Virtual TMB

Template Model Builder in a box
Version 1.6.2 (2015-10-28)

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This is the manual for Virtual Template Model Builder (Virtual TMB) version 1.6.2.
The latest edition of the manual is available at:
http://www.hafro.is/~arnima/tmb.html

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1 Preamble

1.1 Credit

The author of Template Model Builder (TMB) is Kasper Kristensen at DTU Aqua, Denmark.

Jan Jaap Poos (IMARES, Netherlands) and Merrill Rudd (University of Washington, USA) provided useful feedback that improved this manual.

1.2 TMB in a virtual machine

The objectives of Virtual TMB are to

– provide TMB, ready to run on a Linux virtual machine

– make convenient features of Emacs `tmb-mode` available to non-Emacs users; in other words, to disable the standard Emacs behavior

Virtual TMB is especially designed for Windows users, enabling them to build and debug models more efficiently than is possible on the native Windows platform. The virtual machine also makes it easy to quickly install TMB on a variety of computers. This can save time at the beginning of a workshop on statistical computing, for example.

The process of creating statistical models with Template Model Builder (TMB) involves writing, compiling, testing, and debugging. Emacs `tmb-mode` allows the user to perform these tasks efficiently, while maintaining a steady focus on the C++ file, instead of shuffling between applications and window tabs.

Experienced Emacs users may prefer to replace the `.emacs` file that comes with Virtual TMB with their own configuration file. TMB Mode (`tmb.el`) is a standard Emacs 'major mode' and comes with installation instructions in the comment header.

1.3 System requirements

It is recommended that the computer should have at least 4 GB of memory and enough disk space for a 6 GB file. The user needs to install VirtualBox (simple installer, less than 200 MB disk space), if it is not already on the computer.

Virtual TMB makes no permanent changes to the computer, and is easy to remove without a trace.

2 Installation

2.1 VirtualBox

The VirtualBox software, available at `https://www.virtualbox.org`, needs to be installed before setting up Virtual TMB. When using VirtualBox, the normal computer is called the "host" and a virtual machine is called a "guest". The user interface of VirtualBox is a dashboard called VirtualBox Manager, where the user can select, configure, and run virtual machines.

An important option to consider before setting up the virtual machine is to specify where it will be stored on the host computer:

    File → Preferences → General → Default Machine Folder

The default setting, 'C:\Users*username*\VirtualBox VMs' may not be practical, for example if the user directory is an automatic backup area, or subject to administrative restrictions.

2.2 TMB virtual machine

The main component of a virtual machine is the virtual disk image (VDI), which is analogous to a physical hard drive. Like on a regular computer, this hard drive is inserted into a machine that has (virtual) hardware components, including a processor and memory.

The first step is to define a virtual machine and configure the hardware components. Here, the user decides how to split the hardware resources between the host computer and the virtual machine. For basic modelling in Virtual TMB, 1 processor core with 2 GB memory is sufficient, but more memory is helpful for advanced modelling. These settings can be changed at any later time:

    Machine → New

       Name: VirtualTMB
       Type: Linux
       Version: Other Linux (64-bit)
       Memory Size: 2048 MB
       Do not add a virtual hard disk
       Create → Continue

If VirtualBox does not provide the option to create a 64-bit virtual machine (only 32-bit), then the user needs to enable virtualization support on the host computer, see [BIOS settings], page 10.

The virtual machine is now analogous to a computer with no hard drive. The next step is to configure it a little bit further:

    Machine → Settings

       General → Advanced
       Shared Clipboard: Bidirectional
       Drag and Drop: Bidirectional
       Display → Screen
       Video Memory: 128 MB
       Acceleration: None
       User Interface → Mini Toolbar: No

It is practical to give the virtual machine access to a folder on the host computer, to save models and other files. The simplest approach is to map the `C:\` drive, but the same procedure can be used to map other locations. This setting can be changed at a later time:

```
Machine → Settings
    Shared Folders → Add
    Folder Path: C:\
    Folder Name: c
    Read-only: No
    Auto-mount: Yes
```

Once the virtual machine is up and running, the user will create a link from the virtual machine to the shared folder, see [Link to shared folder], page 4.

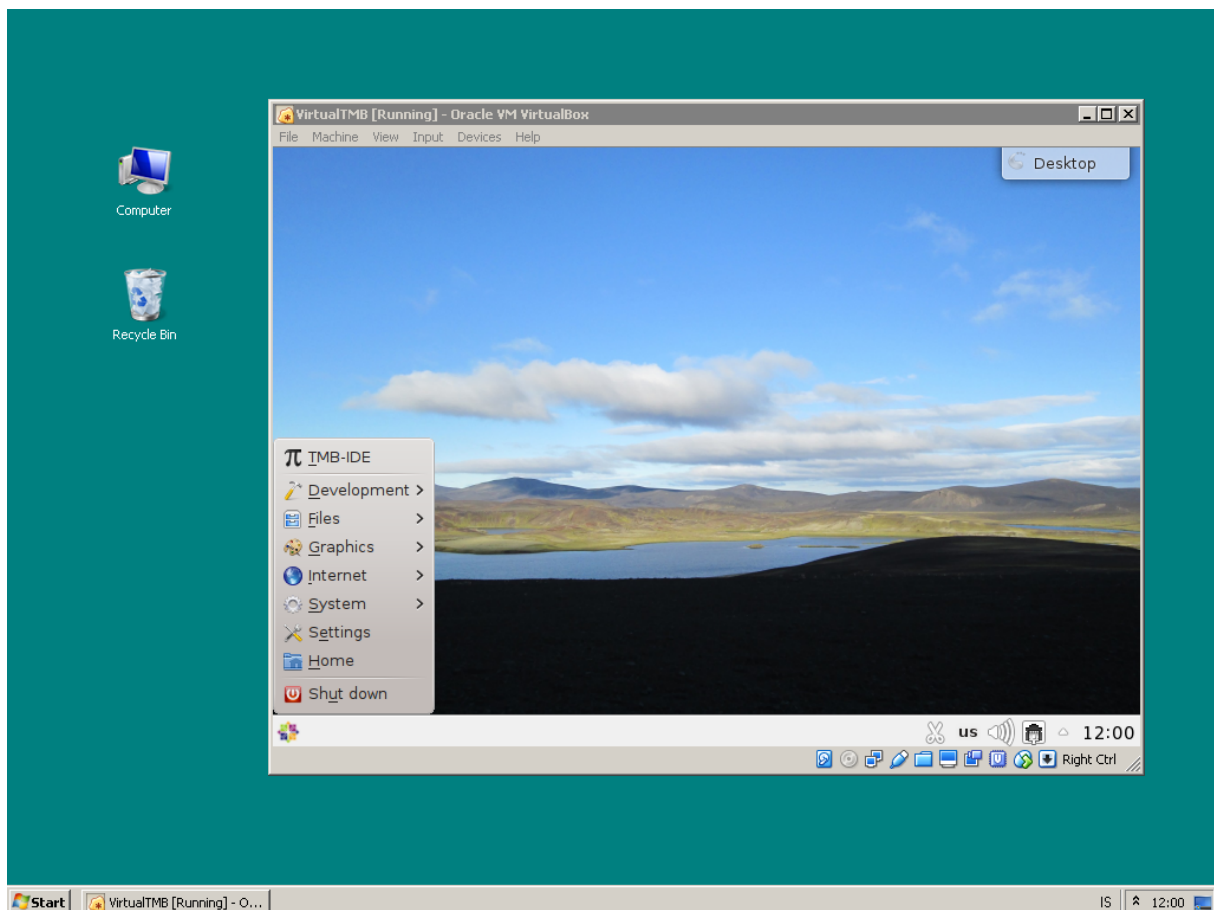The final step is to insert the disk image into the virtual machine. First move the `VirtualTMB.vdi` file into the directory containing the virtual machine, named something like:

```
C:\Users\username\VirtualBox VMs\VirtualTMB
```

Then insert it into the virtual machine:

```
Machine → Settings
    Storage → Add Hard Disk
    Choose Existing Disk: VirtualTMB.vdi
```

Fasten the seatbelt and double-click VirtualTMB.

3 User environment

3.1 Fullscreen

Shortly after the desktop wallpaper appears, Virtual TMB is ready for use. The right `Ctrl` key is a special `Host` key in VirtualBox, and `Host-f` toggles between fullscreen mode (guest only) and shared screen (host and guest side by side).

3.2 Keyboard

To configure the keyboard layout, right-click the letters 'us' on the right side of the taskbar and `Configure`. Then select *Layout* → *Configure Layouts* → *Add* and the desired configuration.

3.3 Programs

The start menu in the left corner of the taskbar shows the main programs that are installed on the virtual machine, including:

TMB-IDE	start Emacs in `tmb-mode` with `.emacs` configuration file
Emacs	same as TMB-IDE
Emacs -Q	start Emacs with no configuration file
Kompare	compare text files
R	start R in a shell
Dolphin	file manager (with Kompare and Konsole capabilities)
Konsole	shell
KWrite	simple text editor
XTerm	shell with small fonts

3.4 Directories

In the standard Linux directory structure, the user has write access inside a directory called

> `/home/`*username*

The tilde sign (`~`) is an abbreviation equivalent to the user's home directory. A fresh installation of Virtual TMB comes with two special directories:

> `~/emacs/lisp` – Emacs support packages for TMB, R, and other things

> `~/r/library` – R packages that the user has installed

To keep a tidy workspace, it is recommended to work with TMB models inside subdirectories,

> `~/workshop/day1`

> `~/models/fancy`

or the like.

Link to shared folder

If the user created a [shared folder], page 3, it will appear inside the `/media` system directory. For example, if a shared folder to the `C:\` drive was named `c`, then it will appear as `/media/sf_c` on the virtual machine.

A symbolic link can be used to make the shared folder easily accessible from the user's home directory on the virtual machine. Inside a Konsole, the following shell command creates a symbolic shell:

> `ln -s /media/sf_c ~/c`

The `ln` command creates a link, `-s` specifies a symbolic link, `/media/sf_c` is the target, and `~/c` is the link name. In this example, files saved in subdirectory `~/c/mymodel` on the virtual machine will appear inside `C:\mymodel` on the host computer.

4 TMB-IDE

4.1 See manual

The main purpose of Virtual TMB is to run TMB-IDE, an environment to develop TMB models efficiently. Please see the TMB-IDE manual (see) for a tutorial on how to compile, run, and debug models.

The small print

To clarify, TMB-IDE is defined as "starting Emacs in `tmb-mode` with a special `.emacs` file that disables the default Emacs keybindings".

Virtual TMB contains TMB-IDE, but users can modify or delete the `.emacs` file, at which point they are using Virtual TMB but not TMB-IDE. Likewise, users can set up TMB-IDE on their computer without any virtual machine. In this way, Virtual TMB and TMB-IDE are related, but not the same.

5 Keybindings

For convenience, the CapsLock key is equivalent to the left Ctrl key. To toggle all-caps, press both Shift keys at the same time.

In combinations, 'C-' is `Ctrl`, 'M-' is `Alt`, 'S-' is `Shift`, and 'W-' is the `Windows` key.

5.1 User environment

`W-up`	Maximize window
`W-down`	Minimize window
`W-left`	Push window left
`W-right`	Push window right
`W-d`	Show desktop
`C-S-escape`	System Monitor
`M-f2`	Run Command
`W-e`	Dolphin
`C-S-d`	Konsole
`C-S-f`	Firefox
`C-S-m`	Emacs (TMB-IDE)
`C-S-r`	R
`C-S-w`	Kompare

5.2 Dolphin

`f4`	Toggle terminal
`M-.`	Toggle hidden files
`C-r`	Refresh
`backspace`	Up
`C-f`	Find file
`C-q`	Quit
`C-n`	New folder
`f2`	Rename
`delete`	Delete
`C-z`	Undo

5.3 Kompare

`M-up`	Previous difference
`M-down`	Next difference
`C-s`	Save
`C-q`	Quit
`M-left`	Unapply difference
`M-right`	Apply difference left → right

5.4 Konsole

`C-a`	Beginning of line (home)
`C-e`	End of line (end)
`C-f`	Forward char (right)
`C-b`	Backward char (left)
`C-p`	Previous command (up)
`C-n`	Next command (down)
`M-f`	Forward word
`M-b`	Backward word
`C-r`	Search history
`C-l`	Clear screen
`C-c`	Cancel command
`C-insert`	Copy
`S-insert`	Paste
`C-d`	Delete char forward (delete)
`C-h`	Delete char backward (backspace)
`M-d`	Delete word forward
`M-backspace`	Delete word backward
`C-k`	Delete rest of line
`C-u`	Delete to beginning of line
`mouse-1`	Copy
`mouse-2`	Paste
`f4`	Dolphin here
`C--`	Zoom out
`C-+`	Zoom in

Shorthand shell commands

`ifind '*pattern*'`	Find filename in subdirectories
`l`	List files in color
`la`	List all files (incl. hidden files)
`ll`	List files with information
`lla`	List all files with information
`u`	`cd ..`
`x`	`exit`

6 Level up

6.1 User

The shell command `whoami` shows the username, and the default password is the same. The user is required to enter it when changing things outside the home directory.

6.2 Update and install software

CentOS packages

Virtual TMB is a standard CentOS Linux distribution, with selected optional packages installed. Thousands of additional packages are available, at the cost of nominal disk space. Virtual TMB is released as a dynamic disk, which will automatically expand from the original 6 GB up to 20 GB, as required. The user can raise the 20 GB ceiling if needed. When experimenting with Virtual TMB, users can take snapshots with VirtualBox, and rewind the virtual machine to an earlier state, if desired.

CentOS is a Linux distribution that values stability and long-term support, but packages like R are updated regularly. To update CentOS packages that are already installed, open Konsole and type:

```
sudo yum update
```

Additional software can be installed, again using the `yum` command:

```
sudo yum install clang
sudo yum install doxygen
sudo yum install libreoffice
sudo yum install mingw64-gcc-c++  # cross compiler
...
```

An exhaustive list of CentOS packages recognized by `yum` can be written to a text file to get an overview,

```
sudo yum list > list.txt
```

and individual packages can be explored without installing:

```
sudo yum info doxygen
```

TMB

To update TMB, follow the instructions on https://github.com/kaskr/adcomp. This will update the contents of the `~/r/library/TMB` directory.

Other software

Other software can be downloaded directly from the the web. RStudio, for example, can be downloaded as a zip archive that only needs to be unzipped before use.

6.3 Configure the environment

Users are encouraged to reconfigure everything in Virtual TMB to whatever is convenient for them. The main configuration components are the files

```
~/.bashrc
~/.emacs
~/.Rprofile
```

and a wide variety of GUI settings to modify keybindings and program behavior.

6.4 Security measures

A Linux virtual machine has good built-in security features by default, compared to the overall security risk of running a regular Windows computer. Users who prefer the maximum possible security can re-enable the GDM login menu, choose a new password, set the shared folder to something more restricted than `C:\`, etc.

6.5 Desktop environment

Virtual TMB is based on the KDE desktop, which has been configured to create a streamlined environment that is optimized for developing TMB models. What makes KDE different from alternative environments is that all KDE programs are highly configurable and allow the user to select personal keybindings for every action, thus providing a more keyboard-oriented workflow.

Users who strongly prefer working in another desktop environment can install one and configure for their needs. This manual and related user support will no longer apply, and the new desktop environment may need some configuration before the user can start developing TMB models. Nevertheless, experienced Linux users may find it useful to install a desktop environment that is famililar to them, for example one of these four:

```
sudo yum install cinnamon               installed size ca. 130 MB

sudo yum group install gnome-desktop              780 MB

sudo yum group install mate-desktop               520 MB

sudo yum group install Xfce                        40 MB
```

The difference between the desktop environments is a matter of habit, more than anything else: whether one is used to having the button here or over there. In terms of baseline memory usage, Xfce and Mate are the lightest, Gnome and Cinnamon are the heaviest, and KDE is in the middle. After turning the virtual machine on, opening a terminal, and running `free -m`, the memory usage of these environments ranges from 240 and 360 MB. Baseline CPU usage and startup times are also comparable between the alternative environments.

After the user installs another desktop environment, the next step is to add a 'Log out' button. Right-click the start menu and select *Application Launcher Menu Settings* → *View* → *Log out* → *OK*. Then log out.

In the login menu, press `Return` to select the default user. Before typing the password, click the cogwheel next to the 'Sign In' button, and select the new desktop environment. After typing the password and signing in, the selected environment will be the default the next time the virtual machine is started.

7 Troubleshooting

7.1 BIOS settings

Almost all processors support the required Intel VT-x or AMD-V virtualization technology, but on some computers it needs to be enabled by the user. If virtualization support is disabled, VirtualBox does not provide the option to create a 64-bit virtual machine.

Virtualization support can be configured in the BIOS menu, which is accessible when the host computer is turned on. The exact procedure varies between computer brands and models, so users need to search in the user manual (or on the web) to find instructions for their specific computer. A typical procedure is along these lines:

- Restart computer
- Press `f2` a few times while the computer is starting up
- When the BIOS menu appears, select `Virtualization Technology` → `Enable`
- Select `Apply` → `Save and Exit`

On some computers, the key to enter the BIOS menu is not `f2`, but `f1`, `f10`, `delete`, or `escape`.

7.2 Virtual TMB doesn't fit inside window

When Virtual TMB was shut down in fullscreen mode and then started in a window, the desktop doesn't fit inside the window. The start menu doesn't show and there are scrollbars on the outer window. There are two alternative solutions:

- Press `Host-f` (the right `Ctrl` key and `f` at the same time) to enter fullscreen mode.
- Resize the window; the desktop will automatically adjust to the window size.

8 References

TMB

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Appendix A Release history

Version 1.6.2

28 October 2015

- New file `~/r/Makevars` sets GCC option `-fno-gnu-unique` so models can be recompiled without closing the R session.
- Updated components: TMB 1.6.2, TMB-IDE 1.6.2, TMB mode 3.0, ESS 15.09-1, and ADMB mode 11.2-6.
- New desktop background.

Version 1.1.1

23 September 2015

- Initial release.