and a reference to the vector itself as `$$` (here unused).

The expression straightforwardly uses that index to access another global vector and return one of its elements. It is then used by the GUI to add additional information to the info column.

- An example of `refers-to` and `_parent`:

```
<compound name='burrows'>
  <stl-vector name='list' pointer-type='burrow'/>
  <int32_t name='sel_index' refers-to='$$._parent.list[$]'/>
</compound>
```



This fragment of XML defines a compound with two fields, a vector and an int, which has a `refers-to` attribute. When that field is displayed in the GUI, it evaluates the expression in the attribute, giving it the *integer value* as `$`, and a *reference* to the integer field as `$$`.

The expression parses as:

```
tmp = $$           ; reference to the int32_t field
tmp = @tmp._parent
tmp = @tmp.list
$tmp[$]
```

Since the only way the GUI could get a reference to the field was to evaluate `@ref-to-burrows.sel_index`, that previous reference is stored in its “back” list, and `@tmp._parent` retrieves it. After that everything is simple.

- An example of `ref-target` with `aux-value`:

```
<int32_t name='race' ref-target='creature_raw' />
<int16_t name='caste' ref-target='caste_raw' aux-value='$.race' />
```

The `race` field just specifies a type as `ref-target`, so the reference simply evaluates the `find-instance` helper of the `creature_raw`, passing it the `race` value as `$`.

In order to find the `caste` however, you need to first find a creature, which requires a `race` value. This value is supplied via the `aux-value` attribute into the `$$` argument to `find-instance`.

Since the value of the `caste` field will be passed through to the helper anyway, when evaluating `aux-value` the `$` argument is set to a *reference* to the holding field, and `$$` is set to its `_parent`. This means that `$.race` in the context of `aux-value` is equivalent to `$$._parent.race` in the context of `refers-to`.

- A complex example of cross-references between arrays:

```
<struct-type type-name='caste_raw'>
  <compound name='body_info'>
    <stl-vector name='body_parts' pointer-type='body_part_raw' />
  </compound>
  <compound name='bp_appearance'>
    <stl-vector name='modifiers' pointer-type='bp_appearance_modifier' />

    <stl-vector name='modifier_idx' type-name='int32_t'
      refers-to='$$._parent._parent.modifiers[$]'
      index-refers-to='$$._parent.part_idx[$].refers-to' />
    <stl-vector name='part_idx' type-name='int16_t'
      refers-to='$$._global.body_info.body_parts[$]' />
    <stl-vector name='layer_idx' type-name='int16_t'
      refers-to='$$._parent._parent.part_idx[$._key].refers-to.'
      =>layers[$]'
      index-refers-to='$$._parent.part_idx[$].refers-to' />
  </compound>
</struct-type>
```

In order to understand this example it is first necessary to understand that `refers-to` specified on a vector is actually transplanted onto the implicitly constructed element tag:

```
<stl-vector name='part_idx'>
  <int16_t refers-to='$$._global.body_info.body_parts[$]' />
</stl-vector>
```

Therefore, `$$` is a reference to the `<int16_t>` field, `$$._parent` is a reference to the vector, `$$._parent._parent` is a reference to the `bp_appearance` compound, etc.

The `$$._global...` works as an abbreviation that applies `_parent` until it reaches a globally defined type, which in this case is the current instance of the `caste_raw` struct.

**NOTE:** `$$._global._global` is the same as `$$._global`, i.e. repeated `_global` is a no-op. The latest version supports `_upglobal`, which is equivalent to `_parent._global`.

Thus, the `refers-to` link on the `part_idx` vector evaluates to the element of the `body_parts` vector, indexed by the *value* of the current `part_idx` vector item.

Likewise, the `refers-to` link on the `modifier_idx` vector goes back to the `bp_appearance` compound, and descends into the `modifiers` vector, using the value of the current item.

The `index-refers-to` link on the same `modifier_idx` vector highlights the shared indexing relation between the bottom vectors by linking to the `part_idx` vector via the current item *index*. Since this attribute is hosted by the vector itself, `$$` points at the vector, and only one `_parent` is needed to reach `bp_appearance`.

This link also demonstrates how the defined relations can be reused in other expressions by accessing the target of the `refers-to` link inside `part_idx`. When the `part_idx` vector is accessed simply as `$$$`, `part_idx[foo]`, it evaluates as:

```
tmp = @xxx.part_idx
tmp = @tmp[foo]
($ tmp t)
```

thus returning just an integer value. However, if an additional dereference step is added, it turns to:

```
tmp = @xxx.part_idx
tmp = @tmp[foo]
obj = @tmp.refers-to
($ obj t)
```

which follows the `refers-to` link and evaluates its target.

Finally, the `layer_idx` vector, in addition to specifying the same `index-refers-to` link as `modifier_idx`, uses the link in `part_idx` to access other objects at its end:

```
refers-to='$$._parent._parent.part_idx[$$._key].refers-to.layers[$]'
```

Note how this link has to use two `_parent` steps again due to being attached to the element of the vector instead of the vector itself. It also has to use the `_key` attribute of the vector element to retrieve the current index in the vector, because here `$` holds the element value.

## Updating DF-structures for a new DF version

### Contents

- *Updating DF-structures for a new DF version*
  - *General Process*
  - *Running Dwarf Fortress*
  - *Available Scripts*
  - *STAGE 1. Linux compound globals*
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- *STAGE 3. Linux primitive globals*
- *STAGE 4. Primary windows compound globals*
- *STAGE 5. Secondary windows compound globals*
- *STAGE 6. Windows primitive globals*

## General Process

Download the new versions. The scripts expect the following directory layout:

```
~userhome/
  Games/
    DF/
      df_linux/      - Current DF for linux
      df_windows/    - Current DF for windows
      df_osx/        - Current DF for osx

      metasm/        - Checkout of the library for ruby scripts
                      from https://github.com/jjyg/metasm
      df_misc/        - Checkout of the ruby scripts
                      from https://github.com/jjyg/df\_misc
      dfhack/         - DFHack checkout
```

- Use “new-release.pl v0.??.??” to automatically perform a number of steps. If you get a mismatch error from match-ctors.pl, see “STAGE 1”.
- Start the linux DF version, and launch the tool.
- Execute (reset-state-annotation)
- Commit.
- Use the tool to verify that the layout of the compound globals on linux is correct, and update xml as necessary. Check that unit seems reasonable, etc. Compare the changes in g\_src between releases. Delete redundant entries for some linux & osx globals in symbols.xml.
- Compile DFHack without plugins for windows and run devel/find-offsets to find globals there.
- With the windows version in wine, run (check-struct-sizes) to see if any objects changed their size. If nothing is obviously wrong, use (check-struct-sizes :annotate? t) to mark correctly sized objects ALIGNED.
- Check the rest of the document for info on finding still missing globals.
- Commit.
- Run make-csv.sh to update CSV files and verify vtable size and argument counts.
- Commit.

## Running Dwarf Fortress

The lisp tool expects that the game is started in a mode where all allocated memory is automatically filled with a certain byte value.

On linux this is achieved by simply starting the game like this:

```
MALLOC_PERTURB_=45 ./df
```

Windows requires applying a patch to a copy of the executable like this:

```
cp -f 'Dwarf Fortress.exe' 'Dwarf_Fortress_malloc.exe'
ruby -I ~/Games/DF/metasm ~/Games/DF/df_patchmalloc.rb 'Dwarf_Fortress_malloc.exe'
```

## Available Scripts

### **new-release.pl**

Takes the full v0.???.?? version number as one required parameter.

Uses md5sum for linux and winedump for windows to find out the new hash and PE timestamp.

Use the stamps to create new sections in symbols.xml Also paste them into make-csv inside start.lisp

Creates an empty v0.???.??lst, and change the open-annotations filename in start.lisp.

Wipes linux/df\_globals.xml empty of all the global definitions.

Runs make-scans.sh to find out addresses of vtables and many linux/osx globals, and pastes them into symbols.xml

### **make-scans.sh**

Runs ruby and perl scripts to extract data from the executables, and writes the output to txt files in subdirectories.

### **make-csv.sh**

Uses the lisp tool and some scripts to produce csv files with offsets for linux and windows. These are useful for manual lookup and some scripts.

### **start.sh**

Starts the lisp tool. You may pass the process ID as a parameter to avoid the prompt.

### **make-keybindings.pl**

Used by make-scans to extract the keybinding enum from g\_src in form of df.keybindings.xml

### **match-ctors.pl**

Used by make-scans to compare the extracted addresses of the compound linux/osx globals with a saved copy from a previous version and thus determine their names.

### **match-vtables.pl**

Used by make-csv.sh to produce a file listing the addresses of all virtual methods in a compact form. Relies on csv files and data from make-scans.sh

## STAGE 1. Linux compound globals

(done by new-release.pl normally)

Linux and OSX initialize and destruct their complex globals in a way that allows to determine their addresses by disassembling a small section of the executable. This is currently done by ruby scripts called from new-release.pl; it is also possible to do that via the lisp tool for linux.

The ruby scripts produce a raw dump of the global addresses as linux/ctors.txt. A perl script is then used to compare it with linux/ctors-base.txt (which is manually edited and committed into the repository), and thus derive the names of the globals by their order. The resulting data is written back to linux/ctors.txt, linux/df.globals.xml and linux/cglobals.txt (which is inserted into symbols.xml).

If the size of a global changes too much, or a new one is added in the middle, this matching may fail. In this case it is necessary to manually match and add the new names to ctors.txt and commit it as ctors-base.txt. After that, run make-scans.sh to rerun the scripts, and paste linux/cglobals.txt into symbols.xml.

OSX behaves exactly the same as linux in this respect.

## STAGE 2. Old way to find Linux compound globals

(now mostly obsolete, retained as fallback and for historical interest)

Globals gps, enabler, gview and init are in the export table for linking with libgraphics, so they are immediately available in (browse @global.\*).

Run (list-globals/linux), paste the results in linux/df.globals.xml, and immediately compare it to the old version from source control. The order of the globals is quite stable, so if sizes look similar, they can be guessed immediately.

The .bss compound section should be done except for 'announcements'.

Run (browse-dataset). The first three -30000 are cursor. Following group of 6 are selection\_rect. After that, at 16-aligned addresses are control\_mode and game\_mode. Tab the game ui to the most common two-pane mode, scroll to the end and find 0x30200. Within this dword ui\_menu\_width is byte 1, ui\_area\_map\_width is byte 2.

(reload), (browse @global.\*), look at the most important globals for misalignment. If found, fix it and delete old tables from symbols.xml.

## STAGE 3. Linux primitive globals

Unpause the game for a moment to let various structures be initialized.

The fields can be found either by a straight memory search, or by looking in the area they are expected to be.

### [A] The 'cur\_year' area.

Located just before ui\_building\_assign\_type.

1. cur\_year / cur\_year\_tick

(find-changes); step with dot; Enter; step; +; step; +; step; +; done

look at values in bss, there will be cur\_year\_tick, and cur\_year is 32 bytes before that.

2. process\_jobs

Designate a building for construction. Look after process\_dig for an enabled boolean.

3. process\_dig

Step the game one step. Designate a tile for digging. Look after cur\_year and before process\_jobs.

Note: this order because designating sometimes sets process\_jobs too.

4. job\_next\_id / ui\_workshop\_job\_cursor

Find a workshop without jobs; (find-changes); add job; Enter; add job; +; add job; +; done Finds job\_next\_id and ui\_workshop\_job\_cursor, the distinction is obvious.

The ui\_workshop\_job\_cursor is expected to be after cur\_year\_tick.

5. ui\_workshop\_in\_add, ui\_building\_in\_resize, ui\_building\_in\_assign

Expected to be in the area after ui\_workshop\_job\_cursor, in this order. Change the relevant state in game and F5.

6. ui\_building\_item\_cursor

Find a cluttered workshop, t; (find-changes); move cursor down; Enter; cursor down; +; cursor down; +; done

Expected to be right after ui\_workshop\_job\_cursor.

7. current\_weather

Subtract 0x1c from cur\_year address. Obviously, a big hack.

It is best to use a save where the contents are non-zero and known to you.

## [B] The ui\_look\_cursor area.

Located in the area of the 124 byte global before ui.

1. ui\_look\_cursor

Like ui\_building\_item\_cursor, but with a cluttered tile and k.

2. ui\_selected\_unit

Find a place with many nearby units; (find-changes); v; Enter; v; new; ...; when returned to origin, 0; 1; 2...; done

Expected to be before ui\_look\_cursor.

3. ui\_unit\_view\_mode

Select unit, page Gen; (find-changes); Inv; Enter; Prf; +; Wnd; +; done

Expected to be after ui\_selected\_unit.

4. pause\_state

(find-changes); toggle pause; Enter; toggle; 0; toggle; 1; etc; done

Expected to be in the area after ui\_look\_cursor.

## [C] The window\_x/y/z area.

Located right after ui\_build\_selector.

1. window\_x, window\_y, window\_z

Use k, move window view to upper left corner, then the cursor to bottom right as far as it can go without moving the view.

(find-changes); Shift-RightDown; Enter; Shift-RightDown; + 10; Shift-RightDown; + 10; done

Finds cursor and two variables in bss. Z is just after them.

### [D] Random positions.

#### 1. announcements

Immediately follows d\_init; starts 25 25 31 31 24 ...

## STAGE 4. Primary windows compound globals

After aligning globals on linux, run (make-csv) to produce offset tables.

### 1. world

Set a nickname, search for it; the unit will have it at offset 0x1C. Then trace back to the unit vector, and subtract its offset.

### 2. ui

Open the 's'quad sidebar page. Navigate to a squad in world.squads.all, then backtrace and subtract the offset of ui.squads.list.

### 3. ui\_build\_selector

Start creating a building, up to the point of material selection. Find the material item through world and backtrack references until .bss.

### 4. ui\_sidebar\_menus

Select a unit in 'v', open inventory page, backtrack from unit\_inventory\_item, subtract offset of unit.inv\_items.

### 5. ui\_look\_list

Put a 'k' cursor over a unit, backtrack to a 0x10 bytes object with pointer at offset 0xC, then to the global vector.

### 6. ui\_advmode

In adventure mode, open the 'c'ompanions menu, then backtrack from world.units.active[0] (i.e. the player) via ui\_advmode.companions.unit

Alternatively, look before ui\_look\_list for "0, 15" coming from the string.

### 7. enabler

(find-changes), resize the window, enter; resize width by +1 char, +; repeat until few candidates left; then done, select the renderer heap object and backtrack to enabler.renderer.

Alternatively, look before ui for clocks changing every frame.

## 8. map\_renderer

Put a 'v' cursor exactly above a unit; backtrack from the unit object.

Alternatively, look before ui\_advmode for the unit pointer list.

## 9. texture

Load the game with [GRAPHICS:YES] in init.txt, and example set. Then search for string "example/dwarves.bmp" and backtrack.

Alternatively, look between ui\_build\_selector and init.

# STAGE 5. Secondary windows compound globals

These are too difficult to find by backtracking or search, so try looking in the expected area first:

## 1. timed\_events

Look for a pointer vector around -0x54 before ui.

## 2. ui\_building\_assign\_\*

### 2a. ui\_building\_assign\_is\_marked

Assign to zone, (find-changes), toggle 1st unit, enter; toggle 1st, 0; toggle 1st, 1; toggle 2nd, new; done

The vector is expected to be just before ui.

### 2b. ui\_building\_assign\_items

Expected to be immediately before ui\_building\_assign\_is\_marked.

### 2c. ui\_building\_assign\_units

Start assigning units to a pasture, backtrack from one of the units.

The vector is expected to be immediately before world.

### 2d. ui\_building\_assign\_type

The vector is expected to be 2nd vector immediately after ui\_look\_list.

## 3. gview

Immediately follows ui.

## 4. Init files

### 4a. d\_init

Follows world after a small gap (starts with flagarray).

### 4b. init

Follows ui\_build\_selector after a small gap.



## 5. gps

Look at around offset `ui_area_map_width+0x470` for pointers.

## 6. created\_item\_\*

### 6a. created\_item\_type

Expected to be at around `-0x40` before `world`.

### 6b. created\_item\_subtype

The first vector immediately after `ui_look_list`.

### 6c. created\_item\_matttype

Immediately before `ui_sidebar_menus`.

### 6d. created\_item\_matindex

Before `ui`, after `timed_events`.

### 6e. created\_item\_count

Immediately before `timed_events`.

## STAGE 6. Windows primitive globals

Like linux primitives, except the ordering is completely different.

This section only describes the ordering heuristics; for memory search instructions see linux primitive globals.

### [A] formation\_next\_id

Followed by `ui_building_item_cursor`, `cur_year`.

### [B] interaction\_instance\_next\_id...hist\_figure\_next\_id

Contains `window_x`, `ui_workshop_in_add`.

### [C] machine\_next\_id

Followed by `ui_look_cursor`, `window_y`.

### [D] crime\_next\_id

Followed by, in this order (but with some gaps):

- `ui_workshop_job_cursor`
- `current_weather` (immediately after `ui_workshop_job_cursor`)
- `process_dig`
- `process_jobs`
- `ui_building_in_resize`
- `ui_building_in_assign`
- `pause_state`

### [E] Random positions.

1. `cur_year_tick`

- Look immediately before `artifact_next_id`.
- 2. `window_z`
  - Look before `proj_next_id`.
- 3. `ui_selected_unit`
  - Look just after `squad_next_id`.
- 4. `ui_unit_view_mode`
  - Look just before `hist_event_collection_next_id`.
- 5. `announcements`
  - Immediately follows `d_init`; starts 25 25 31 31 24 ...

## Patching the DF binary

Writing scripts and plugins for DFHack is not the only way to modify Dwarf Fortress. Before DFHack, it was common for tools to manually patch the binary to change behaviour, and DFHack still contains tools to do this via the *binpatch* command.

**Warning:** We recommend using a script or plugin instead of a raw patch if at all possible - that way your work will work for many versions across multiple operating systems. There's a reason nobody has written patches since 0.34.11!

### Contents

- *Patching the DF binary*
  - *Getting a patch*
  - *Using a patch*
    - \* *Patching at runtime*
    - \* *Patching on disk*
  - *Tools reliant on binpatches*
    - \* *fix-armory*
    - \* *gui/assign-rack*

## Getting a patch

There are no binary patches available for Dwarf Fortress versions after 0.34.11

This system is kept for the chance that someone will find it useful, so some hints on how to write your own follow. This will require disassembly and decent skill in *memory research*.

- The patches are expected to be encoded in text format used by IDA.
- See [Commit 8a9e3d1a728](#) for examples.
- [Issue 546](#) is about the future of the binpatches, and may be useful reading.

If you want to write a patch, the armory patches discussed here and documented below would probably be the best place to start.

## Using a patch

There are two methods to apply a patch.

### Patching at runtime

The *binpatch* script checks, applies or removes binary patches directly in memory at runtime:

```
binpatch [check|apply|remove] <patchname>
```

If the name of the patch has no extension or directory separators, the script uses `hack/patches/<df-version>/<name>.dif`, thus auto-selecting the version appropriate for the currently loaded executable.

This is the preferred method; it's easier to debug, does not cause persistent problems, and leaves file checksums alone. As with many other commands, users can simply add it to *dfhack\*.init* to reapply the patch every time DF is run.

### Patching on disk

**Warning:** This method of patching is deprecated, and may be removed without notice. You should use the runtime patching option above.

DFHack includes a small stand-alone utility for applying and removing binary patches from the game executable. Use it from the regular operating system console:

**binpatch check "Dwarf Fortress.exe" patch.dif** Checks and prints if the patch is currently applied.

**binpatch apply "Dwarf Fortress.exe" patch.dif** Applies the patch, unless it is already applied or in conflict.

**binpatch remove "Dwarf Fortress.exe" patch.dif** Removes the patch, unless it is already removed.

If you use a permanent patch under OSX or Linux, you must update `symbols.xml` with the new checksum of the executable. Find the relevant section, and add a new line:

```
<md5-hash value='????????????????????????????????' />
```

In order to find the correct value of the hash, look into `stderr.log`; DFHack prints an error there if it does not recognize the hash.

## Tools reliant on binpatches

Some DFHack tools require the game to be patched to work. As no patches are currently available, the full description of each is included here.

## fix-armory

Enables a fix for storage of squad equipment in barracks.

Specifically, it prevents your haulers from moving squad equipment to stockpiles, and instead queues jobs to store it on weapon racks, armor stands, and in containers.

---

**Note:** In order to actually be used, weapon racks have to be patched and manually assigned to a squad. See [gui/assign-rack](#).

---

Note that the buildings in the armory are used as follows:

- Weapon racks (when patched) are used to store any assigned weapons. Each rack belongs to a specific squad, and can store up to 5 weapons.
- Armor stands belong to specific squad members and are used for armor and shields.
- Cabinets are used to store assigned clothing for a specific squad member. They are **never** used to store owned clothing.
- Chests (boxes, etc) are used for a flask, backpack or quiver assigned to the squad member. Due to a probable bug, food is dropped out of the backpack when it is stored.

**Warning:** Although armor stands, cabinets and chests properly belong only to one squad member, the owner of the building used to create the barracks will randomly use any containers inside the room. Thus, it is recommended to always create the armory from a weapon rack.

Contrary to the common misconception, all these uses are controlled by the *Individual Equipment* usage flag. The *Squad Equipment* flag is actually intended for ammo, but the game does even less in that area than for armor and weapons. This plugin implements the following rules almost from scratch:

- Combat ammo is stored in chests inside rooms with Squad Equipment enabled.
- If a chest is assigned to a squad member due to Individual Equipment also being set, it is only used for that squad's ammo; otherwise, any squads with Squad Equipment on the room will use all of the chests at random.
- Training ammo is stored in chests inside archery ranges designated from archery targets, and controlled by the same Train flag as archery training itself. This is inspired by some defunct code for weapon racks.

There are some minor traces in the game code to suggest that the first of these rules is intended by Toady; the rest are invented by this plugin.

## gui/assign-rack

Bind to a key (the example config uses P), and activate when viewing a weapon rack in the `q` mode.



This script is part of a group of related fixes to make the armory storage work again. The existing issues are:

- Weapon racks have to each be assigned to a specific squad, like with beds/boxes/armor stands and individual squad members, but nothing in the game does this. This issue is what this script addresses.
- Even if assigned by the script, **the game will unassign the racks again without a binary patch**. This patch is called `weaponrack-unassign`, and has not been updated since 0.34.11. See [Bug 1445](#) for more info.
- Haulers still take equipment stored in the armory away to the stockpiles, unless *fix-armory* is used.

The script interface simply lets you designate one of the squads that are assigned to the barracks/armory containing the selected stand as the intended user. In order to aid in the choice, it shows the number of currently assigned racks for every valid squad.