A Brief Introduction to Linux

What is it? What can I use it for?

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LTS Research Computing
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Outline

1. Introduction to Linux
2. Linux Components
3. Live Demo

Introduction to Linux

Unix History I

- Unix was conceived and implemented in 1969 at AT&T Bell labs by Ken Thompson, Dennis Ritchie, Douglas McIlroy, and Joe Ossanna.
- First released in 1971 and was written in assembler.
- In 1973, Unix was re-written in the programming language C by Dennis Ritchie (with exceptions to the kernel and I/O).
- The availability of an operating system written in a high-level language allowed easier portability to different computer platforms.
- The GNU Project, started in 1983 by Richard Stallman, had the goal of creating a "complete Unix-compatible software system" composed entirely of free software.
- 386BSD released in 1992 and written by Berkeley alumni Lynne Jolitz and William Jolitz. FreeBSD, NetBSD, OpenBSD and NextStep (Mac OSX) descended from this
- Andrew S. Tanenbaum wrote and released MINIX, an inexpensive minimal Unix-like operating system, designed for education in computer science
- Frustated with licensing issues with MINIX, Linus Torvalds, a student at University of Helsinki began working on his own operating system which eventually became the "Linux Kernel"
- Linus released his kernel for anyone to download and help further development.

Unix History II

Linus's message to comp.os.minix on Aug 26, 1991

Hello everybody out there using minix -
I'm doing a (free) operating system (just a hobby, won't be big and professional like gnu) for 386(486) AT clones. This has been brewing since april, and is starting to get ready. I'd like any feedback on things people like/dislike in minix, as my OS resembles it somewhat (same physical layout of the file-system (due to practical reasons) among other things).
I've currently ported bash(1.08) and gcc(1.40), and things seem to work. This implies that I'll get something practical within a few months, and I'd like to know what features most people would want. Any suggestions are welcome, but I won't promise I'll implement them :-)
Linus (email address)
PS. Yes - it's free of any minix code, and it has a multi-threaded fs. It is NOT protable (uses 386 task switching etc), and it probably never will support anything other than AT-harddisks, as that's all I have :-(.

`https://groups.google.com/forum/?fromgroups=#!msg/comp.os.minix/dlNtH7RRrGA/SwRavCzVE7gJ`

- Linux is only the kernel, an Operating System also requires applications that users can use.
- combined with free software available from the GNU project gave birth to a new Operating System known as "GNU/Linux"
- GNU/Linux or simply Linux is released under the GNU Public License: Free to use, modify and distribute provided you distribute under the GNU Public License.

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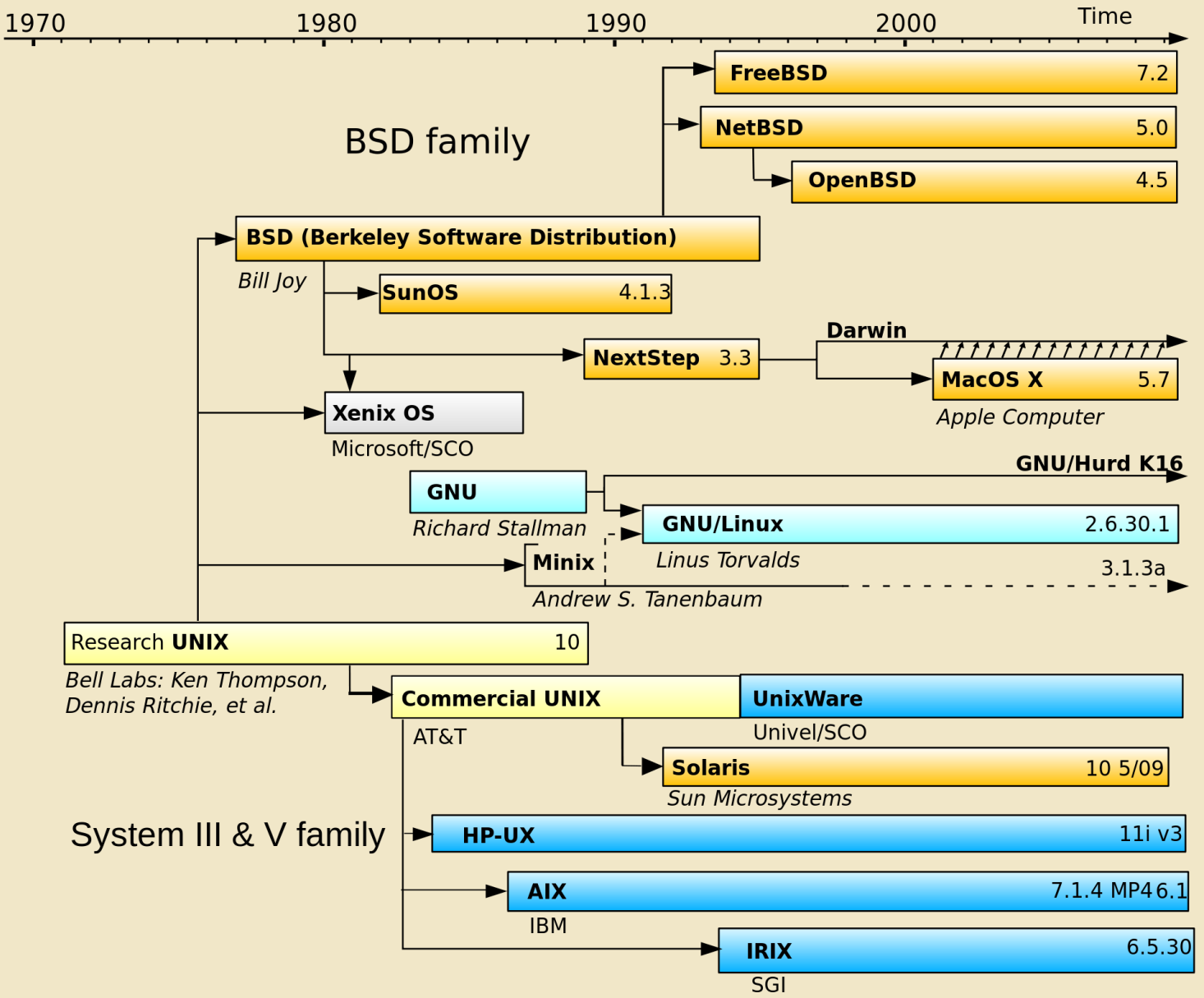
http://en.wikipedia.org/wiki/Linux


1970
1980
1990
2000
Time
BSD family
FreeBSD 7.2
NetBSD 5.0
OpenBSD 4.5
BSD (Berkeley Software Distribution)
Bill Joy
SunOS 4.1.3
NextStep 3.3
Darwin
MacOS X 5.7
Apple Computer
Xenix OS
Microsoft/SCO
GNU/Hurd K16
GNU
Richard Stallman
GNU/Linux 2.6.30.1
Linus Torvalds
Minix
3.1.3a
Andrew S. Tanenbaum
Research UNIX 10
Bell Labs: Ken Thompson,
Dennis Ritchie, et al.
Commercial UNIX
UnixWare
Univel/SCO
AT&T
Solaris 10 5/09
Sun Microsystems
System III & V family
HP-UX 11i v3
AIX 7.1.4 MP4 6.1
IBM
IRIX 6.5.30
SGI

What is Linux?

- Linux is an operating system that evolved from a kernel created by Linus Torvalds when he was a student at the University of Helsinki.
- It's meant to be used as an alternative to other operating systems, Windows, Mac OS, MS-DOS, Solaris and others.
- Linux is the most popular OS used in a Supercomputer

OS Family	Count	Share %
Linux	488	97.6
Unix	10	2
Mixed	1	0.2
Windows	1	0.2

- If you are using a Supercomputer/High Performance Computer for your research, it will be based on a *nix OS.
- It is required/neccessary/mandatory to learn Linux Programming (commands, shell scripting) if your research involves use of High Performance Computing or Supercomputing resources.

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http://www.top500.org/statistics/list/

June 2015 List

What is a Linux OS, Distro, Desktop Environment?

- Many software vendors release their own packaged Linux OS (kernel, applications) known as distribution
- Linux distribution = Linux kernel + GNU system utilities and libraries + Installation scripts + Management utilities etc.
  1. Debian, Ubuntu, Mint
  2. Red Hat, Fedora, CentOS
  3. Slackware, openSUSE, SLES, SLED
  4. Gentoo
- Application packages on Linux can be installed from source or from customized packages
  1. deb: Debian based distros e.g. Debian, Ubuntu, Mint
  2. rpm: Red Hat based distros, Slackware based distros.
- Linux distributions offer a variety of desktop environment.
  1. K Desktop Environment (KDE)
  2. GNOME
  3. Xfce
  4. Lightweight X11 Desktop Environment (LXDE)
  5. Cinnamon
  6. MATE
  7. Dynamic Window Manager

Where is Linux used?

- Linux distributions are tailored to different requirements such as
  1. Server
  2. Desktop
  3. Workstation
  4. Routers
  5. Embedded devices
  6. Mobile devices (Android is a Linux-based OS)
- Almost any software that you use on windows has a roughly equivalent software on Linux, most often multiple equivalent software

e.g. Microsoft Office equivalents are OpenOffice.org, LibreOffice, KOffice

- For complete list, visit `http://wiki.linuxquestions.org/wiki/Linux_software_equivalent_to_Windows_software`
- Linux offers you freedom, to choose your desktop environment, software.

Popularity of Linux Distributions

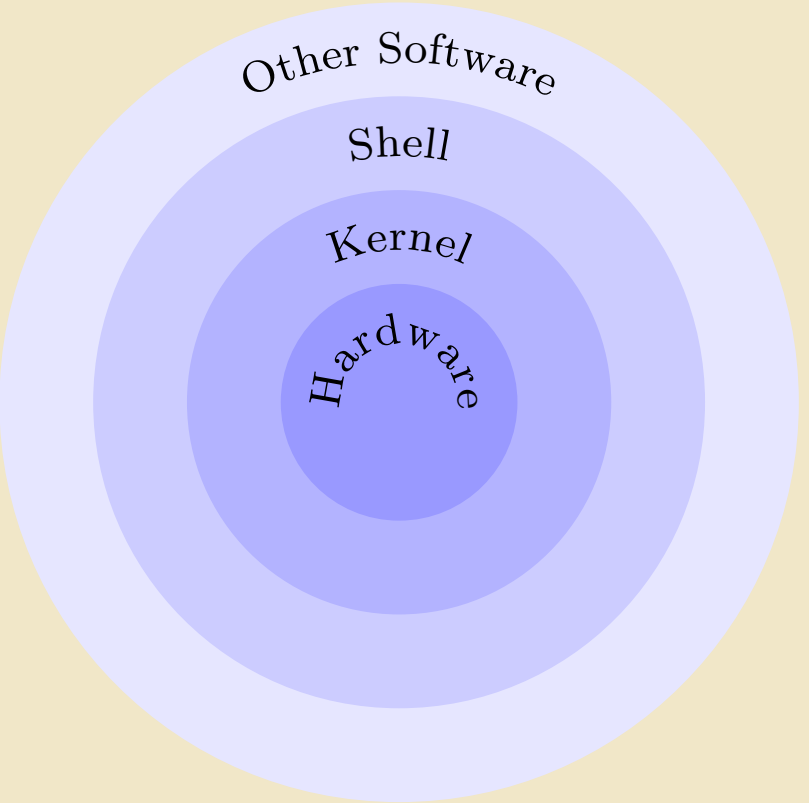
- DistroWatch provides news, popularity rankings, and other general information about:
  1. various Linux distributions,
  2. free software/open source Unix-like operating systems such as OpenSolaris, MINIX and BSD.
- DistroWatch is NOT an indication of market-share or quality nor is it an indication of how many users but it is clearly an indication of what users are looking at.

Rank	Distribution	Hits	
1	Mint	3105	–
2	Debian	1764	▲
3	Ubuntu	1603	–
4	openSUSE	1198	▲
5	Fedora	1142	–
6	Mageia	1016	▼
7	CentOS	970	▼
8	Manjaro	943	–
9	LXLE	788	▲
10	Arch	759	–

Linux Components

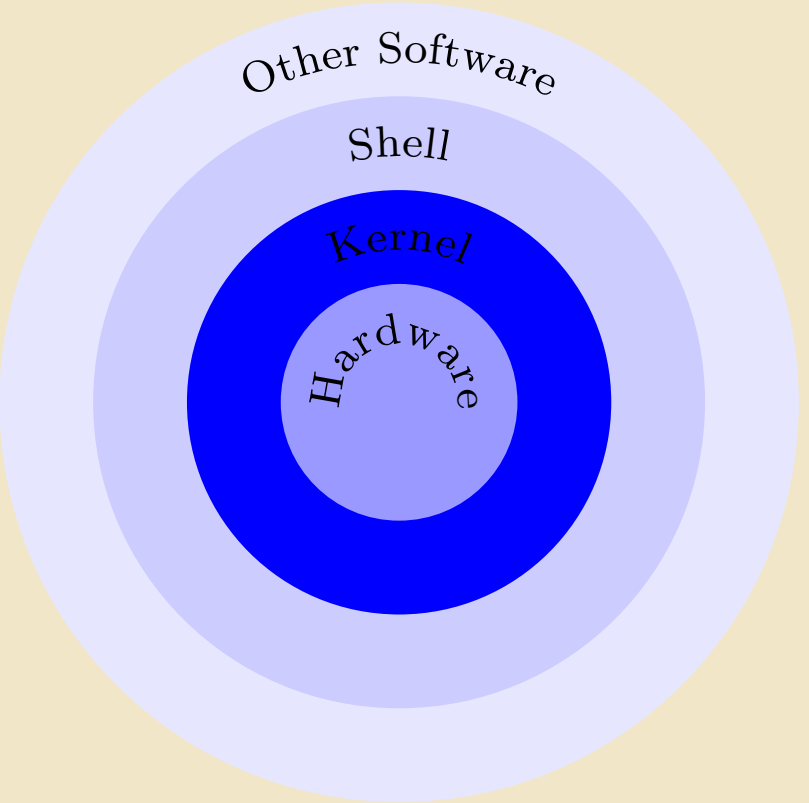
Linux Components

- Kernel
- Shell
- Applications/Programs



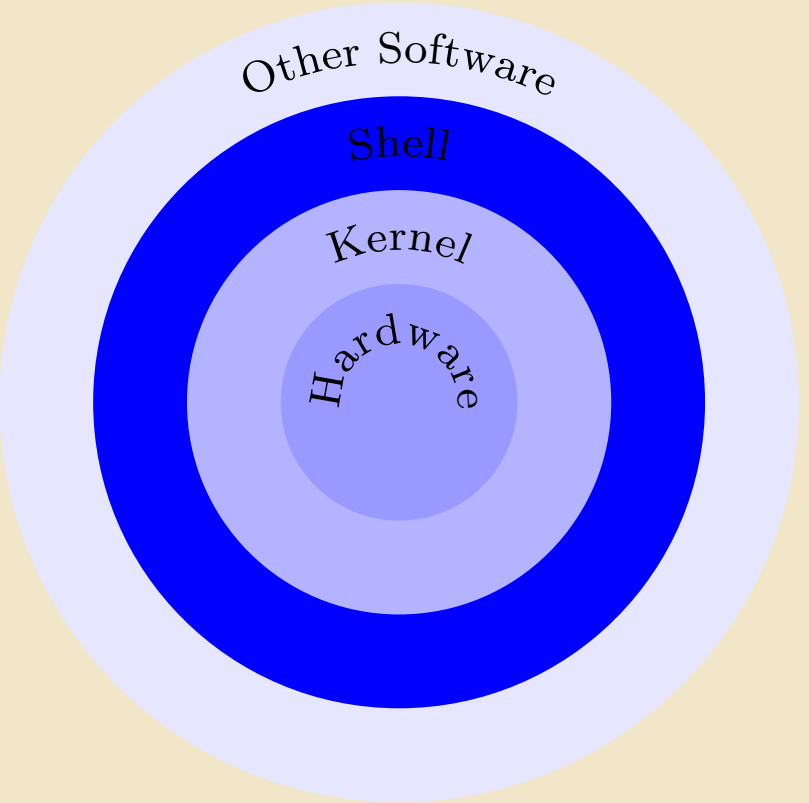
Linux Components

- Kernel
  - The kernel is the main component of most computer operating systems
  - It is a bridge between applications and the actual data processing done at the hardware level.
  - The kernel's responsibilities include managing the system's resources (the communication between hardware and software components).
  - provides the lowest-level abstraction layer for the resources (especially processors and I/O devices) that application software must control to perform its function.
  - It typically makes these facilities available to application processes through inter-process communication mechanisms and system calls.



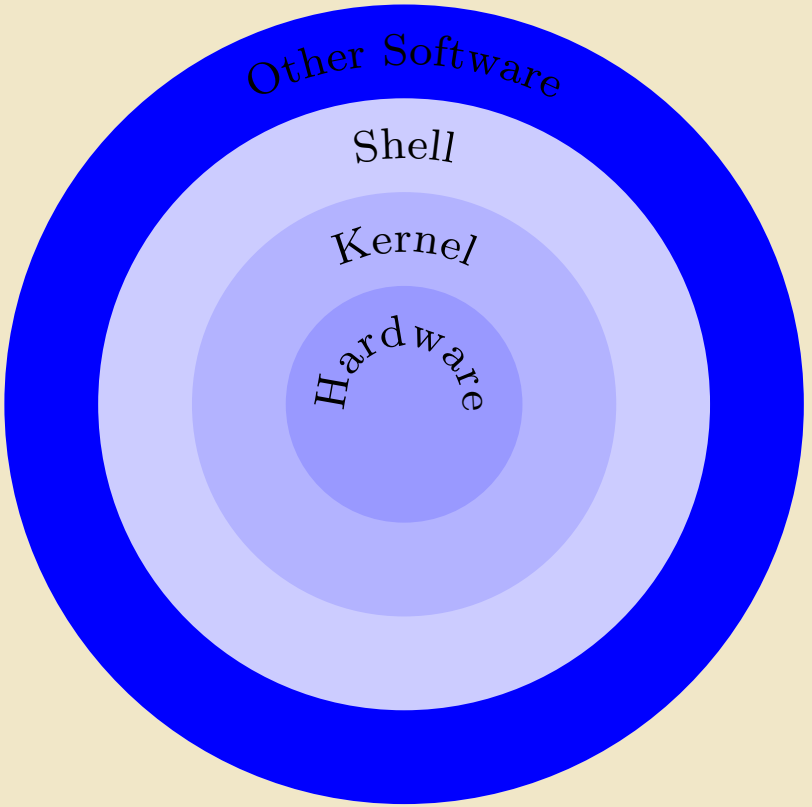
Linux Components

- Shell
  - The command line interface is the primary interface to Linux/Unix operating systems.
  - Shells are how command-line interfaces are implemented in Linux/Unix.
  - Each shell has varying capabilities and features and the user should choose the shell that best suits their needs.
  - The shell is simply an application running on top of the kernel and provides a powerful interface to the system.



Linux Components

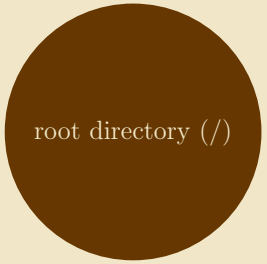
- Applications/Programs
  - Linux provides a vast collection of application software, both free (open and closed source) and commercial, for research, teaching and every day leisure activities.
  - Almost any software that you use on windows has a roughly equivalent software on Linux, most often multiple equivalent software
  - Most, if not all (open source) software, that you need will be available from the distribution repositories.
  - RedHat Family: `yum install packagename`
  - openSuSE Family: `zypper install packagename`
  - Ubuntu Family: `apt-get install packagename`
  - Users can also install by downloading and installing from source.
    Usually involves three steps: `configure`, `make`, and `make install`



Files and Processes

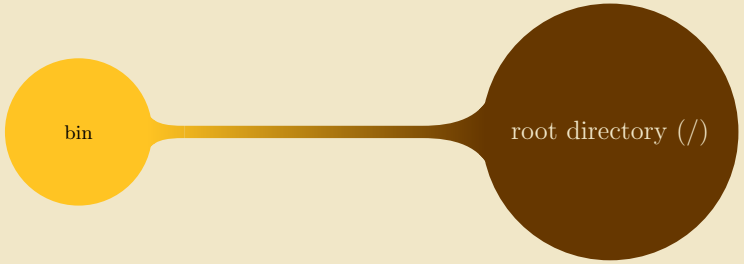
- Everything in Linux/UNIX is either a file or a process
- A File is a collection of data, created by users using text editors, running compilers, etc.
- Examples of Files:
  1. document such as collection of ascii text as in report, essay, etc.
  2. program written in some high level programming language
  3. instructions comprehensible to machine but not a casual user such as executable, binary file
  4. directory containing information about its contents such as subdirectories or other files
- A process is an executing program identified by a unique process identifier or PID.

File System Hierarchy



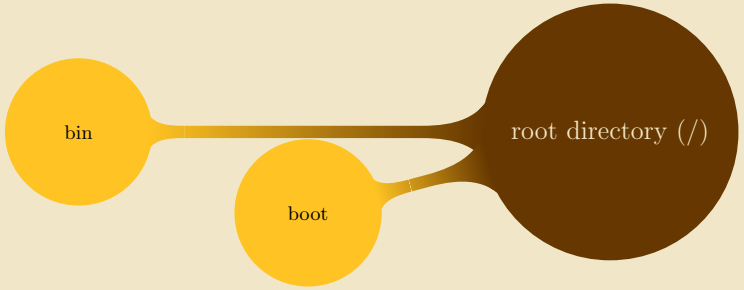
- All files are arranged in a hierarchial structure, like an inverted tree.
- The top of the hierarchy is traditionally called **root** (written as a slash /)

File System Hierarchy



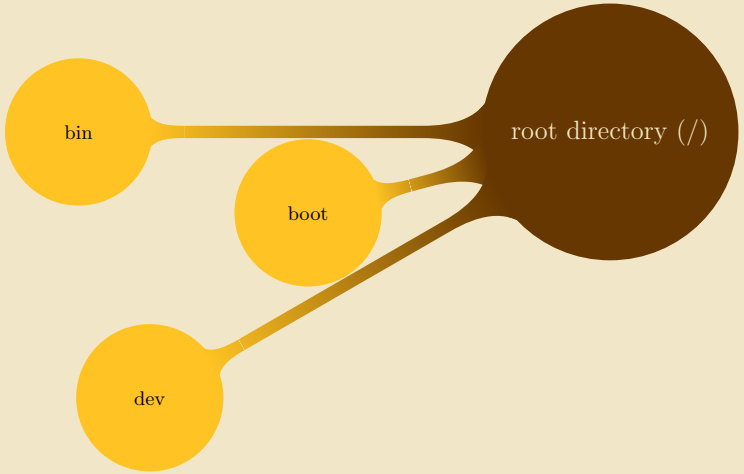
- contains files that are essential for system operation, available for use by all users.

File System Hierarchy



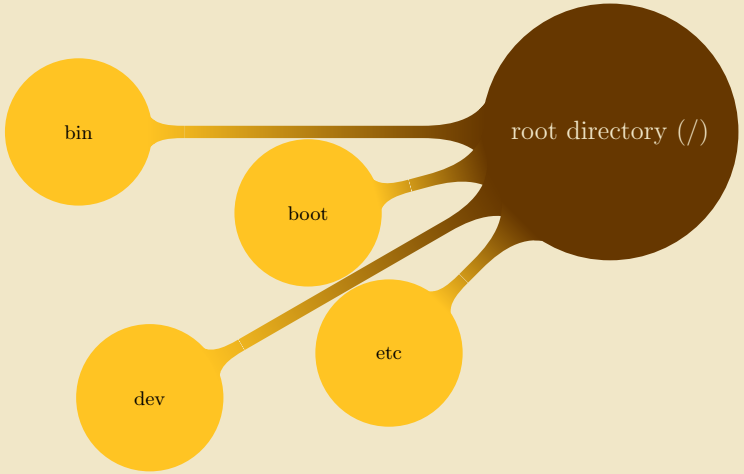
- contains bootable kernel and bootloader

File System Hierarchy



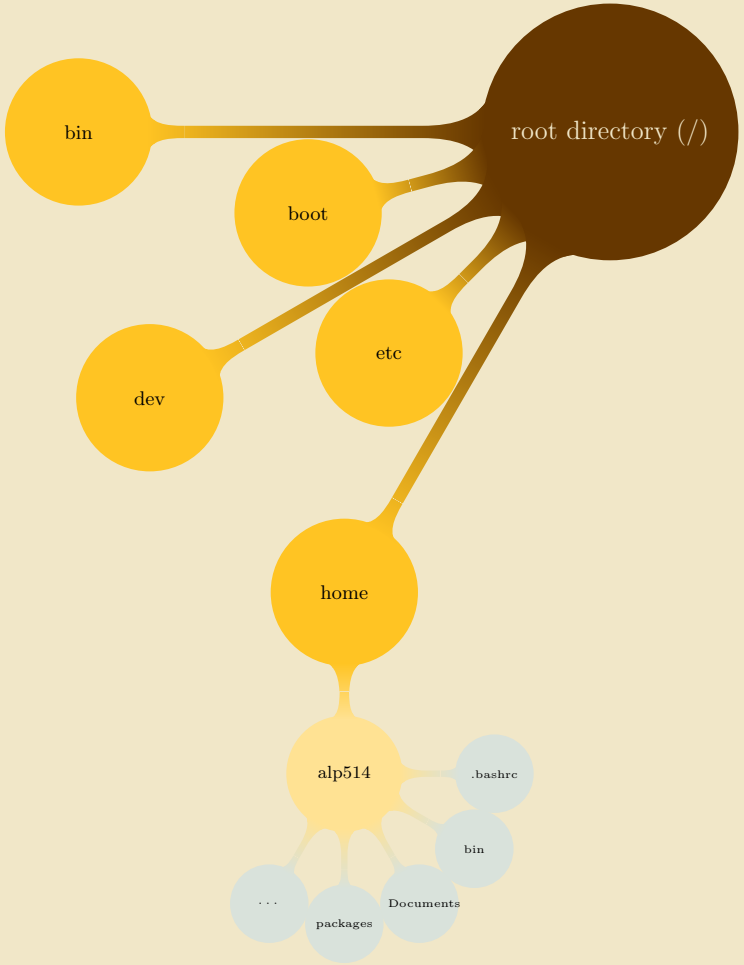
- contains various devices such as hard disk, CD-ROM drive etc

File System Hierarchy



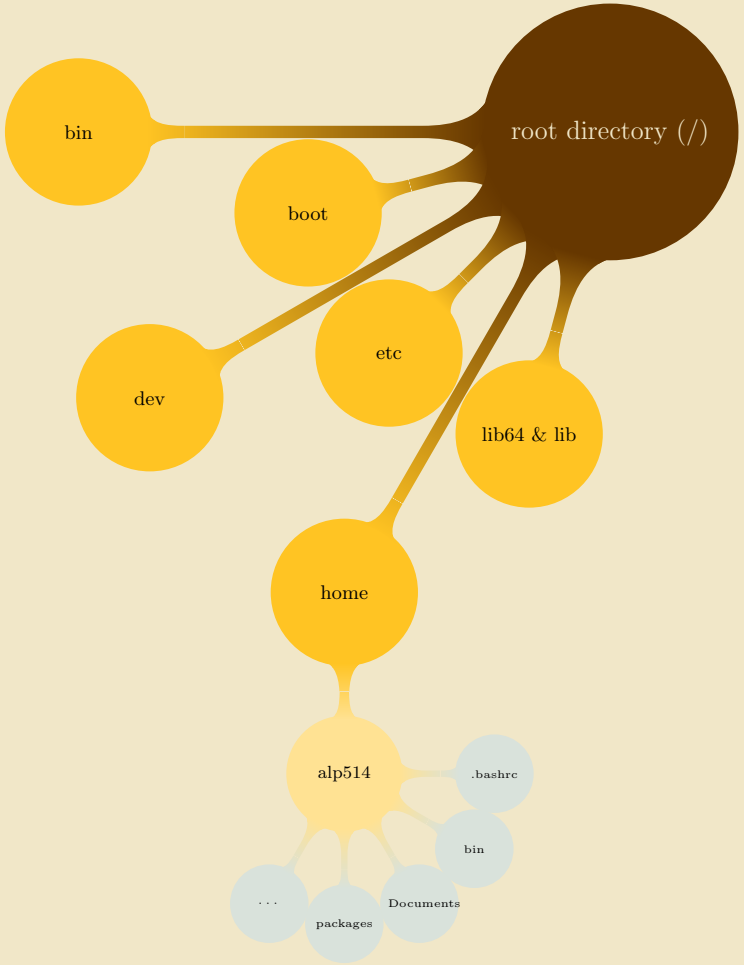
- contains various system configurations

File System Hierarchy



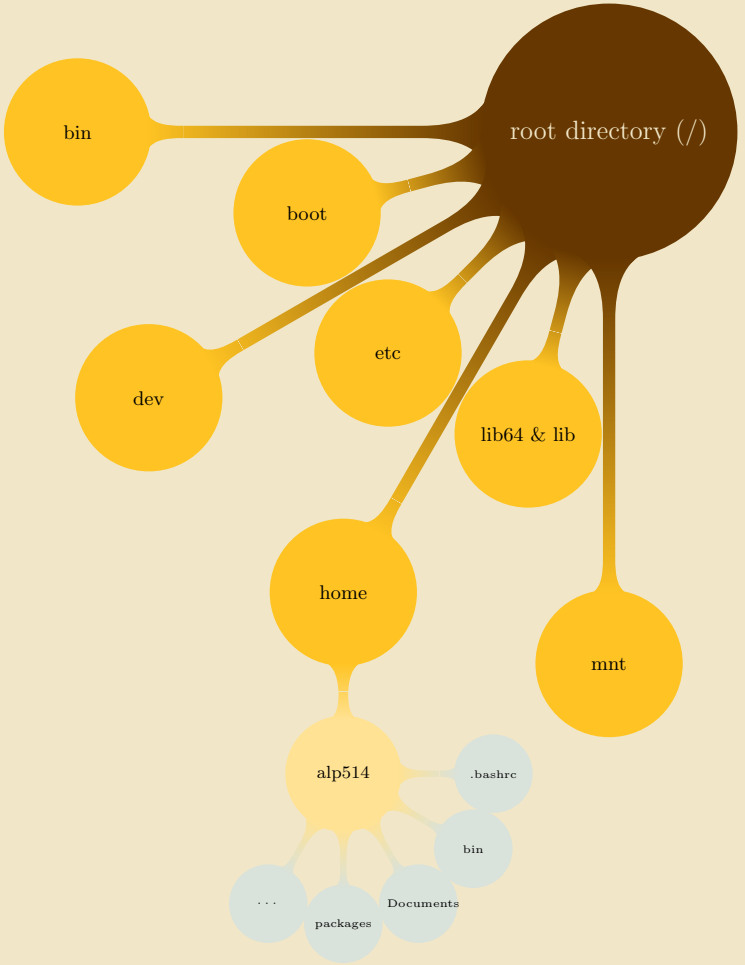
- contains home directories of all users. This is the directory where you are at when you login to a Linux/UNIX system.

File System Hierarchy



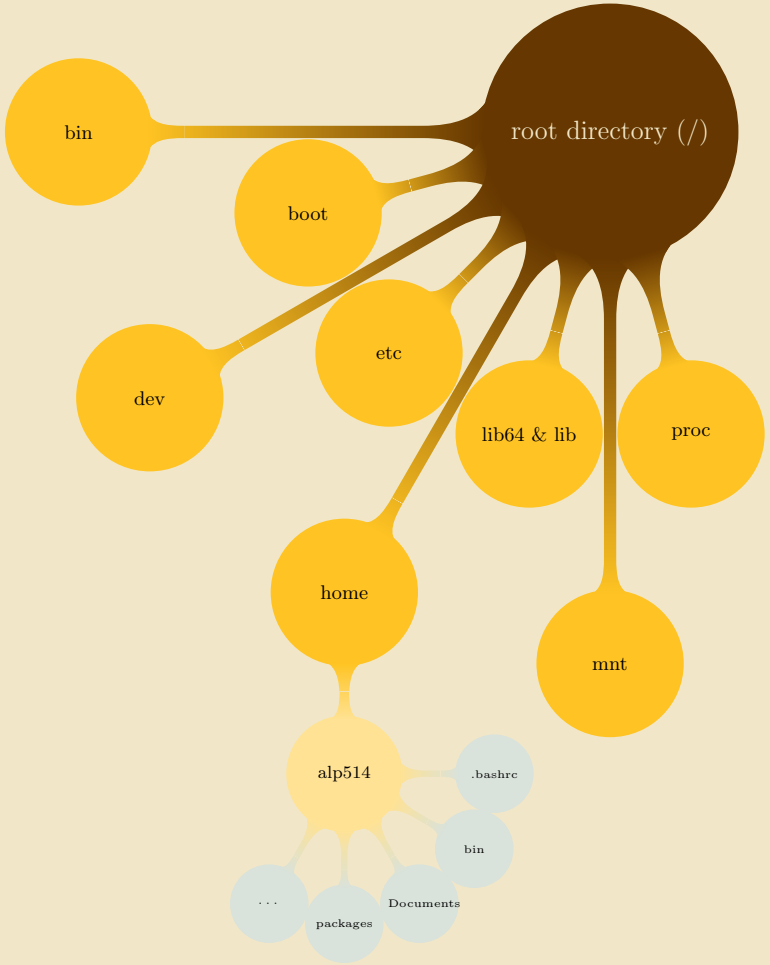
- contains libraries that are essential for system operation, available for use by all users.

File System Hierarchy



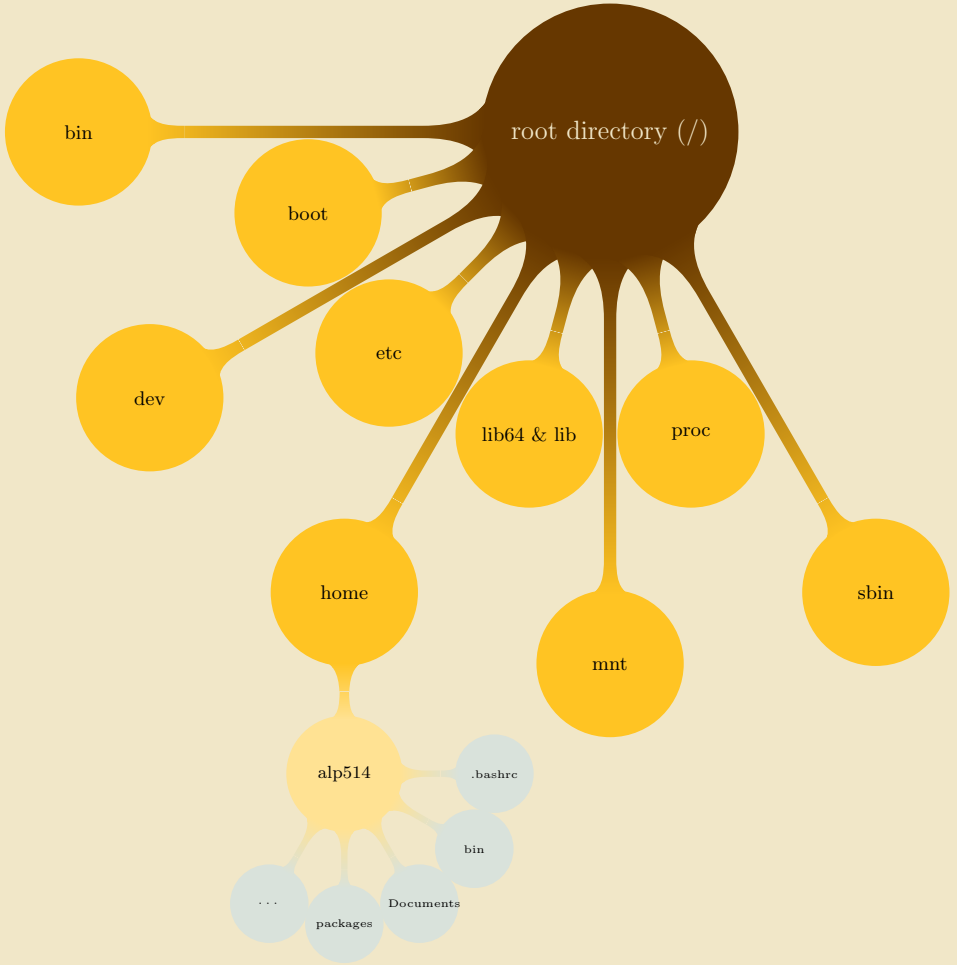
- directories where disk drives are mounted

File System Hierarchy



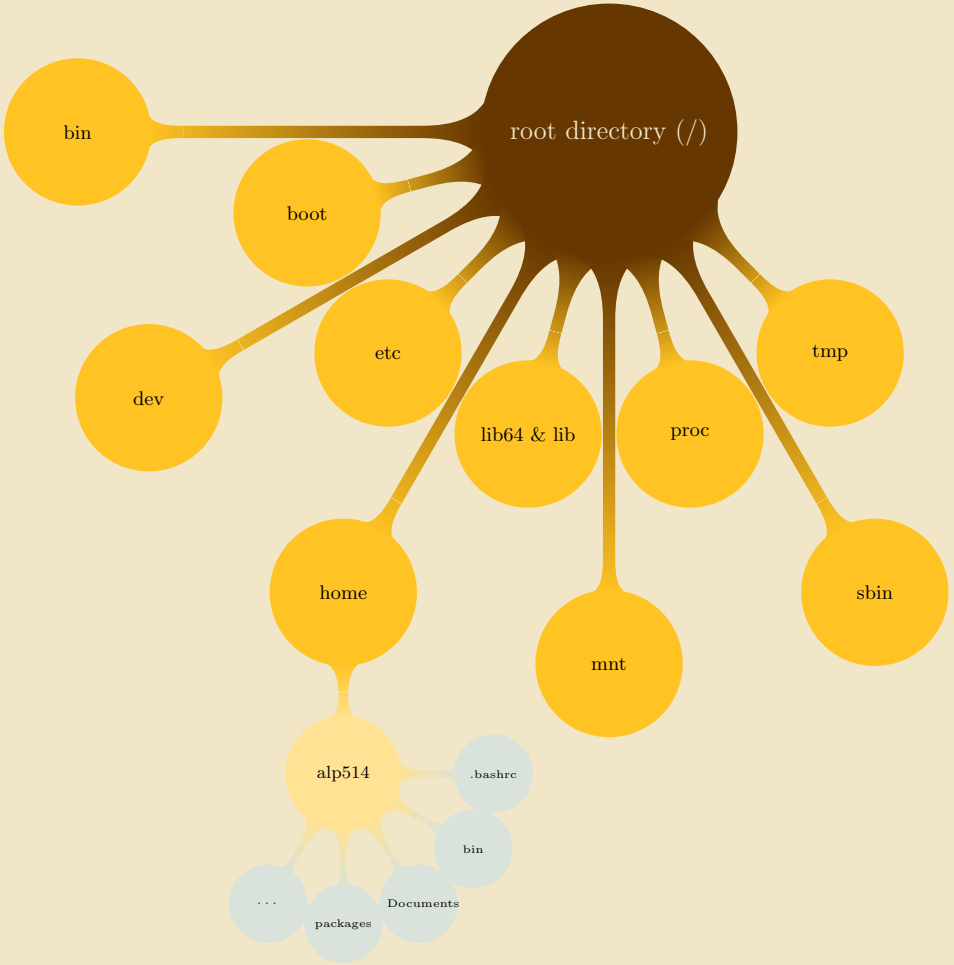
- process information pseudo-file system containing runtime system information (e.g. system memory, devices mounted, hardware configuration, etc).
- can be regarded as a control and information centre for the kernel.

File System Hierarchy



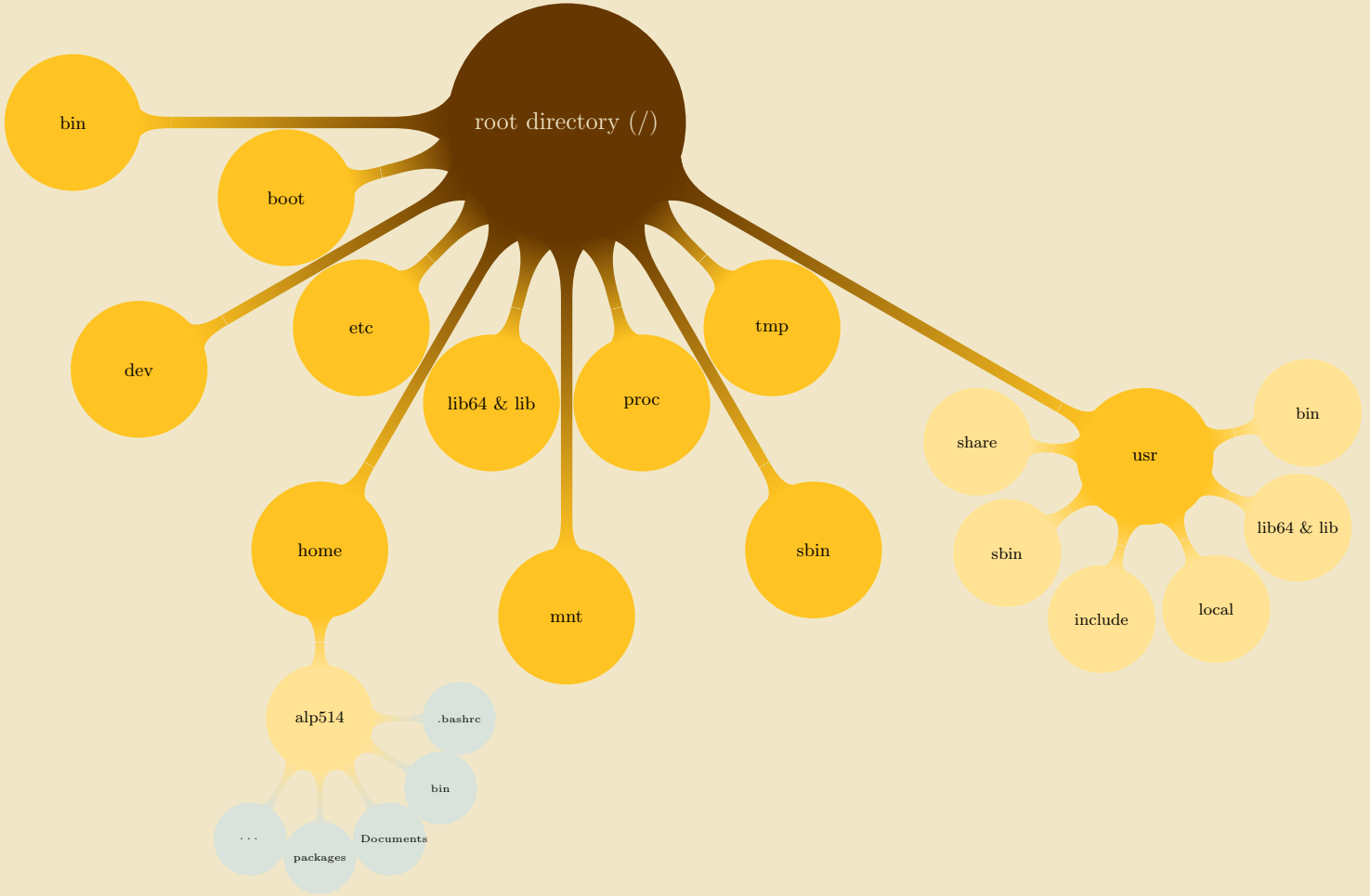
- same as bin but only accessible by **root**

File System Hierarchy



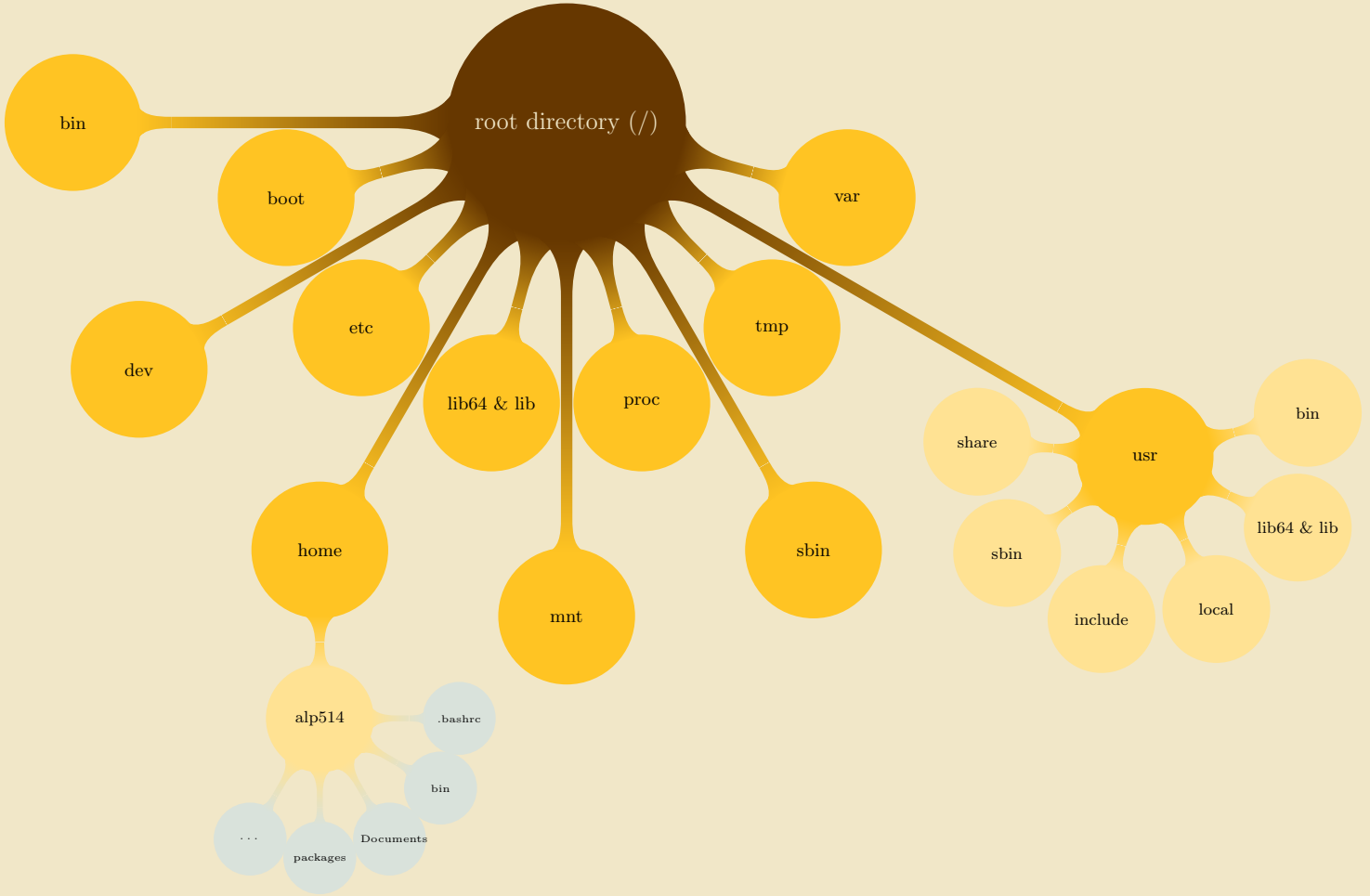
- temporary file storage

File System Hierarchy



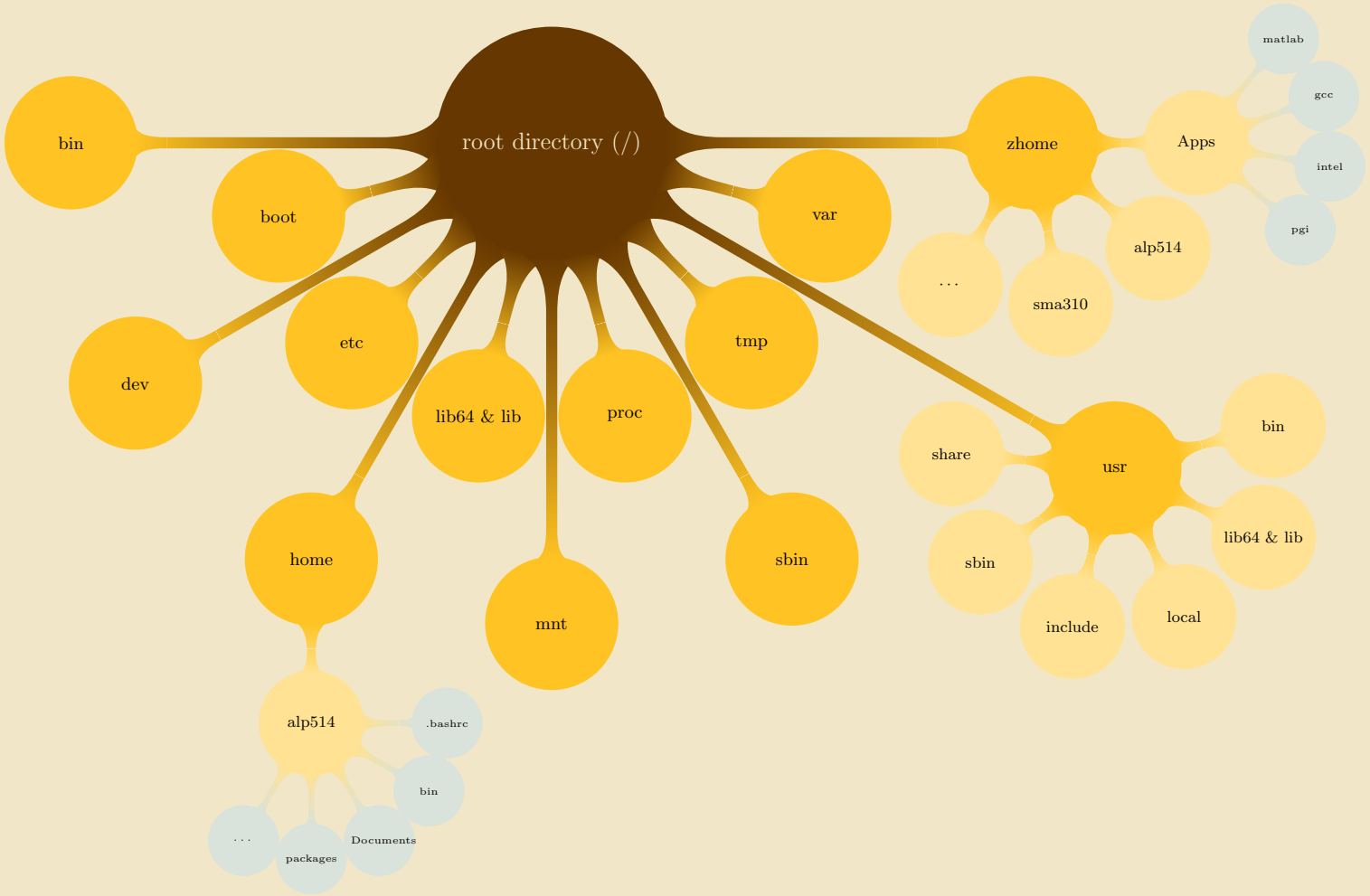
- contains user documentations, binaries, libraries etc

File System Hierarchy



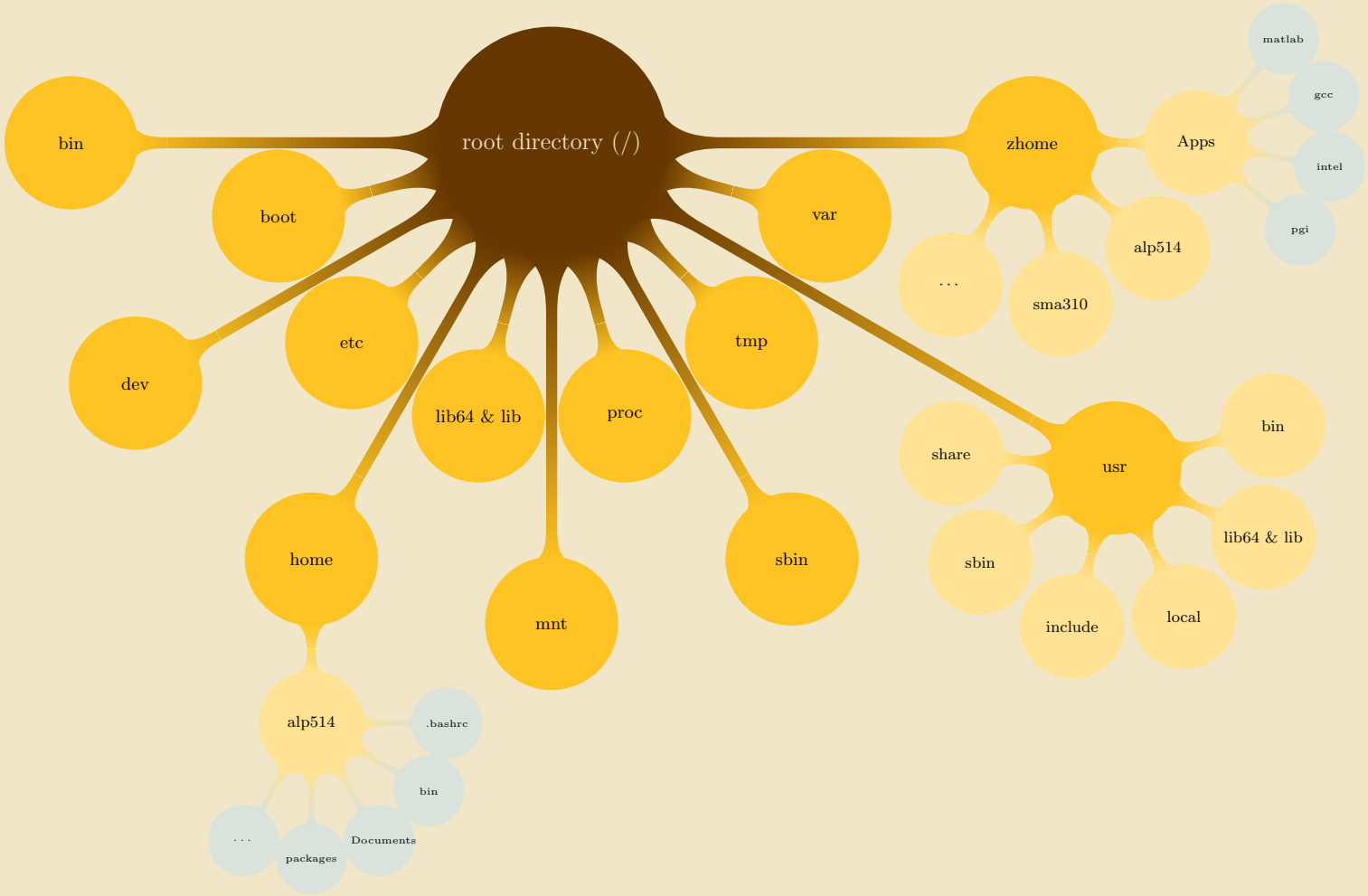
- used to store files which change frequently (system level not user level)

File System Hierarchy



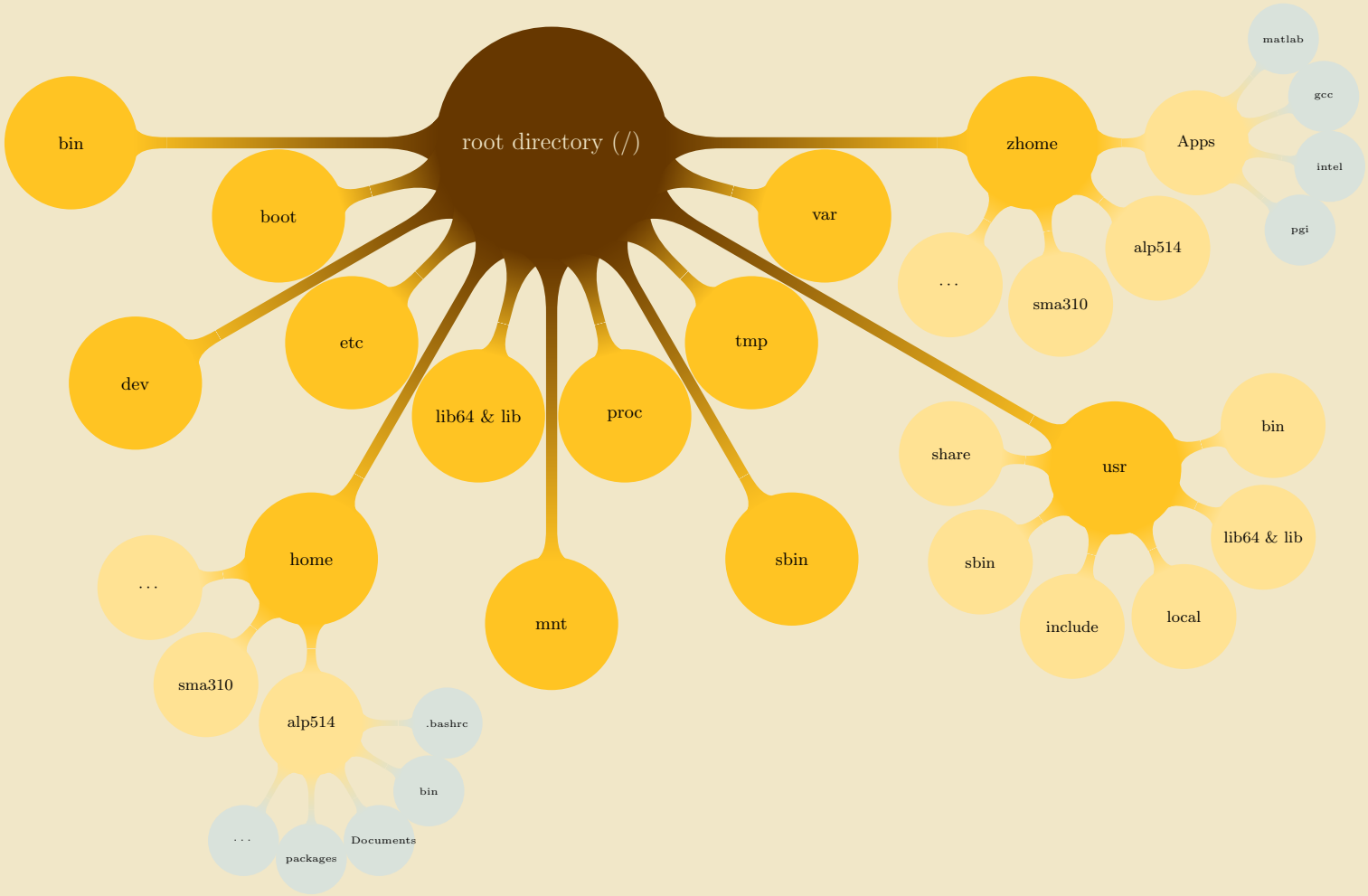
- where we install applications common to all HPC systems

File System Hierarchy



- Installing your own OS: /bin,/lib{64},/etc,/dev and /sbin must be on the same partition.

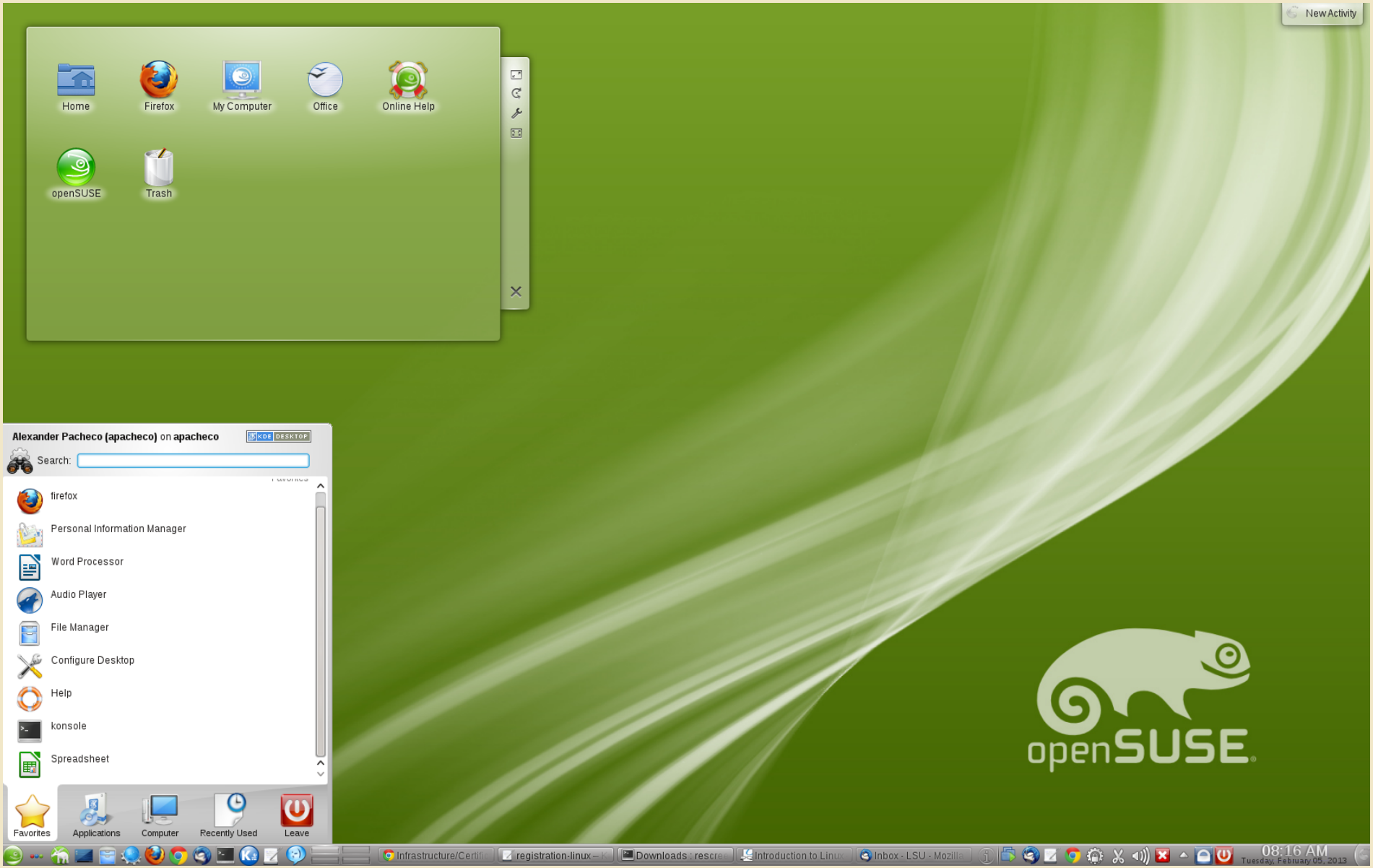
File System Hierarchy



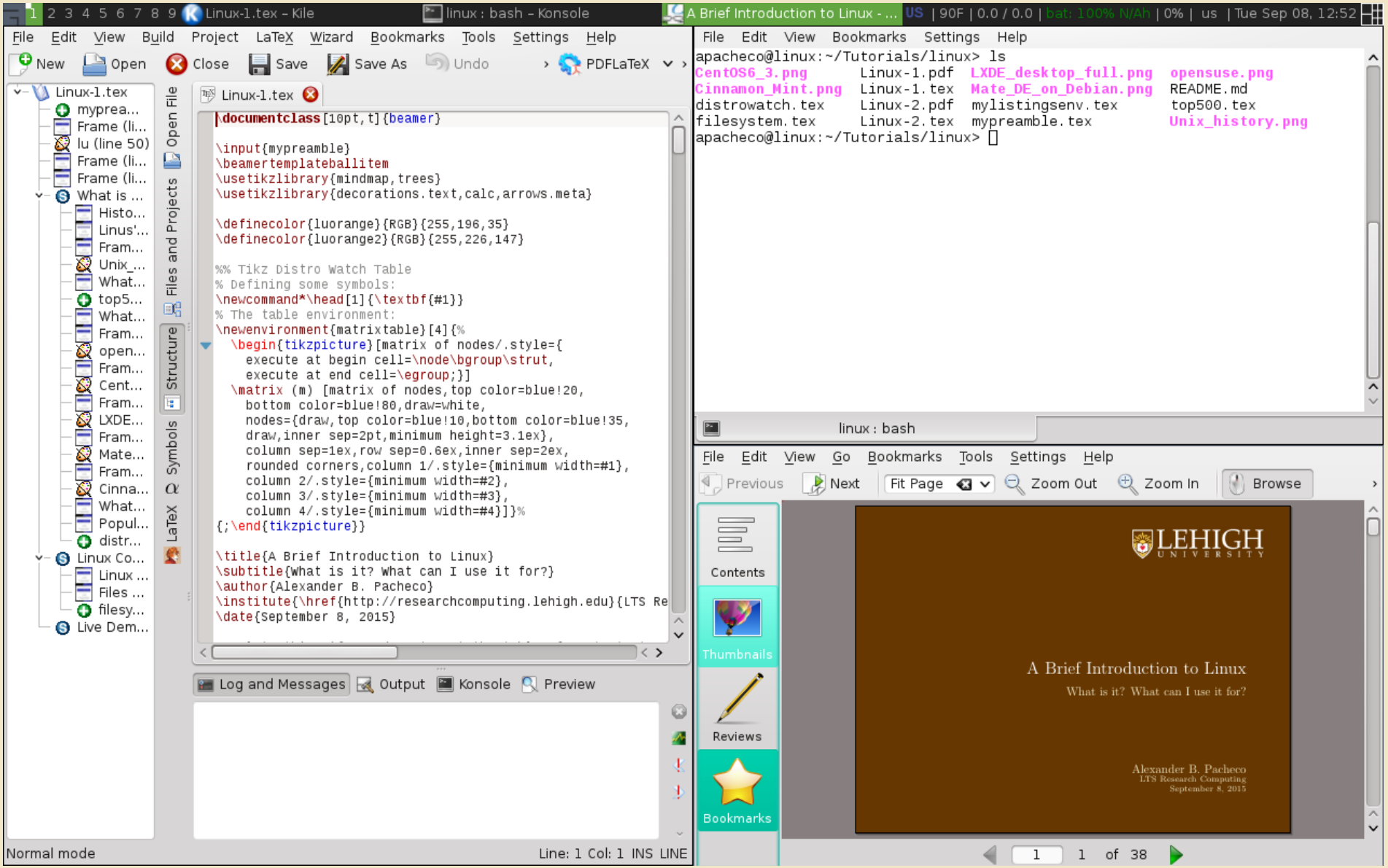
- UNIX like OS's are designed for multi user environments i.e. multiple users can exist on the system.
- Special user called **root** is the administrator and has access to all files in the system.

Live Demo

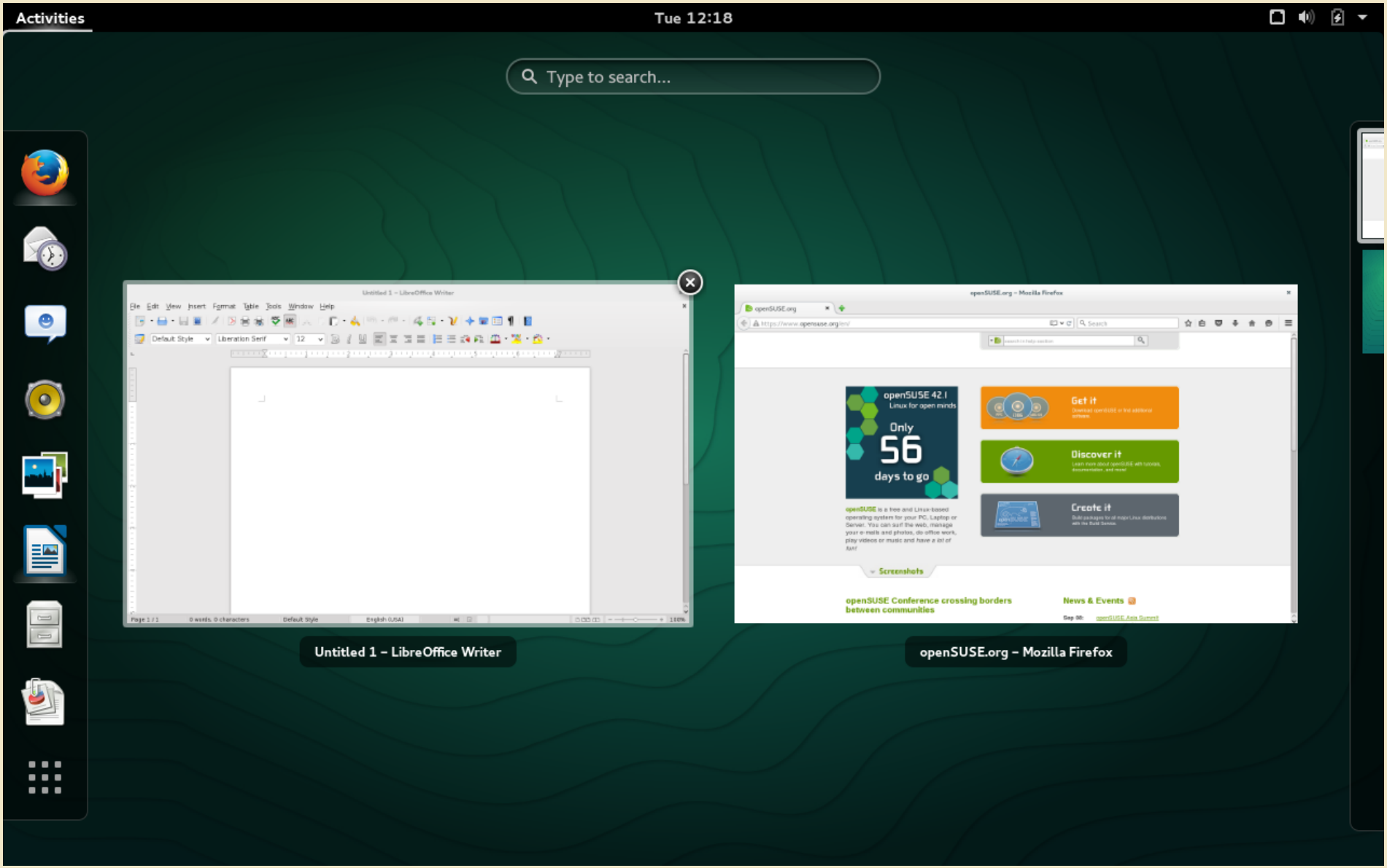
openSUSE KDE Desktop



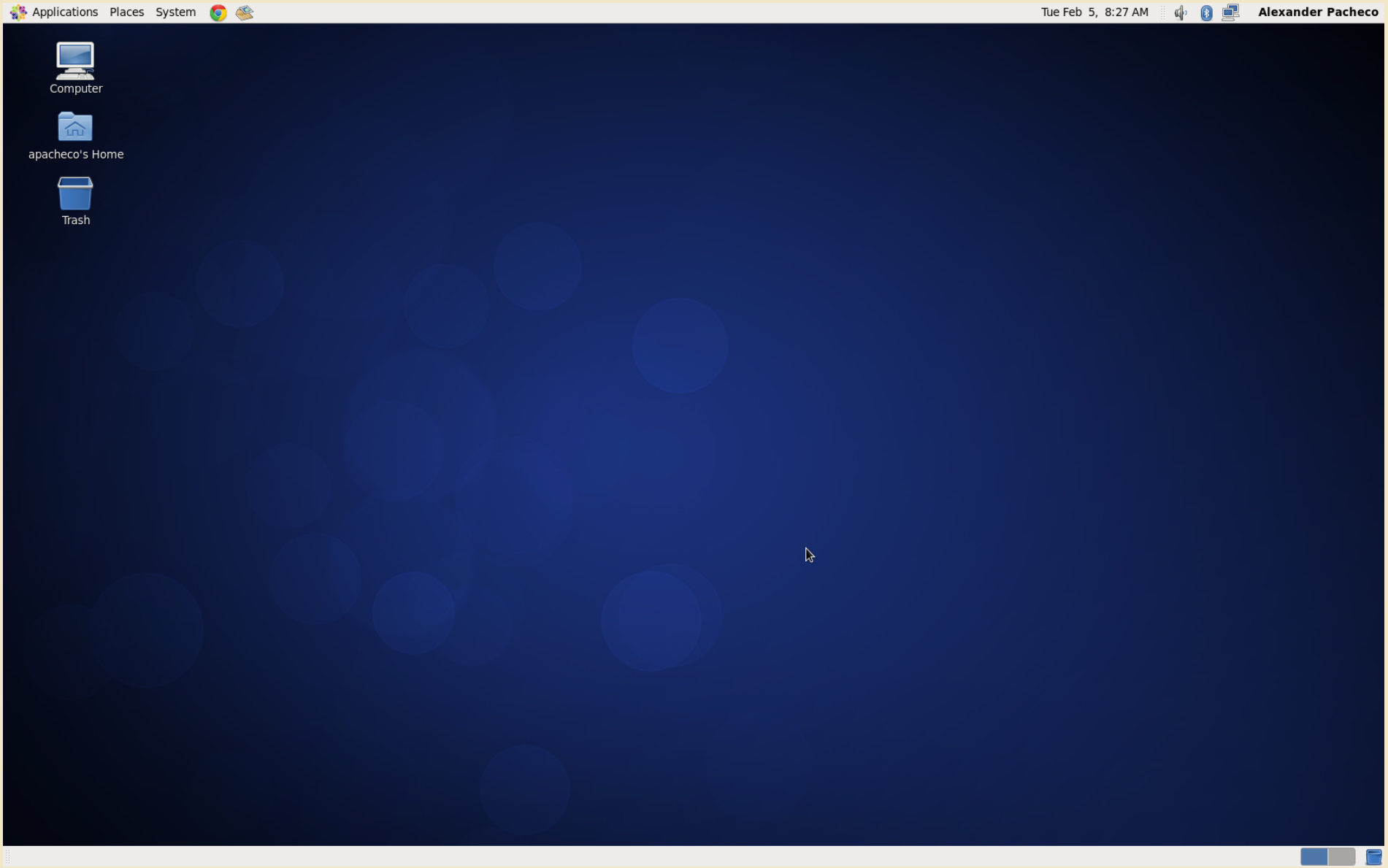
openSUSE Awesome Dynamic Window Manager



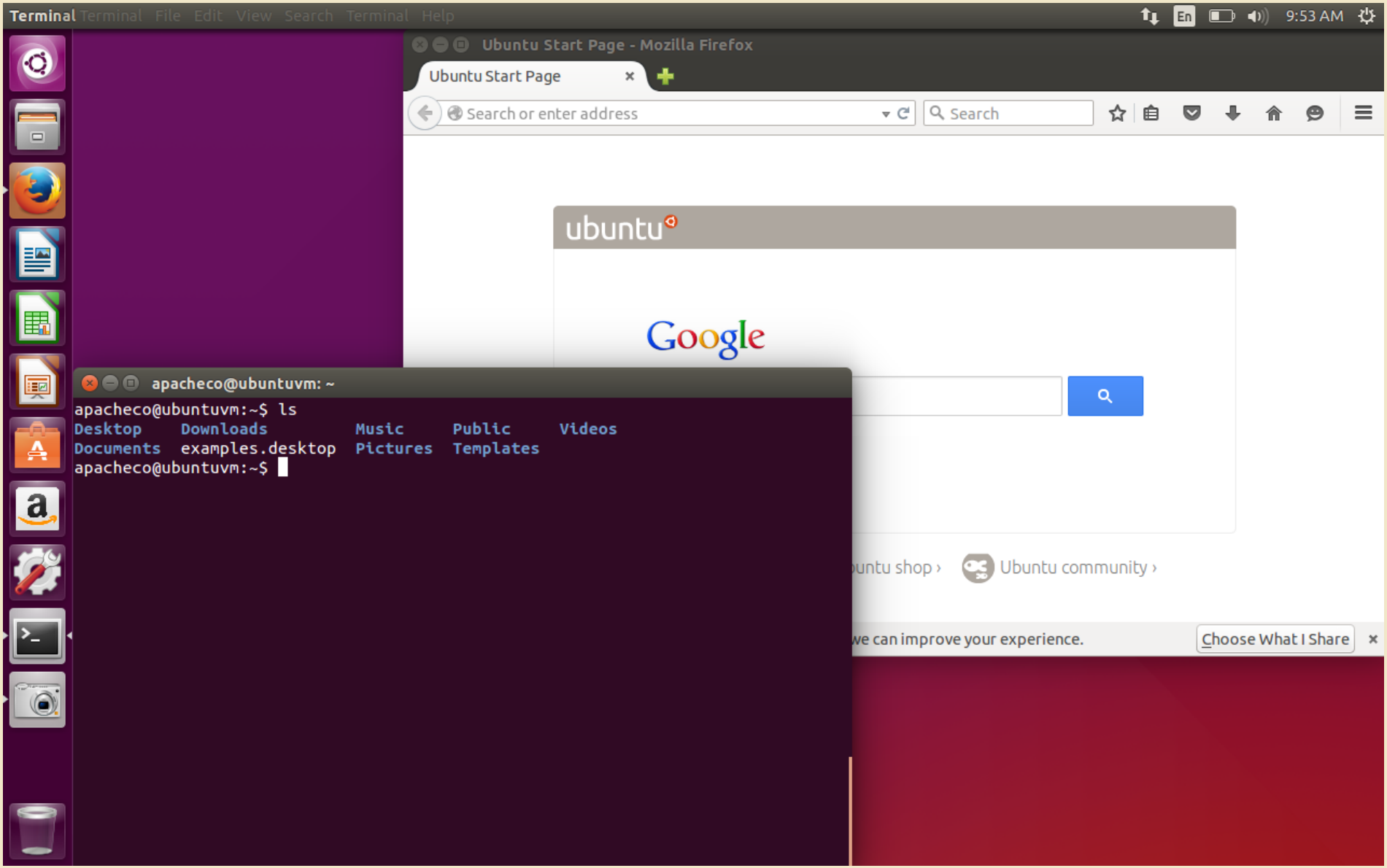
openSUSE GNOME



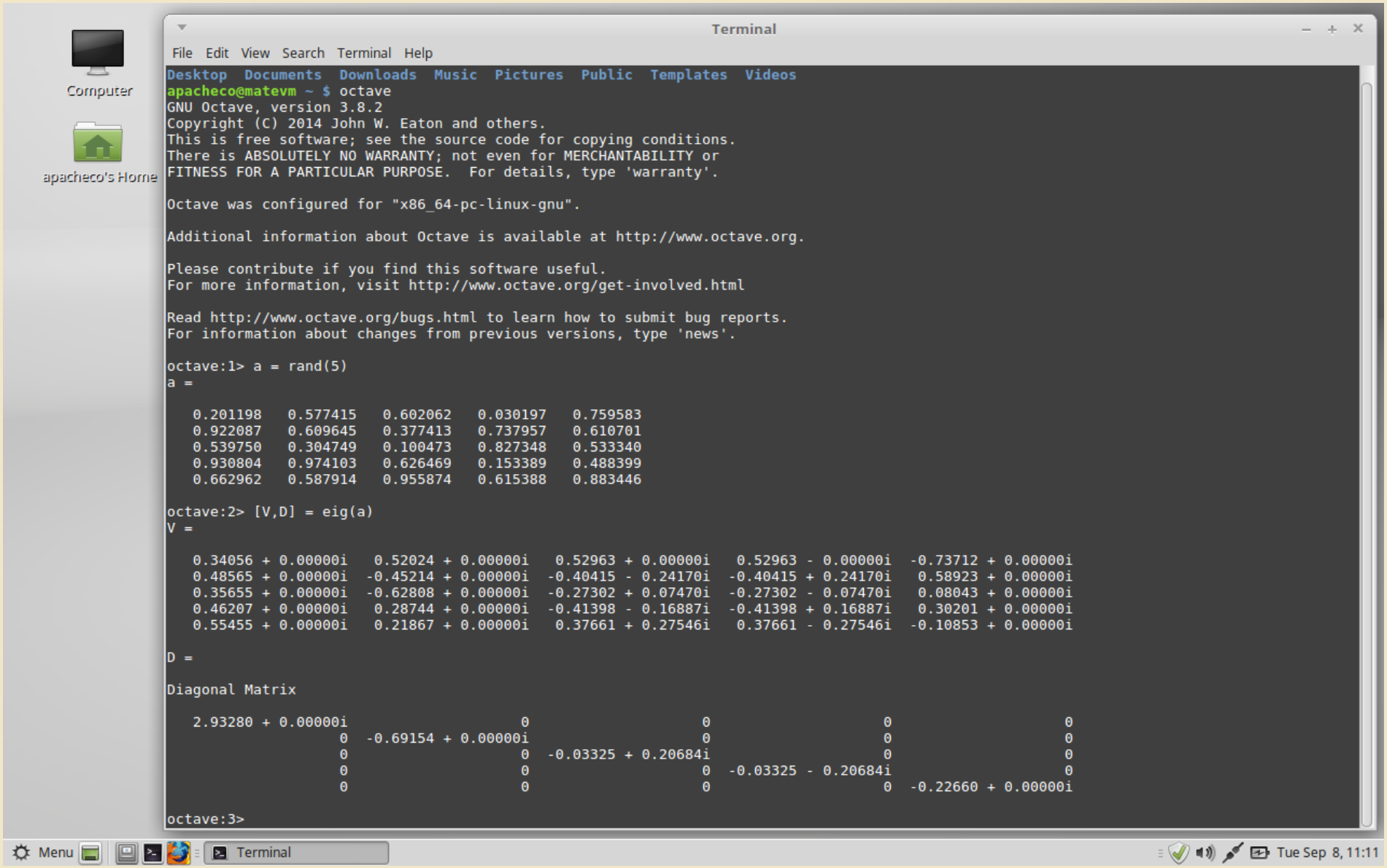
CentOS GNOME Desktop



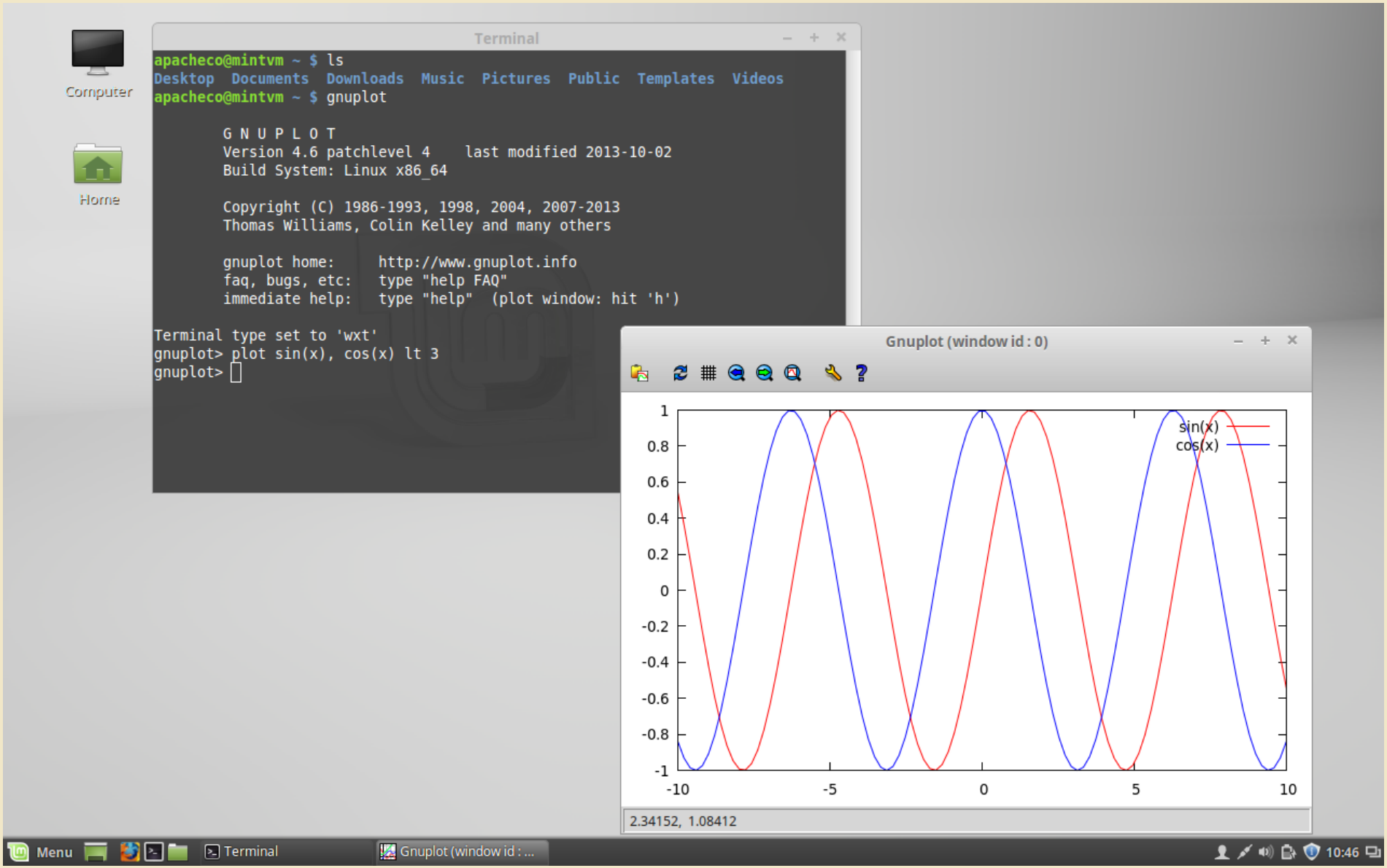
Ubuntu Unity Desktop



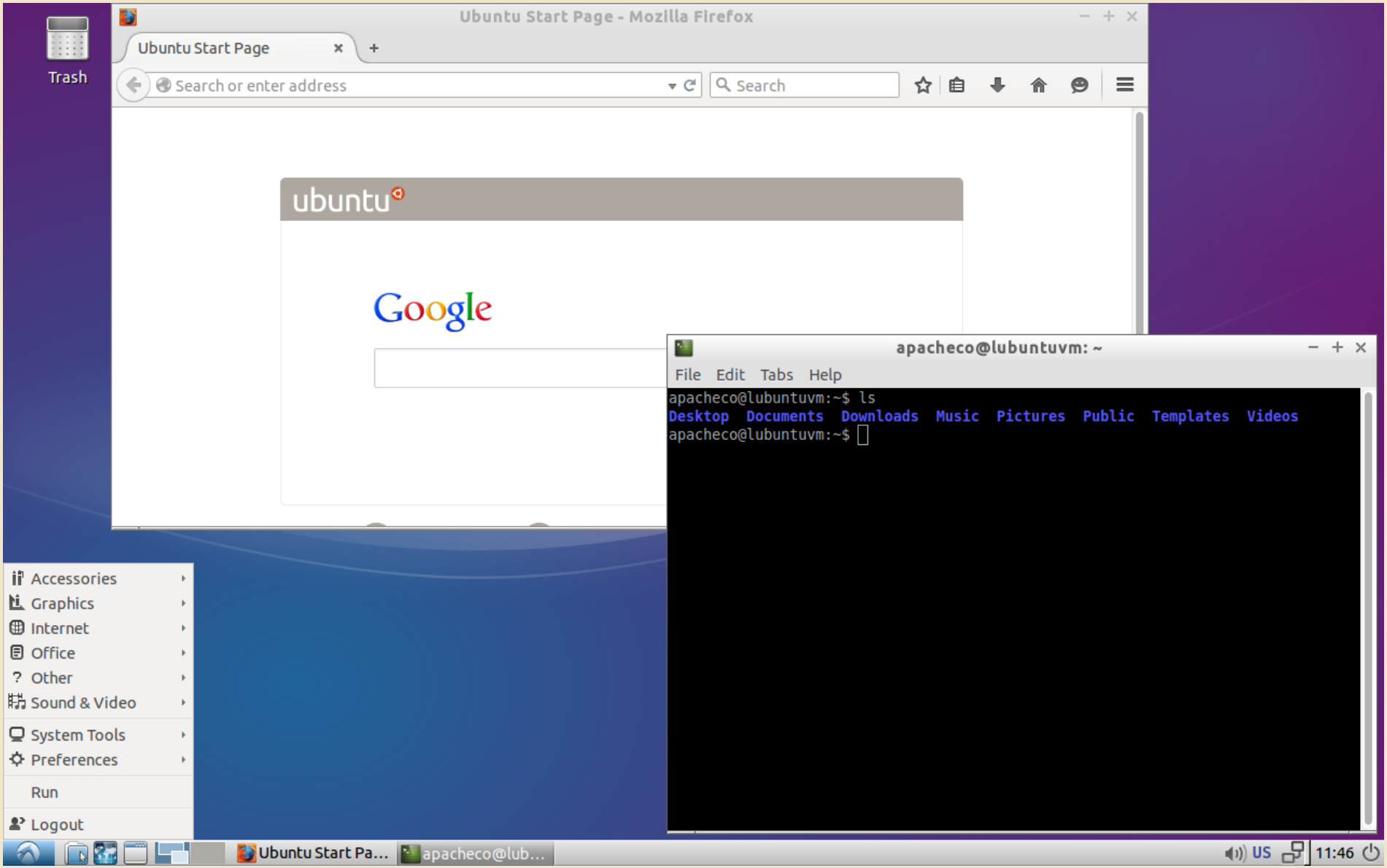
Linux Mint Debian Edition MATE Desktop



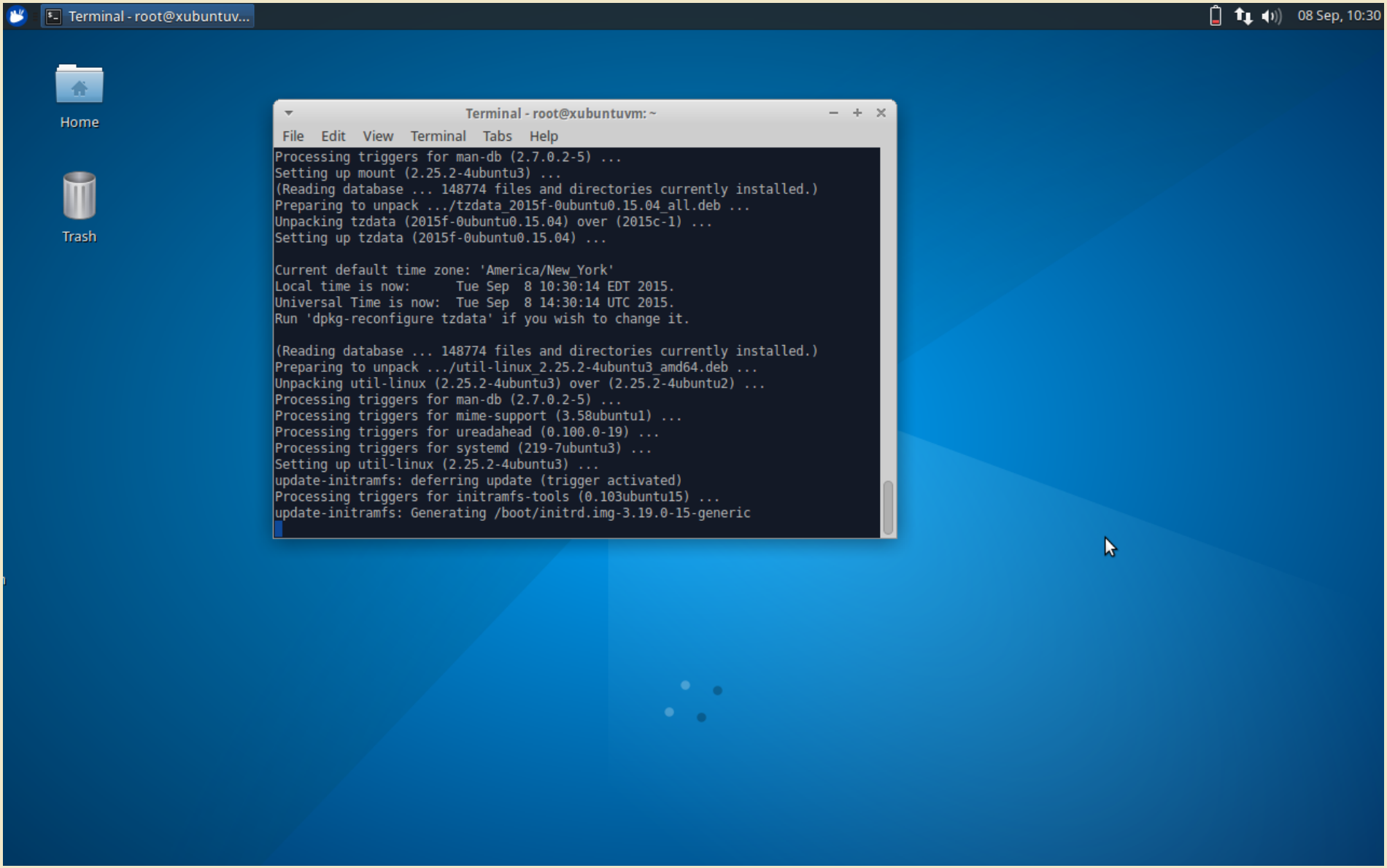
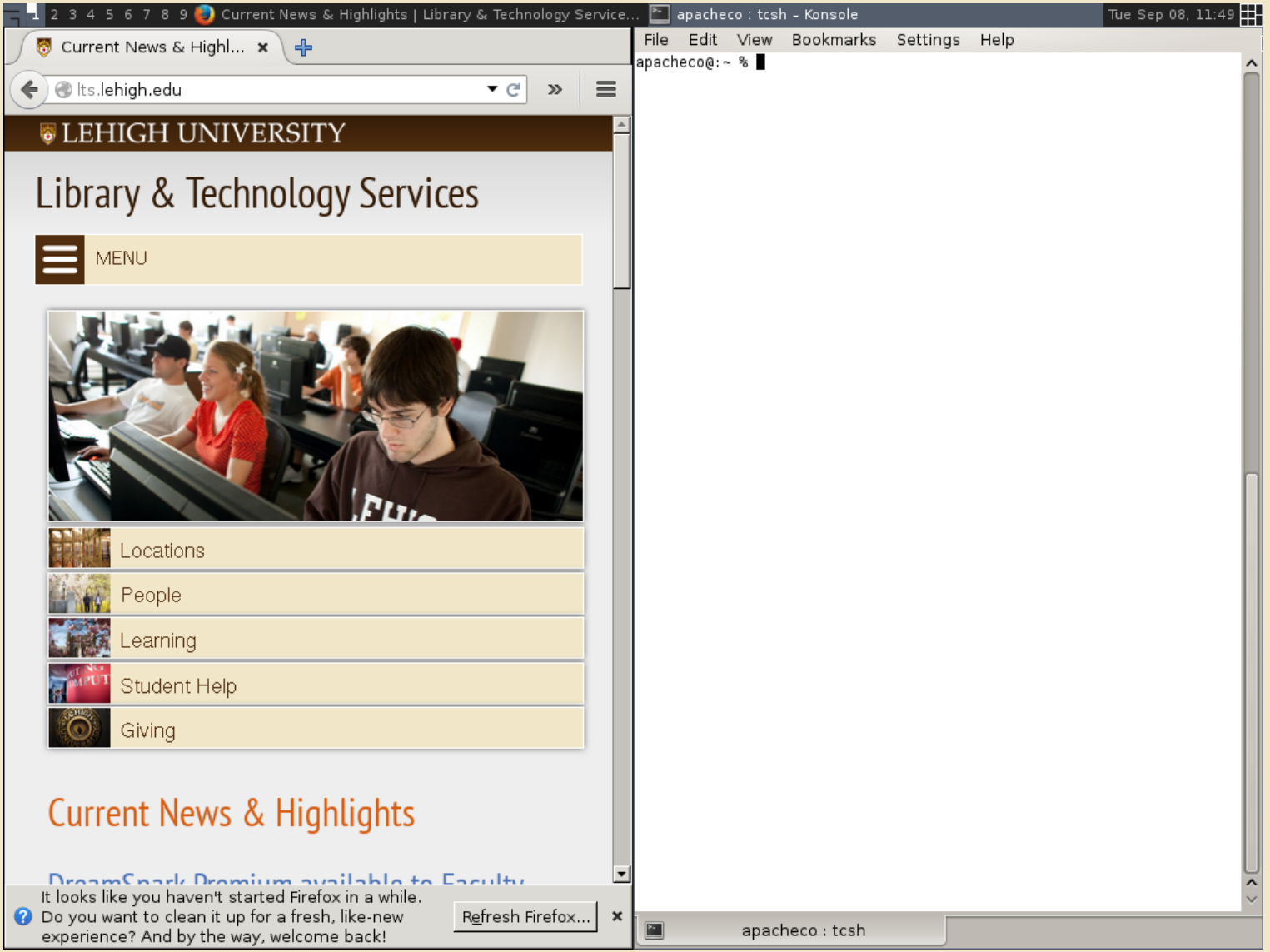
Linux Mint Cinnamon Desktop



Lubuntu LXDE Desktop



Xubuntu Xfce Desktop



FreeBSD (Unix not Linux) Awesome DWM