

# GNU/Linux, Ubuntu - A Functional View

A. Mani

Department of Pure Mathematics, Calcutta University  
9/1B, Jatin Bagchi Road  
Kolkata-700029 India  
E-Mail: [a.mani.cms@gmail.com](mailto:a.mani.cms@gmail.com)  
Homepage: <http://www.logicamani.in>

WWFS-FWD'2016, NSEC, Kolkata

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# ABSTRACT

In this talk aspects of typical GNU/Linux distributions will be reviewed from a functional perspective. Recent developments and more involved tasks will also be considered from a comparative point of view. For implementation of recent developments, the distro of choice will be Ubuntu.

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# Myself

- Research in Algebra, Logic, Rough Sets, Vagueness and related areas.
- Course development in Machine Learning, Soft Computing.
- Occasionally involved in independent consultancy in KDD, Statistics and Specifications
- GNU/R expert,
- Free Software Activism: Ubuntu Women Project, GLUG Kolkata, (ilug-Cal.info), Fedora, LQ, GNU/R India
- Functional Feminist

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# What is GNU/Linux?

## GNU/Linux is

- Free Software, mostly under the GNU-GPL
- Robust Modern Operating System
- Extremely Flexible and Customizable
- Huge amount of free software can run on it.
- Secure by Design
- Runs on an extremely wide range of hardware.

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# *Distro Components*

- KDE-Plasma Desktop 5.6+, GNOME-3.2+, XFCE, LXDE, KDE-3, Enlightenment, Awesome
- Unity, GNUStep, Fluxbox, Icewm, AfterStep, FVWM, Ion3
- X: LDM, SDDM, GDM, XDM, SLIM, WDM, LXDM, CDM, XDM : loaded by daemon or systemd
- Huge number of Applications.
- GNU Utilities, X11R7+, Wayland, Mir
- Linux Kernel(4.6.3+) , Linux Libre Kernel

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# Distros

- GNU/Debian: Kubuntu, Ubuntu, Gnewsense, Skolelinux, Knoppix
- Slackware: VectorLinux, RIP, Slax, Frugalware
- Fedora: RHEL, BLAG, CentOS, Scientific Linux, Fermi
- Gentoo: Sabayon, Utoto. Mandriva, PCLinuxOS, BOSS
- Rescue: Systemrescue CD, Gparted, Clonezilla, Parted Magic
- [www.linuxtracker.net](http://www.linuxtracker.net), DistroWatch

# GUI vs Konsole

- GUIs implement a small subset of what is possible in Konsole/terminal
- GUIs add further complexity to the basic commands.
- Features of GUIs become more obscure with complexity

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# Common Packages

- Vim, GNU/Emacs, Kate, Gedit, TEA
- LibreOffice, Calligra, AbiWord, OpenOffice, Scribus
- Okular, Evince, pdftk, Xournal, pdfedit
- Clamav, Spamassasin, Bogofilter, rkhunter
- GIMP, Inkscape, ImageMagick, Gwenview, F-Spot
- Mplayer, SMplayer, VLC, K3B, Blender, Xine

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# Files

- Everything is a file
- Names of files should not include special characters: `() [] ' " / > < | ; ! # & * % $`
- File Types: Normal (-), Directory (d), Symlink (l), Character Device Node (c), Block Device Node (b), Pipes (p), Sockets (s)
- owner-user, group, others: read(r), write (w), Execute (x).
- `#ls -l abc.txt`
- `-rw-r-r- 1 xyz username 1687 2012-03-25 17:27 abc.txt`

# Filesystem Hierarchy

**Origin** : Ken Thompson and Dennis Ritchie in 1970.

**FHS** \*buntu follows the **Filesystem Hierarchy Standard**.

**/** root directory: Every other file is under the root directory.

**/boot** Includes the kernel, initrd/RAM disk, bootloader and related configuration files for bootup.

**/etc** Has most of the configuration files for the system. Most of them can be manually edited. Examples:  
**/etc/init/\***, **/etc/init.d/\*** , **/etc/fstab** ,  
**/etc/passwd**

**/bin** Contains binaries required by the system including shells, ls, grep, cat, mount, rm etc.

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# Filesystem Hierarchy-2

- /lib** contains important dynamic libraries and kernel modules
- /lib32** Shared 32-bit libraries
- /lib64** Shared 64-bit libraries for system binaries.
- /root** Home of super user.
- /var** For variable data that changes as the system is running. Subdirectories: backups, cache, crash, games, lib, local, lock, log, mail, opt, run, spool, tmp
- /sbin** Contains system binaries. These require super user privileges for execution.

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# FS Hierarchy-3

- /srv** may contain data directories of services such as HTTP (`/srv/www/`) or FTP.
- /sys** virtual filesystem that can be accessed to set/get info about the kernel's view of the system.
- /tmp** Temporary files of programs may go here.
- /proc** Virtual directory for info about processes
- /dev** Files refer devices available to the system.
- /run** `/run` is a transient tmpfs for the boot process. Deprecates non transient `/var/run`, `/var/lock`, `/lib/init/rw`
- /media** `/media` is intended as a mount point for external devices, such as hard drives or removable media (floppies, CDs, DVDs).
- /home** Ordinary users keep their home directories here.

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# Filesystem Hierarchy-4

**/usr** : for users.

**/usr/bin** Binaries used by users

**/usr/?** bin, games, include, lib, lib32, lib64, local, sbin,  
share, src, X11R6

**/usr/include** Header files for GCC

**/usr/share** Documentation, Config files and shared data for the  
user applications.

**/usr/src** Source code files for the system's software

**/usr/local** Data and applications for local use as opposed to  
use on a network. Also for applications  
incompatible with package manager.

# Modern File Hierarchy

- /cdrom, /lib32 , /tmp, /bin, /lib64,
- /proc, /selinux, /usr, /boot, /lost+found, /var,
- /dev, /media, /etc, /mnt, /root, /run,
- /sys, /home, /lib, /opt, /sbin, /target
- Subdirectories of /usr: bin, games, include, lib, lib32, lib64, local, sbin, share, src, X11R6
- Make extra directories in /media for mounting partitions/volumes.

# How To Install a Distro

- Boot from install CD/ DVD/ USB image/Hard Disk.
- Installers of most distros are very user-friendly.
- Partitioning and Assigning Mount Points.
- Understand Basic User Types. Remember to Back up any Data
- Advanced: Network Install, Kickstart Files
- Not Recommended: Installs from within M\$ OS

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# Partitioning and Mount Points

- Partition Table (Disk label) : gpt, msdos (mbr), sun, bsd, pc98, mac
- Partitions: 3 Primary + 1 Extended (many logical partitions inside) (of dos partition table).
- GUID Partition Table: a finite number of primaries
- Device Names : /dev/sda. /dev/sda1, Labels, UUID
- A partition should be mounted at a mount point (a directory like say /abc ) for for read/write operations.
- Parted Magic / System Rescue Live CDs: GParted, QtParted, KPartition Editor, Parted.
- Filesystem Types: XFS, Ext4, Ext3, JFS, Btrfs, Reiserfs. Ext2, ZFS

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# Partitioning and Mount Points-2

- To use a partition, you need to mount it.
- Create all of /boot (1GB) , / ( 20–60GB), /home (you decide), swap (min (2xMemory, 2GB)), Others (you decide)
- LVM: Live order-free resizing.  
<https://wiki.archlinux.org/index.php/Lvm>
- LVM: Do not use on single hard drive computers.
- `#mount -t xfs /dev/sda3 /abc`
- `#umount /abc`

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# Logical Volume Manager LVM

- Volume Group : collection of physical and logical volumes with a name
- Physical Volume: correspond to disks/block devices
- Logical Volumes: are virtual partitions with a filesystem. They can span across multiple disks.
- LVM Advantage: Most operations can be done while the system is running: resizing, moving, Partitions, Snapshots
- Gparted: create partition with lvm flag (8e)
- Initialize it as a physical volume: `sudo pvcreate /dev/sda1`

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# LVM Commands

- Create Volume Group : `sudo vgcreate abc /dev/sda1`
- Create Logical Volume named efg in abc: `sudo lvcreate -n efg -L 10g abc`. Block Device for the volume would be like : `/dev/mapper/abc-efg`
- Display Logical and Physical Volumes: `lvs`, `pvs`, `lvdisplay`, `pvdisplay`
- Extend a Logical Volume: `sudo lvextend -L +5g abc/efg`
- Expansion of filesystem is essential after this: `sudo resize2fs /dev/abc/efg`
- Moving Partitions : `sudo pvmove -n bar /dev/sda1`

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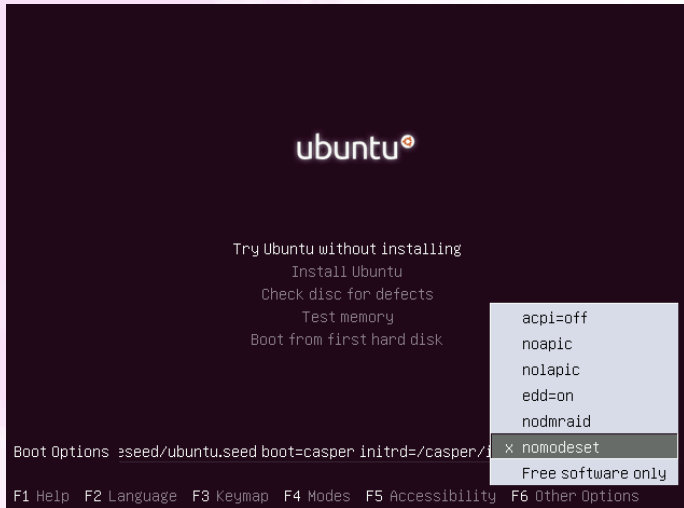
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# Boot Parameters

- kernel xxxxx nomodeset; init=/sbin/sh ; sdb=noprobe
- libata.force=3.0G ; nfsroot= xxx (for diskless stations))
- noinitrd, nomce, iommu=off, selinux=1, vga=ask



# Hardware

- Driver modules need to be loaded for devices to function... usually this is automatic.
- `#lspci -v #dmesg (kernel's ring buffer) #lshw -sanitize #dmidecode #lsusb -v`
- `#lsmod #modinfo #cat /proc/modules #modprobe module_name`
- Do not use proprietary driver modules like `fglrx (radeon)`, `nvidia`.
- Sound: ALSA, Pulseaudio, Phonon, JACK
- Hard Disks: `gsmartcontrol`, `smartctl` , `hdparm`

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# Hardware-2

- udev: manages device nodes in /dev (replaces hotplug, hwdetect, hal in kernels > 2.6.13)
- udev rules: /etc/udev/rules.d/ # udevadm info -a -n [device name]
- udev rules may need to address complications due to parallelism.
- <https://wiki.archlinux.org/index.php/Udev>
- [http://www.reactivated.net/writing\\_udev\\_rules.html](http://www.reactivated.net/writing_udev_rules.html)

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# FSTAB

- `UUID=abc12 /abc xfs defaults 0 1`
- `LABEL=efg /abc ext4 noauto,owner 0 2`
- `/dev/sr0 /media/dvdrw iso9660 noauto,user 0 0`
- `master.foo.com:/home /mnt nfs rw 0 0`
- `[fs_spec] [fs_file] [fs_vfstype] [fs_mntops] [fs_freq]`  
`[fs_passno]`

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# Boot Process

- BIOS Phase: BIOS Checks MBR of Computer (X86\*)
- Transfers Control to Boot Loader (Grub2/ Lilo/external drive/network )
- Bootloader Phase: Grub2 locates kernel (vmlinuz) and places initramfs images in memory.
- Kernel Phase: Kernel decompresses images to /sysroot in memory. Finds root partition with initrd.
- Checks and Mounts / . Starts /sbin/init, Frees Memory.
- Sysvinit/Upstart/ Systemd Phase: Event-driven init that starts services or tasks. /etc/events.d. Systemd follows non-posix compliant coding standards, hinders inter-operability and interferes with configuration.

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# Networking: Wired

- `#sudo apt-get install pppoeconf`
- Install rp-pppoe in Fedora; `#rpm -Uvh rp-pppoe*.rpm`
- `#pppoe-setup`; `#sudo pppoeconf`
- DataOne: username, server, password, firewall:standalone/etc.
- USB ADSL Modems: Bad Idea
- nameserver ISP\_DNS ; 8.8.8.8 ; 8.8.4.4 ; /etc/resolv.conf

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# General Networking

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- NetworkManager; /etc/NetworkManager.conf; Distro-Specific
- #ifconfig -a ; #iwconfig; #nm-tool

# General Networking (cont'd)

```
$ nm-tool
NetworkManager Tool

State: connected

- Device: eth0 [System eth0] -----
  Type:                Wired
  Driver:               8139too
  State:                connected
  Default:              yes
  HW Address:           00:21:C0:C1:B3:29

Capabilities:
  Carrier Detect:      yes
  Speed:               100 Mb/s

Wired Properties

  Carrier:              on

IPv4 Settings:
  Address:              192.137.1.2
  Prefix:               24 (255.255.255.0)
  Gateway:              192.137.1.1

  DNS:                  192.137.1.1
```

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# RPM, YUM

- Yumex, Packagekit : GUI
- `#yum upgrade -y; #yum list available|grep djvu`
- `#yum install koffice yum-plugins*`
- `#rpm -Uvh scribus*.rpm; #rpm -qa qt`
- `/etc/yum.conf ; /etc/yum.d ; /var/cache/yum ;`
- `#yum clean all; #yum remove acroread ; #package-cleanup -leaves`

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# DEB, APT

- Software Control Center, KPackagekit, Adept, Synaptic : GUI
- `#apt-get upgrade`; `#apt-get install pdftk`
- `#apt-get -f install`; `#apt-file update`
- `#apt-cache search djvu` ; `#apt-cache depends lsof`
- `#dpkg -i *.deb` ; `#dpkg -S /bin/*` ; `#dpkg -l |grep tex`
- `/etc/apt`; `#apt-get purge acroread`

# More Package Management: Compiling

- Compiling from Source; untar sources to /gs (say)
- # cd ./gs && ./configure && make && make install
- G Hard Depends on H iff H's removal breaks G fatally.
- G Soft Depends on H iff H's removal does not break G fatally.
- Actual Depends, Recommends and Suggests: Debian way.
- RPM does not have this, but some work arounds are possible.

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# Commands: Builtins and Others

- `#cat /proc/cpuinfo >>efg.txt`
- `#yum list available |grep gimp`
- `#ls -l -R ./abc |grep rwx`
- `#free -t; #pkill process_name`
- `#kill $(pgrep frozen_program) : pgrep gets pid`
- `mv, cp, find, locate, du, ps -A, chmod, umask.`

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# FireWall, Etc for Desktops

- Are basically filters on ports in the system.
- System-config-firewall, Guarddog
- Firestarter, Firewall Builder.
- For Desktop Users simply use the Wizard.
- Root Kit Hunter: `# rkhunter -c`
- AntiVirus: Clamav (To check how badly M\$ PCs are infected)

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# Security-Enhanced Linux

- SELinux is an implementation of a flexible mandatory access control architecture.
- Policies also based on Type Enforcement, Roles or Multiple Levels.
- All processes and files are labeled with a type.
- A type defines a domain for processes, and a type for files. Processes run in their own domains.
- SELinux policy rules define how processes interact with files and other processes.
- Default setting is 'No Access' (strict)
- SELinux policy is administratively-defined, enforced system-wide and is not set at user discretion

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# Security with Freedom

Through SELinux (since FC3), Fedora

- Offers high-grade security on every computer without much overheads
- Permits any commercially certified application to be security-certified automatically
- Permits PCs to remain secure even under RREs (remote root exploit).
- has mandatory security policies secured at OS Level
- eliminates vendor lock in and permits innovation

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# DAC vs MAC in Linux

- SELinux adds Mandatory Access Control to the Kernel (with LSM)
- Discretionary Access Control - Traditional Unix way
- `# ls -Z < filename >` reveals SELinux Context
- `-rwxrw-r- user1 group1`  
`unconfined_u:object_r:user_home_t:s0 file`
- Here, SELinux provides a user (`unconfined_u`), a role (`object_r`), a type (`user_home_t`), and a level (`s0`).
- These are used to make access control decisions

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# GPG for Security

- Email Passwords and local encryption do not protect mails from getting snooped on by Govt and Corporate Agencies
- GNU Privacy Guard is an open PGP standards compliant encryption program.
- Each user has a unique Public and Private Key
- Former is shared to public.
- User can encrypt a email with public key with GPG.
- The encrypted mail can be read by recipient if they have their private key.

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# Arch vs Ubuntu

- Ubuntu is GNU/Debian with many additions. Arch is built from scratch.
- Arch: DIY GNU/Linux. \*buntu: Preconfigured system with less options
- Arch development is community driven and admits all user interfaces. Ubuntu is restricted by Canonical's commercial goals (Unity)
- Arch: Rolling Release. \*buntu: Discrete Releases
- Arch: ports-like package build system + Arch User Repository. \*buntu : apt, docker?
- Arch community has few non contributors to development, packaging, maintenance compared to \*buntu.

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# Contributing to Ubuntu

- UW Wiki, Documentation
- Project Specific Bug Fixing
- Community Development: LOCO
- Quality Assurance
- Ubuntu in Education Projects
- Ubuntu Women Outreach

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# Links

- Ubuntu user Documentation
- LQ : [www.linuxquestions.org](http://www.linuxquestions.org)
- GLUG-Kolkata: [www.ilug-cal.info](http://www.ilug-cal.info)
- Linux Libre: [www.fsfla.org](http://www.fsfla.org)
- Debian Guides: [www.debian.org](http://www.debian.org)
- Arch Documentation: <https://wiki.archlinux.org/>

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# CHEERS !