A Brief Introduction to Linux

What is it? What can I use it for?

Alexander B. Pacheco
LTS Research Computing
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Outline

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).
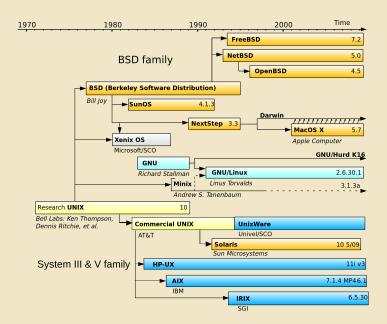I've currently ported bash(1.08) and gcc(1.40), and things seem to work. This implies that I'll get something practical within a few months, and I'd like to know what features most people would want. Any suggestions are welcome, but I won't promise I'll implement them :-)
Linus (email address)
PS. Yes - 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

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.
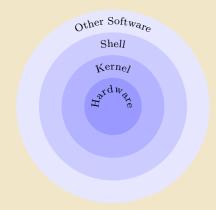
Popularity of Linux Distributions

- 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
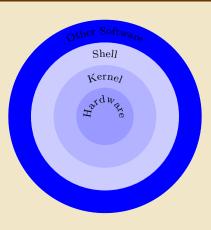
- Shell
  - The command line interface is the primary interface to Linux/Unix operating systems.
  - Shells are how command-line interfaces are implemented in Linux/Unix.
  - Each shell has varying capabilities and features and the user should choose the shell that best suits their needs.
  - The shell 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
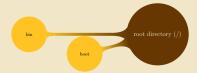
- Everything in Linux/UNIX is either a file or a process

- 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

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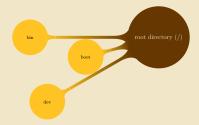
- All files are arranged in a hierarchial structure, like an inverted tree.
- The top of the hierarchy is traditionally called **root** (written as a slash /)

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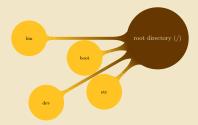
- contains files that are essential for system operation, available for use by all users.

- contains bootable kernel and bootloader

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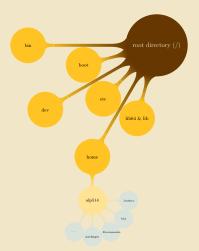
- contains various devices such as hard disk, CD-ROM drive etc

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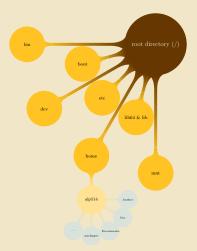
- contains various system configurations
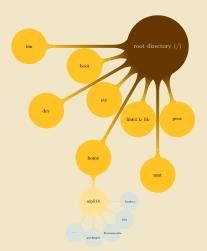
- contains home directories of all users. This is the directory where you are at when you login to a Linux/UNIX system.

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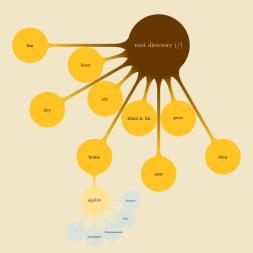
- contains libraries that are essential for system operation, available for use by all users.

File System Hierarchy
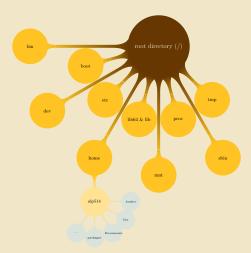
- directories where disk drives are mounted

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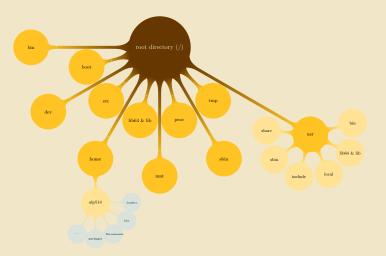
- process information pseudo-file system containing runtime system information (e.g. system memory, devices mounted, hardware configuration, etc).
- can be regarded as a control and information centre for the kernel.

File System Hierarchy
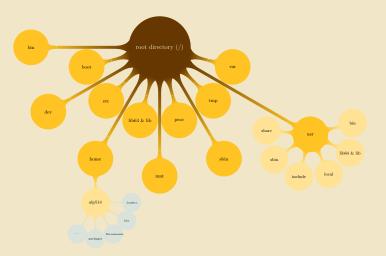
- same as bin but only accessible by **root**

File System Hierarchy
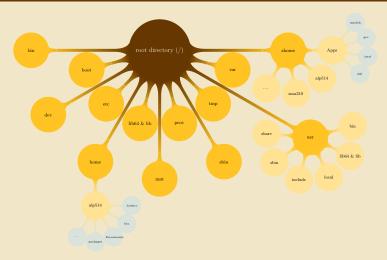
- temporary file storage

File System Hierarchy
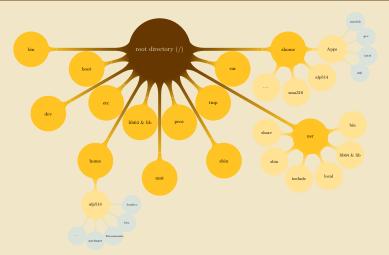
- contains user documentations, binaries, libraries etc

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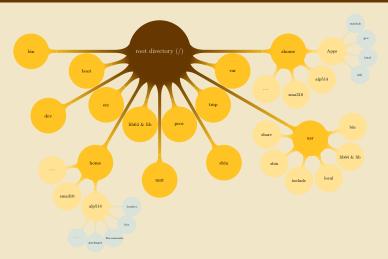
- used to store files which change frequently (system level not user level)

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
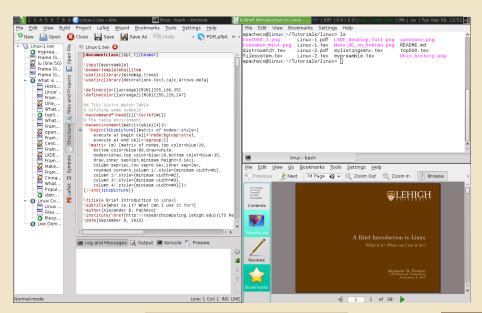
- UNIX like OS's are designed for multi user environments i.e. multiple users can exist on the system.
- Special user called **root** is the administrator and has access to all files in the system.
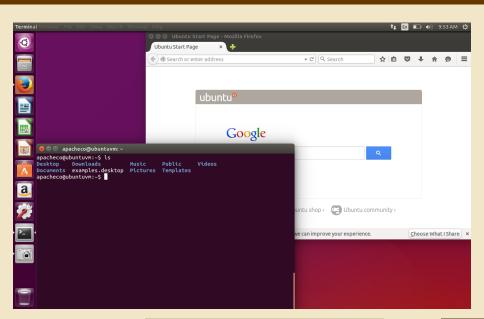
Live Demo
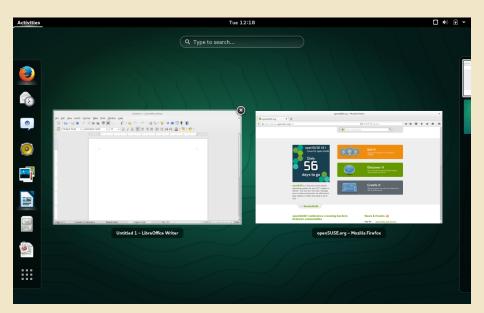
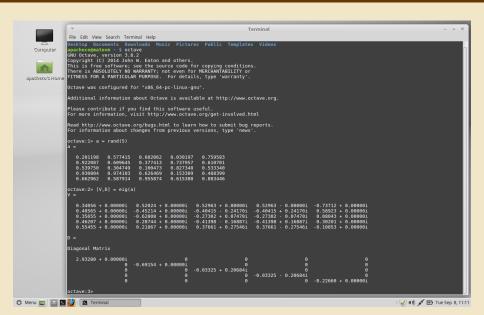# openSUSE Awesome Dynamic Window Manager
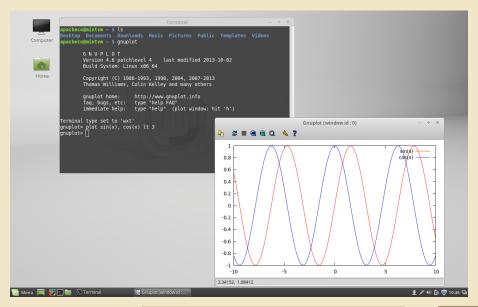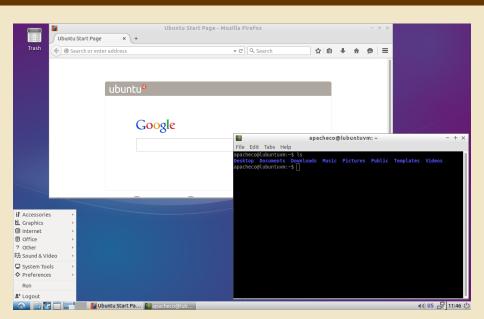
openSUSE GNOME

CentOS GNOME Desktop

Linux Mint Debian Edition MATE Desktop

Lubuntu LXDE Desktop

Xubuntu Xfce Desktop

FreeBSD (Unix not Linux) Awesome DWM