Introduction to Linux

What is Linux

Linux is a Unix like Computer Operating System developed under free and open-source software development and distribution.

- ***Free Software***
- ***32/64 bit operating system***
- ***Runs on different architectures – micro to mainframes***
- ***First kernel released in 1994***
- ***Co-exists with other OS***
- ***Graphical Interface***
- ***Multiuser, multi tasking and multi processor OS***

Unix Operating System

- AT & T System V OS
- Developed in 1960+
- Variants
  - AIX from IBM
  - HP-UX from HP
  - Solaris from Sun systems
  - Open Solaris
- Linux – a clone of Unix

Linux OS

- Linus + Minix = Linux
- First version 1984
  - Linux kernel
  - GNU Software
  - Software Packages

Hardware for Linux

Requires very bare minimum hardware

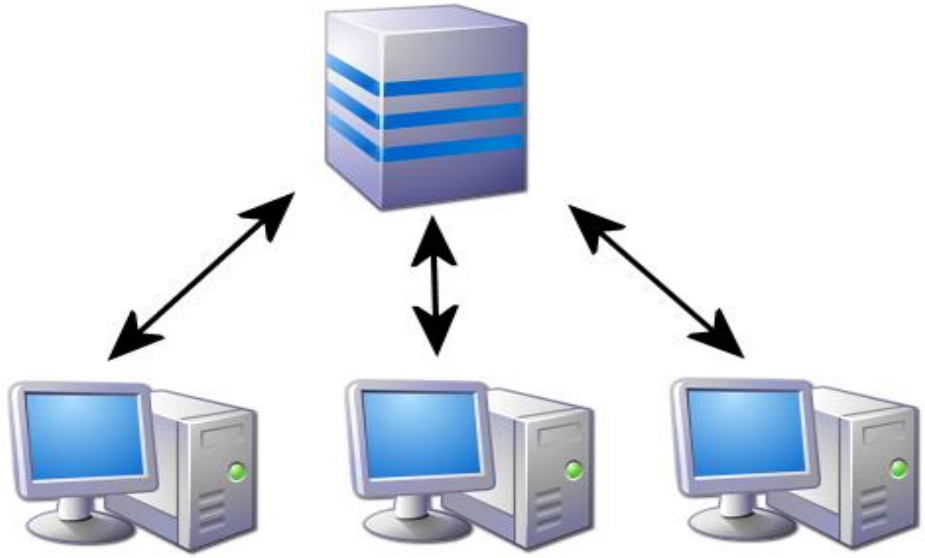
- 1 GB RAM
- Less than 10GB HDD Space
- Co –exists with other OS
- Above 16 bit micro-processor

Features of Linux

- Multi-user capability
- Multi-tasking capability
- Communication
- Security
- Portability

Multi-User

Host-Server



Clients/Users

Computer Resources are accessible to many users.

Multi-Tasking

- Capable of running more than one job at a time
- Time shared
- Switching occurs very fast

Example Process:-

TASK 1 - e-Mail
TASK 2 - Browser
TASK 3 - Editor
TASK 4 – Media Player

Communication & Security

- Over the Network
- E-Mail/web/FTP/SSH
- LAN & WAN Networks- no barrier
- Login and passwords
- File Permissions
- File encryption

Other Features

- It can work efficiently on anything from wristwatch to World's fastest Supercomputer.
- Scalable in terms of processor count, Number of users, Memory size,I/O, Resource management etc..
- Robust : Server/Cluster can run for many days without rebooting.

Linux used as….

- DNS Server
- DHCP Server
- Authentication Server
- Firewall
- Application Server
- Web Server
- NTP Server
- NFS Server
- HPC Cluster
- Many More……

Linux Distributions

More distributions are available (New/outdated).
Choice depends on user requirements and experience.

- *RHEL*
- *CENTOS*
- *Ubuntu*
- *Puppy*
- *Fedora*
- *SUSE*
- *Slackware*
- *Kali*

Where is Linux

- Internet built around unix
- Mobile devices
- Network devices
- Desktops and Servers
- Super Computers
- Architectures
  - X86-64 and X86-32
  - IBM Power PC
  - ARM Processors
  - Texas processors etc

Linux Everywhere

Top Super Computers list worldwide.

- https://top500.org/

Top Super Computers list INDIA

- https://topsc.cdacb.in

Why Linux

- Open Source and Free
- Multiuser and Multitasking OS
- Robust and Reliable
- Scalable and portable
  - Scalable – Processor counts, Users, Memory, I/O etc
  - Portable – works efficiently on Wrist watch to Super Computers

Which is best Linux !?

- Based on
  - Application
  - Hardware support
  - User friendly
  - Community Support
  - Knowledge base
  - User experience

GNU and GPL

- GNUs Not Unix
- Unix like OS
- Free OS
- GNU application packages

  gcc, glibc, GNOME etc
- GNU public license

GNU GPL

- Aim of GPL
  - Run the Program
  - Study and modify
  - Copy and redistribute
  - Improve
  - sell and re-sell

Linux and GNU

- Linux distribution = Linux kernel + GNU tools
- Linux/GNU maintained by FOSS
- Linux provides Kernel
- GNU Provides
  - Applications
  - Tools and libraries

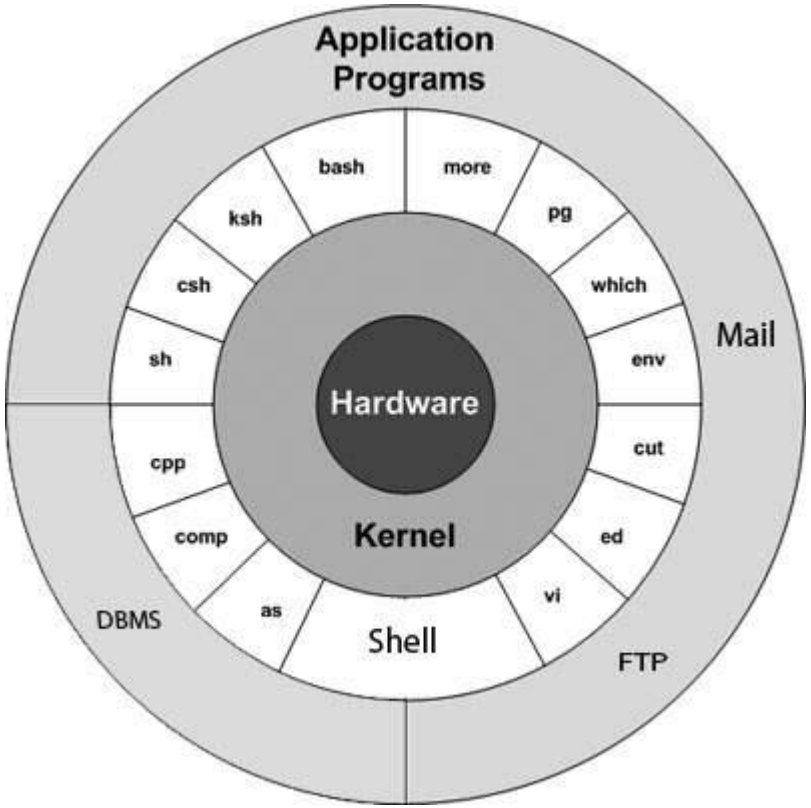
Linux and GNU Advantage

- Stability
- Free and opensource
- Wide range of hardwares
- Security
- Community Support
- Vast knowledge base

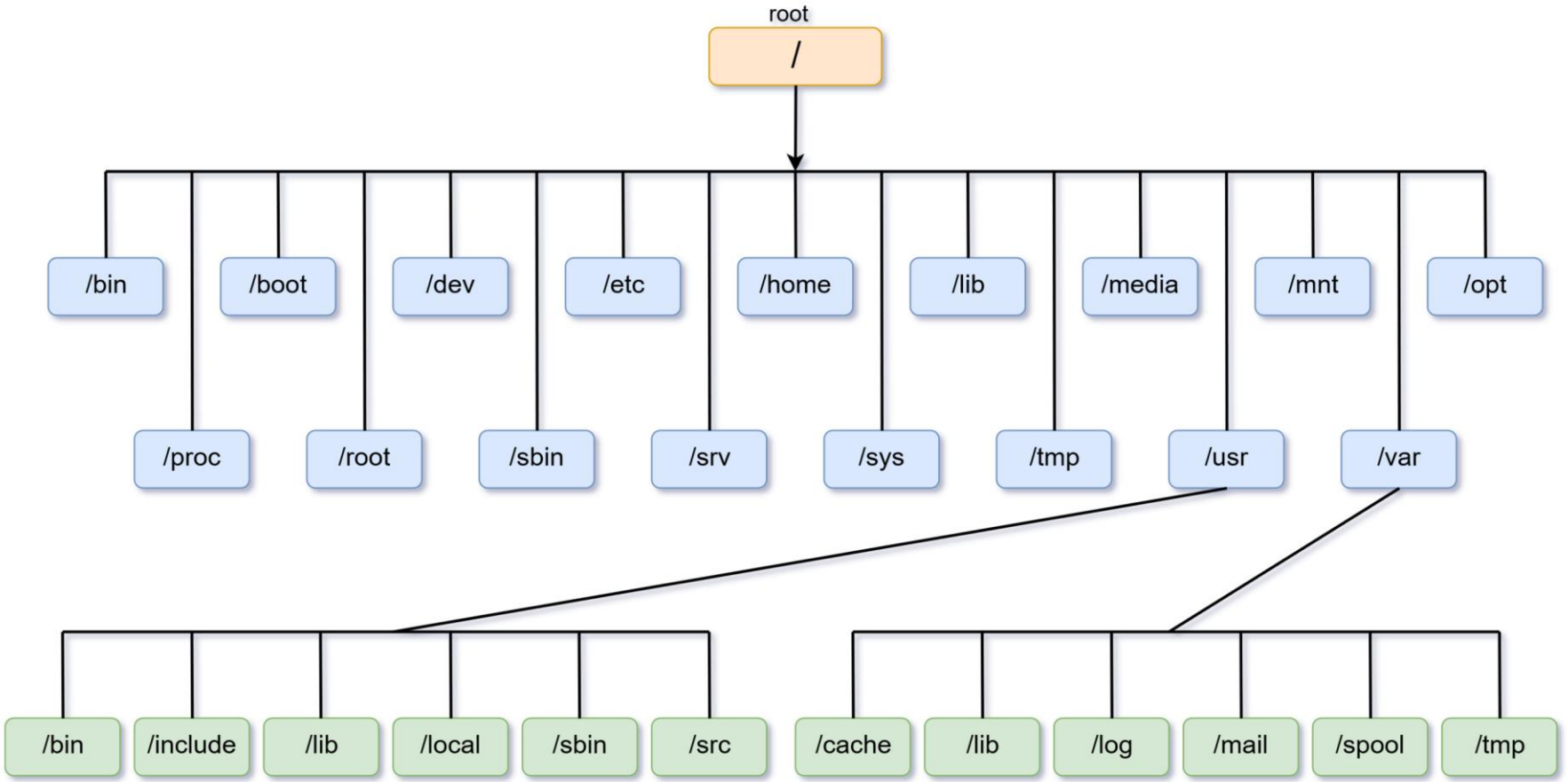
Linux Dis-advantages

- More distributions are available (New/outdated).
- Choice depends on user requirements and experience.
- Official support needs subscription
- Applications compatibility between windows and linux
- Some application become obsolete or no further developments.
- Community Support dependency.
- New users find Windows OS more easy and comfortable.
- Administration difficulty due to change in cmd names/paths.

Linux System Organization



Linux File System



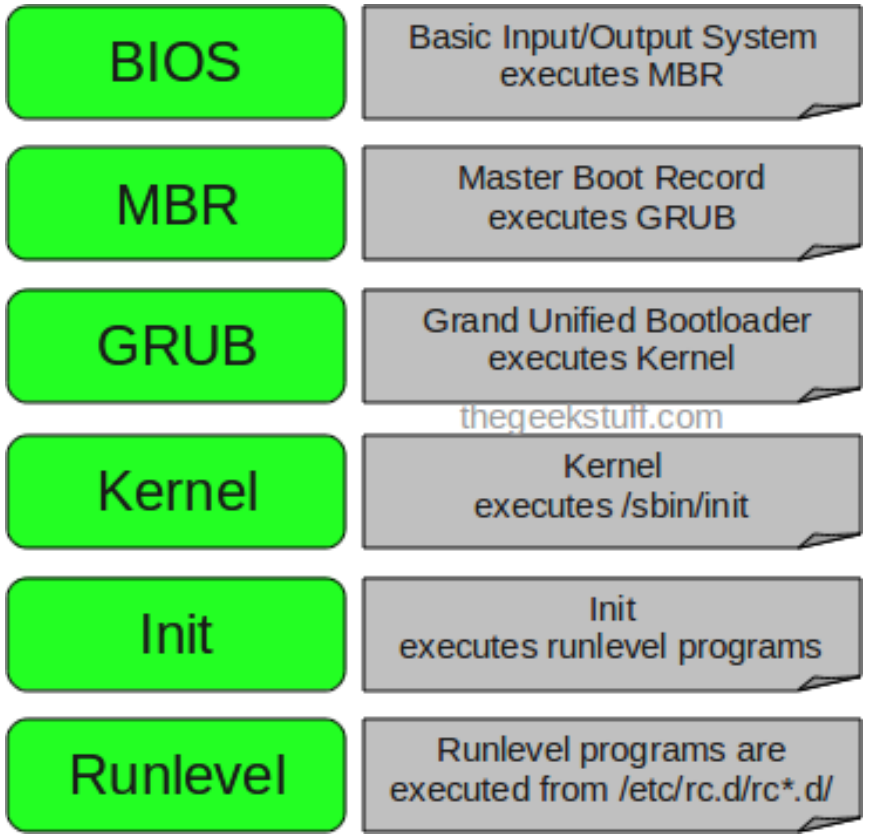
File System Details

/	root directory
/boot	files for booting system
/etc	configuration files
/bin	important system binaries
/sbin	contains system admin programs(super user)
/usr	user applications
/lib	dynamic libraries
/home	user home directories
/root	super user home dir
/var	contains variable data constantly generated when system is running
/dev	device files.

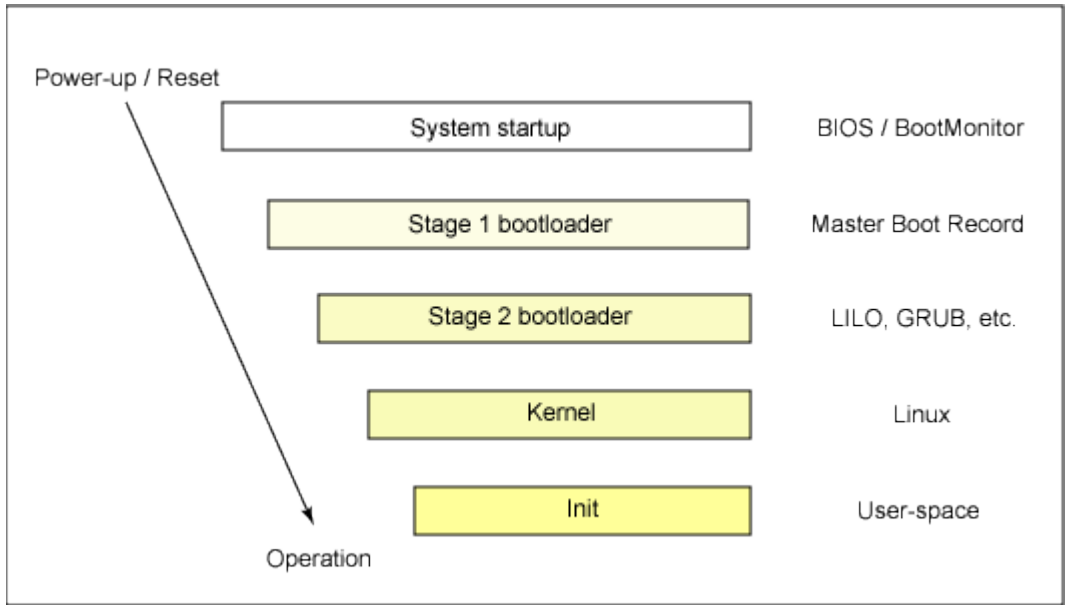
Linux Shells

- Bourne Shell
- C Shell
- Korn Shell

Linux Boot Process



Linux Boot Process



BIOS
(Basic Input and Output System)

- Basic Input/Output System Contains information about the machine's configuration. Eg. IDE controller, NIC
- PC knows which device to boot from via BIOS
- PC tries to run code from the MBR, ie. 1st 512 bytes of the disk
- MBR tells the PC to load the boot loader from certain disk partition
- The boot loader loads the kernel

Boot Loader LILO & GRUB

- Traditional and stable
- Boot manager or bootstrap
- LILO is outdated
- GRUB 1.0 and 2.0
- Understands File system
- Reads Partition table

Boot Loader
(LILO and GRUB/GRUB2)

GRUB	LILO
GRUB stands for GRAND UNIFIED BOOT LOADER	LILO stands for LINUX LOADER
GRUB support for unlimited boot entries	LILO only support up to 16 different boot selection
GRUB boot from network	LILO does not boot from network
There is no need to change a GRUB if configuration file changed, GRUB is dynamically configurable	There is need to change a LILO if configuration file is change , LILO is not dynamically configuarable
GRUB has interactive command interface	LILO does not have interactive command interface
GRUB has knowledge of file system	LILO doesn't have any knowledge of file system

Boot Loader
(GRUB and GRUB2)

GRUB	GRUB 2
Two config file	One config file
Difficult to make changes	System Admin friendly
Partition number from 0	Partition number 1
Config file format is different	Its like scripting format
Supports free & Proprietary OS	Supprts even more OS
LVM and RAID not understandable	Understands LVM and RAID
Image size is large with few modules	Small and modular

Kernel Initialization

A program itself

- /vmlinuz or /boot/vmlinuz
- Two-stage loading process
  1. initrd (init RAM disk)
     A transient root filesystem in RAM
     before a real root filesystem is available
     Eg. It is used to install file system
     modules into the kernel
  2. The real root filesystem
- Device detection and configuration
  You tell the kernel what to expect
  The kernel probes the H/W itself
- Kernel threads creation
  Eg. init (a user process)

Startup Scripts

- After Kernel initialization, a process called init is created with PID 1
- init runs startup scripts (normal shell scripts) to perform specific tasks, eg.
  - Setting the hostname, time zone, etc
  - Checking and mouting the disks
  - Configuring network interfaces
  - Starting up daemons and network services

Startup Scripts

Startup scripts (rc files) are run based on run levels

0 the level in which the system is completely shut down
1 single-user mode
2 multiuser mode w/out NFS
3 full multiuser mode
4 unused
5 X11
6 reboot level

- Starts with run level 0 to the default run level (usually 3)
- /etc/inittab tells init what to do at each level
- To find out which run level the system is current in
  $ runlevel

Startup Scripts

init runs the scripts from /etc/rc.d/rc[0-6].d/

/etc/rc.d/rc0/K25sshd → /etc/init.d/sshd

/etc/rc.d/rc3/S55sshd → /etc/init.d/sshd

Each server/daemon provides a master script

Stored in /etc/init.d

Understands the arguments: start, stop, restart

/etc/init.d/sshd start

run level 0 → 3

/etc/rc.d/rc3/S* start

run level 3 → 0

/etc/rc.d/rc0/K* stop

Reboot & Shutdown

- To shutdown
  - Shutdown –h now
  - Poweroff
  - init 0
  - Halt
  - Shutdown –h +15 (minutes)
- To Reboot
  - Shutdown –r now
  - Reboot
  - init 6