



# Day 1 - Linux



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# Introduction to Linux

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- LINUX is an operating system or a kernel distributed under an open-source license. Its functionality list is quite like UNIX.
- It was initially released by Linus Torvalds on September 17, 1991. It is a free and open-source operating system and the source code can be modified and distributed to anyone
- Linux is an open-source operating system like other operating systems such as Microsoft **Windows**, Apple Mac OS, iOS, Google android, etc.

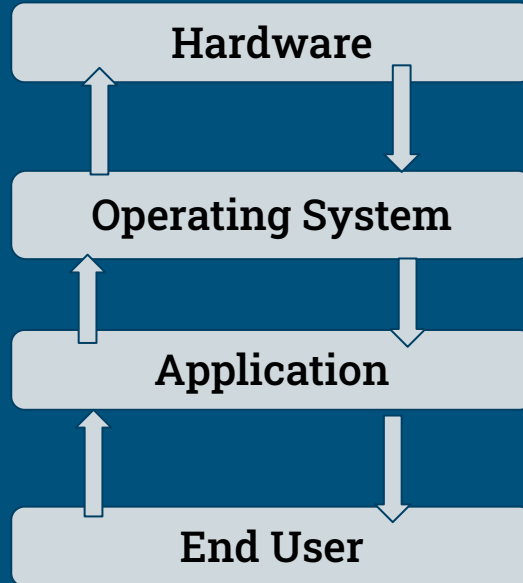
# Operating System

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An operating system is a software that enables the communication between computer hardware and software.

It conveys input to get processed by the processor and brings output to the hardware to display it. This is the basic function of an operating system. Although it performs many other important tasks, let's not talk about that.

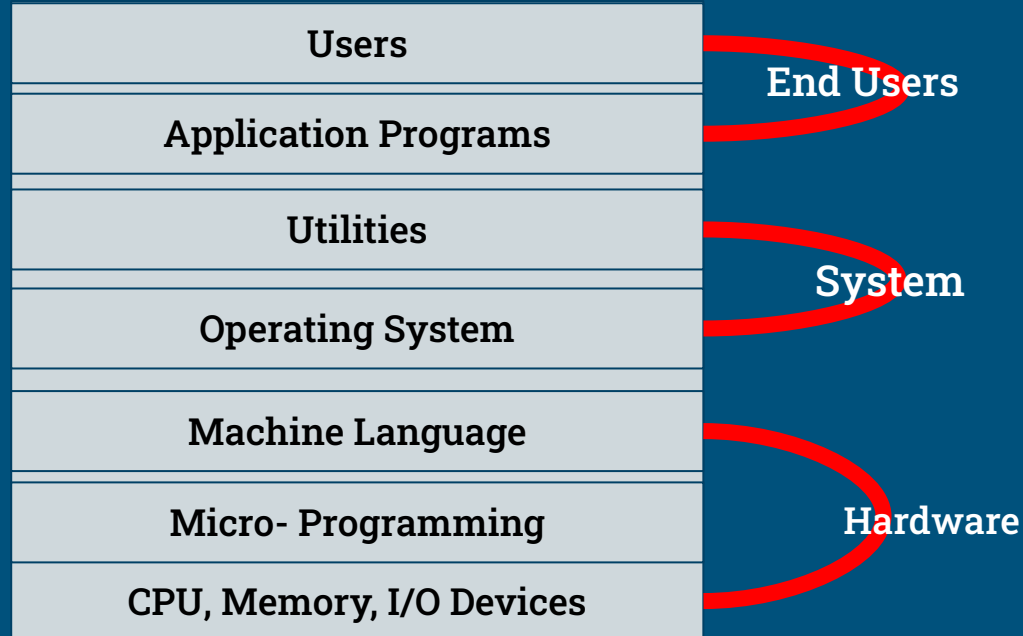
The kernel is a program at the heart of the Linux operating system that takes care of fundamental stuff, like letting hardware communicate with software.



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A Computer System consists of:

- Users (people who are using the computer)
- Application Programs (Compilers, Databases, Games, Video player, Browsers, etc.)
- System Programs (Shells, Editors, Compilers, etc.)
- Operating System ( A special program which acts as an interface between user and hardware )
- Hardware ( CPU, Disks, Memory, etc)



# What does an Operating system do?

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1. Process Management
2. Process Synchronization
3. Memory Management
4. CPU Scheduling
5. File Management
6. Security

# History of Linux

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The History of Linux began in 1991 with the beginning of a personal project by a Finland student Linus Torvalds to create a new free operating system kernel. Since then, the resulting Linux kernel has been marked by constant growth throughout history.



First Linux  
Code released



1991

Slackware  
Becomes First  
Widely Adopted  
Distribution



1993

Tech Giants  
Begin  
Announcing  
Platform  
Support For  
Linux



1998

IBM Runs  
Famous  
Linux AD During  
The Superbowl



2003

The Linux  
Foundation is  
Formed To  
Promote and  
Standardise  
Linux



2007

Linux Turns 20  
and Powers The  
World Super  
Computers,  
Phones, Atms



2011



Linus Licenses  
Linux Under  
The GPL An  
Important  
Decision That  
Will Contribute  
To Its Success

1992



Linus Visits  
Aquarium, Gets  
Bit By A  
Penguin and  
Chooses it As  
Linux MASCOT

1996



Red Hat Goes  
public

1999



Linux Appears  
on the Cover Of  
Business Week

2005



The Linux  
Based Android  
OS Outships  
All other Smart  
Phone OS's In  
The US &  
Climbs To  
Dominance

2010

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What is the latest version for Linux?

The latest version of the friendly operating system is here. Install it on your computer today!

Linux Mint 21.1

# Kernel Vs Os

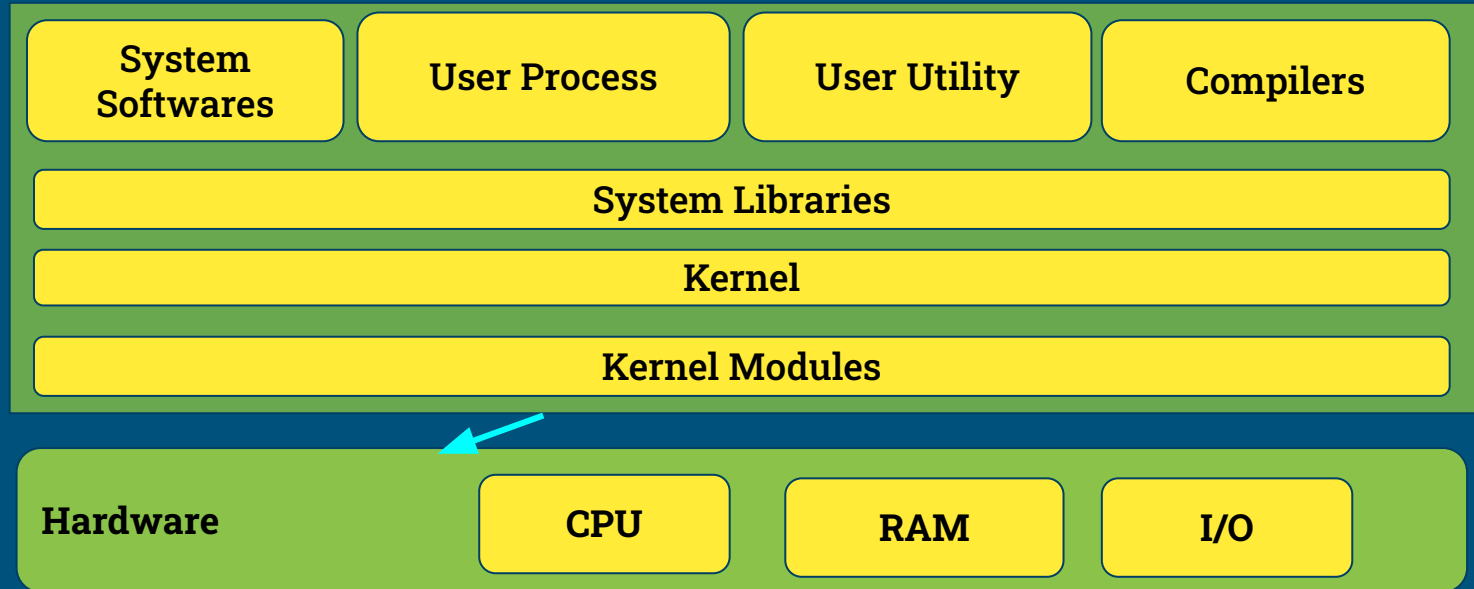
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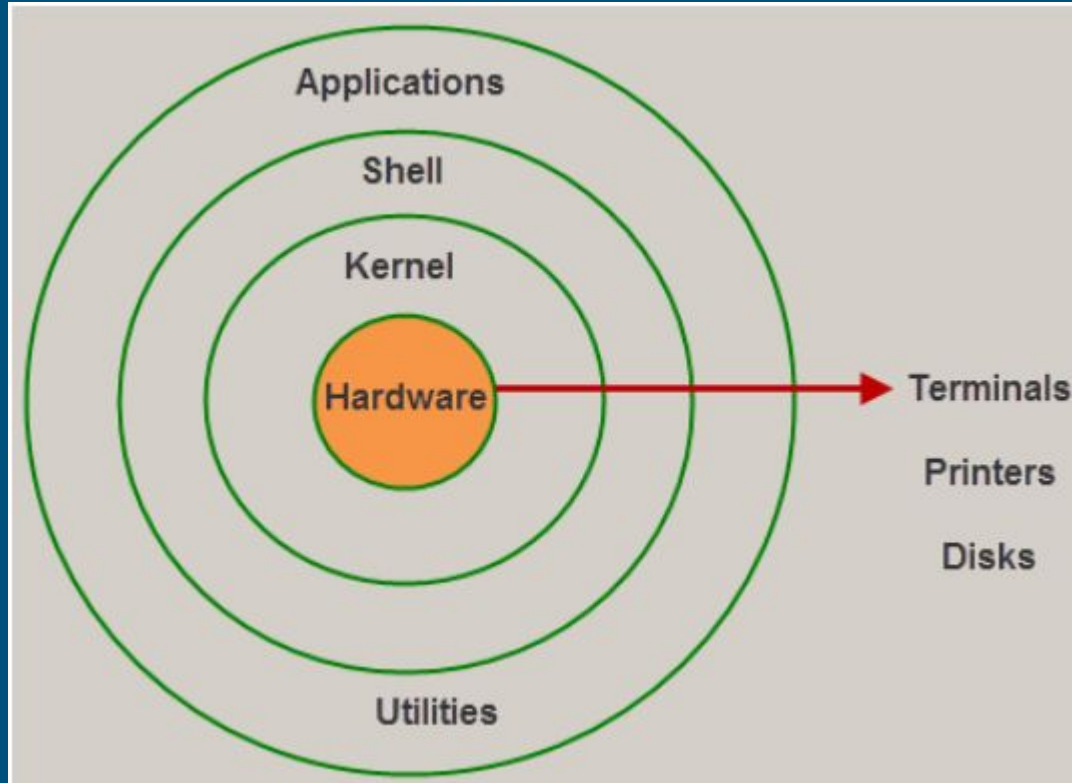
An OS is a software program that manages computer hardware resources and provides common services for computer programs.

The kernel is a core part of the operating system that interacts directly with the computer hardware

# Architecture of Linux

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# Types of kernel

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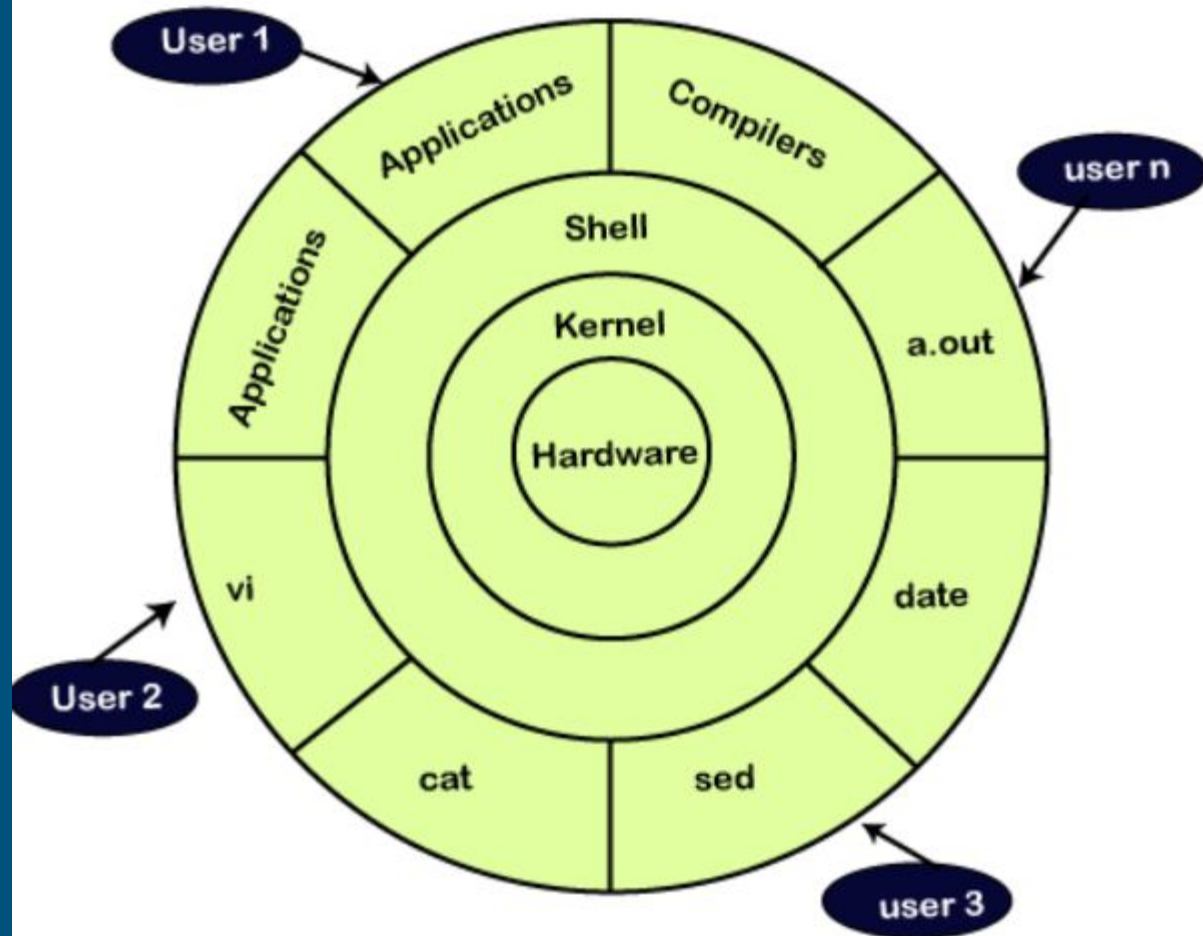
# Kernel

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The kernel is the core part of the operating system, which is responsible for all the major activities of the LINUX operating system.

It establishes communication between devices and software. Moreover, it manages system resources. It has four responsibilities:

1. Device Management
2. Memory Management
3. Process Management
4. Handling System Calls





# Device Management

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A system can be connected to many devices. A kernel stores all the data related to all the device in the device driver.

Thus kernel knows what device can do and how to manipulate for better performance.

It will manages communications between all devices .

# Memory management

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Kernel keep tracks of used and unused memory and make sure that process should not manipulate data of each other using virtual memory address

# Process Management

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Kernel assigns enough time and give priorities to processes before handling CPU to other processes.

It deals with security and ownership information

# Handling System calls

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Programmer can write a query or ask the kernel to perform a task

## 2. System Libraries

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System libraries are special functions, that are used to implement the functionality of the operating system and do not require code access rights of kernel modules.

# 3. System Tools

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System Utility programs are liable to do individual and specialized-level tasks

Linux OS has a set of utility tools, which are usually simple commands. It is a software which GNU project has written and publish under their open source license so that software is freely available to everyone.

With the help of commands, you can access your files, edit and manipulate data in your directories or files, change the location of files, or anything.

## 4. Development Tools

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To update your system, you have additional tools and libraries. These additional tools and libraries are written by the programmers and are called toolchain. A toolchain is a vital development tool used by the developers to produce a working application

# 5. End User Tool

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These end tools make a system unique for a user. End tools are not required for the operating system but are necessary for a user.

Some examples of end tools are graphic design tools, office suites, browsers, multimedia players, etc.



# Shell

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A Shell provides you with an interface to the system. It gathers input from you and executes programs based on that input. When a program finishes executing, it displays that program's output.


Shell is an environment in which we can run our commands, programs, and shell scripts. There are different flavors of a shell, just as there are different flavors of operating systems. Each flavor of shell has its own set of recognized commands and functions.

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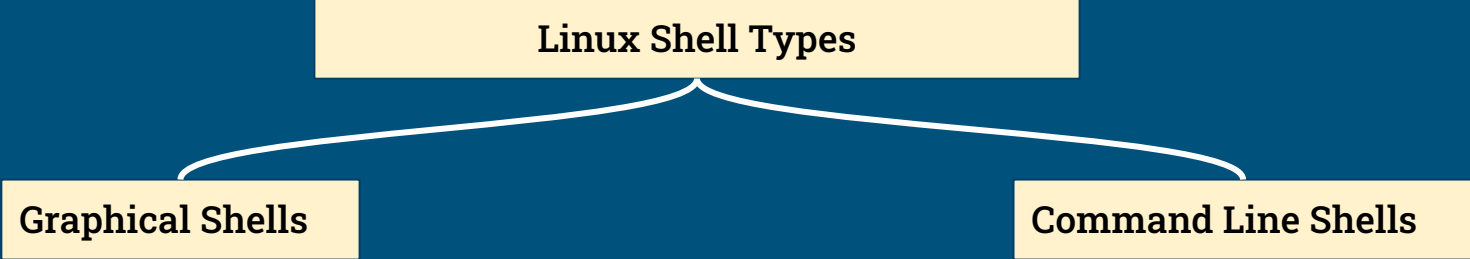
The shell sends the result to the user over the screen when it has completed running a program which is the common output device. That's why it is known as "command interpreter".

The shell is not just a command interpreter. Also, the shell is a programming language with complete constructs of a **programming language** such as functions, variables, loops, conditional execution, and many others.

For this reason, GNU/Unix **Linux** Shell is stronger than the Windows shell.



## Linux Shell Types



```
graph TD; A[Linux Shell Types] --> B[Graphical Shells]; A --> C[Command Line Shells];
```

Graphical Shells

Command Line Shells

# Graphical Shells

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These shells specifies the manipulation of programs that are based on the graphical user interface (GUI) by permitting for operations like moving, closing, resizing, and opening windows and switching focus among windows as well.

Eg: Ubuntu OS, Window OS

# Command-line Shell

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It is an operating system shell that uses **alphanumeric** characters typed on a keyboard to provide instructions and data to the operating system, interactively.

Various shells could be accessed with the help of a command-line interface by users.

A unique program known as Command prompt in Windows or Terminal in macOS/Linux is offered for typing in the human-understandable commands like "ls", "cat", etc and after that, it is being run. The result is further shown to the user on the terminal. Command-line shell is very dominant and it permits users for storing commands in a file and run them together.

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There are various types of shell:

1. Bash Shell
2. Csh/Tsh Shell
3. Ksh Shell
4. Zsh Shell
5. Fish

# Bash Shell

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-bash means Bourne Again Shell

It is a default shell over several distributions of Linux today. It is a sh-compatible shell. Bourne shell is usually installed as `/bin/sh` on most versions

It could be installed over Windows OS. It facilitates practical improvements on sh for interactive and programming use which contains:

- Job Control
- Command-line editing
- Shell Aliases and Functions
- Unlimited size command history
- Integer arithmetic in a base from 2-64

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For the Bourne shell the:

Command full-path name is `/bin/sh` and `/sbin/sh`,

Non-root user default prompt is `$`,

Root user default prompt is `#`.



# What is a Linux Distribution?

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Linux is open-source, free to use kernel. It is used by programmers, organizations, profit and non-profit companies around the world to create Operating systems to suit their individual requirements.

To prevent hacking attempts, many organizations keep their Linux operating systems private. Many others make their variations of Linux available publicly so the whole world can benefit at large.

These versions/ types /kinds of Linux operating system are called Distributions.

# How many distributions are out there?

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There are hundreds of Linux operating systems or Distributions available these days. Many of them are designed with a specific purpose in mind. For example, to run a web server or to run on network switches like routers, modems, etc.

The latest example of one of the most popular smartphone-based Linux Distribution is Android!

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## 1. CentOS

It is one of the most used Linux Distribution for enterprise and web servers. It is a free enterprise class Operating system and is based heavily on Red Hat enterprise Distro.

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## 2. Fedora

Another Linux kernel based Distro, Fedora is supported by the Fedora project, an endeavor by Red Hat. It is popular among desktop users. Its versions are known for their short life cycle.

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### 3. LinuxMint

It is one of the most popular Desktop Distributions available out there. It launched in 2006 and is now considered to be the fourth most used Operating system in the computing world.

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## RedHat

Another popular enterprise based Linux Distribution is Red Hat Enterprise. It has evolved from Red Hat Linux which was discontinued in 2004. It is a commercial Distro and very popular among its clientele

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## Ubuntu

This is the third most popular desktop operating system after Microsoft Windows and Apple Mac OS. It is based on the Debian Linux Distribution, and it is known as its desktop environment.

# Advantages of Linux

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- The main advantage of Linux, is it is an open-source operating system. This means the source code is easily available for everyone and you are allowed to contribute, modify and distribute the code to anyone without any permissions.
- In terms of security, Linux is more secure than any other operating system. It does not mean that Linux is 100 percent secure it has some malware for it but is less vulnerable than any other operating system. So, it does not require any anti-virus software.



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- The software updates in Linux are easy and frequent.
  - Various Linux distributions are available so that you can use them according to your requirements or according to your taste.
  - Linux is freely available to use on the internet.
  - It has large community support.
  - It provides high stability. It rarely slows down or freezes and there is no need to reboot it after a short time.

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- It maintain the privacy of the user.
  - The performance of the Linux system is much higher than other operating systems. It allows a large number of people to work at the same time and it handles them efficiently.
  - It is network friendly.
  - The flexibility of Linux is high. There is no need to install a complete Linux suit; you are allowed to install only required components.
  - Linux is compatible with a large number of file formats.
  - It is fast and easy to install from the web. It can also install on any hardware even on your old computer system.
  - It performs all tasks properly even if it has limited space on the hard disk.

# Disadvantages of Linux

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- It is not very user-friendly. So, it may be confusing for beginners.
- It has small peripheral hardware drivers as compared to windows.

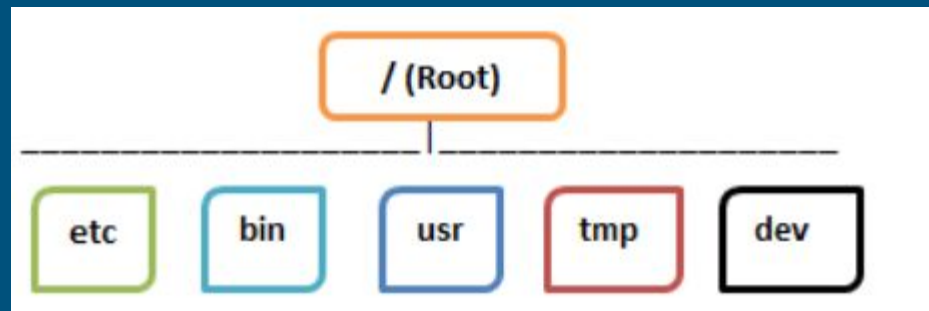
# Windows Vs. Linux File System

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When we compare file system in Windows and Linux, in Microsoft Windows, files are stored in folders on different data drives like C: D: E:

But, in Linux, files are ordered in a tree structure starting with the root directory.

This root directory can be considered as the start of the file system, and it further branches out various other subdirectories. The root is denoted with a forward slash '/'.



# Types of Files

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General

Directory

Device

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## General Files

General Files also called as Ordinary files. They can contain image, video, program or simply text. They can be in ASCII or a Binary format. These are the most commonly used files by Linux Users.

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## Directory Files

These files are a warehouse for other file types. You can have a directory file within a directory (sub-directory). You can take them as 'Folders' found in Windows operating system.



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## Device Files:

In MS Windows, devices like Printers, CD-ROM, and hard drives are represented as drive letters like G: H:. In Linux, there are represented as files. For example, if the first SATA hard drive had three primary partitions, they would be named and numbered as `/dev/sda1`, `/dev/sda2` and `/dev/sda3`.

**Note:** All device files reside in the directory `/dev/`

# Windows Vs. Linux: Users

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There are 3 types of users in Linux.

1. Regular
2. Administrative(root)
3. Service

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## Regular User

A regular user account is created for you when you install Ubuntu on your system. All your files and folders are stored in `/home/` which is your home directory. As a regular user, you do not have access to directories of other users.

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## Root User

Other than your regular account another user account called root is created at the time of installation. The root account is a superuser who can access restricted files, install software and has administrative privileges. Whenever you want to install software, make changes to system files or perform any administrative task on Linux; you need to log in as a root user. Otherwise, for general tasks like playing music and browsing the internet, you can use your regular account.

## Service user

Linux is widely used as a Server Operating System. Services such as Apache, Squid, email, etc. have their own individual service accounts. Having service accounts increases the security of your computer. Linux can allow or deny access to various resources depending on the service.

Note:

1. You will not see service accounts in Ubuntu Desktop version.
2. Regular accounts are called standard accounts in Ubuntu Desktop

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In Windows, there are 4 types of user account types.

1. Administrator
2. Standard
3. Child
4. Guest

# Windows Vs. Linux: File Name Convention

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In Windows, you cannot have 2 files with the same name in the same folder.

While in Linux, you can have 2 files with the same name in the same directory, provided they use different cases.

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In Linux, a directory is created as /home/

Consider, a regular user account “Tom”. He can store his personal files and directories in the directory “/home/tom”. He can’t save files outside his user directory and does not have access to directories of other users. For instance, he cannot access directory “/home/jerry” of another user account “Jerry”.

The concept is similar to C:\Documents and Settings in Windows.

When you boot the Linux operating system, your user directory (from the above example /home/tom) is the default working directory. Hence the directory “/home/tom is also called the Home directory which is a misnomer.



# Windows Vs. Linux: Other Directories

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Comparing Windows vs Linux for other directories, in Windows, System and Program files are usually saved in C: drive. But, in Linux, you would find the system and program files in different directories. For example, the boot files are stored in the /boot directory, and program and software files can be found under /bin, device files in /dev. Below are important Linux Directories and a short description of what they contain.



# Windows Vs. Linux:

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## Windows

Windows uses different data drives like C: D: E to store files and folders.

Windows has different drives like C: D: E

Hard drives, CD-ROMs, printers are considered as devices

There are 4 types of user account types 1) Administrator, 2) Standard, 3) Child, 4) Guest

## Linux

Unix/Linux uses a tree-like hierarchical file system.

There are no drives in Linux

Peripherals like hard drives, CD-ROMs, printers are also considered files in Linux/Unix

There are 3 types of user account types 1) Regular, 2) Root and 3) Service Account

# Windows Vs. Linux:

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## Windows

Administrator user has all administrative privileges of computers.

In Windows, you cannot have 2 files with the same name in the same folder

In windows, My Documents is default home directory.

## Linux

Root user is the super user and has all administrative privileges.

Linux file naming convention is case sensitive. Thus, sample and SAMPLE are 2 different files in Linux/Unix operating system.

For every user /home/username directory is created which is called his home directory.

# Manipulate Terminal

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To perform different operations like delete, update or moving files. To do these we have different operation on files.

To manage your files, you can either use

- Terminal (Command Line Interface – CLI)
- File manager (Graphical User Interface -GUI)

# Why learn Command Line Interface?

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The command line is a quick, powerful, text-based interface developers use to more effectively and efficiently communicate with computers to accomplish a wider set of tasks.

## 1. Go to terminal :

```
cdac_kh@DESKTOP-1I7VS4V: ~  
Welcome to Ubuntu 20.04.3 LTS (GNU/Linux 4.4.0-19041-Microsoft x86_64)  
  
* Documentation:  https://help.ubuntu.com  
* Management:    https://landscape.canonical.com  
* Support:       https://ubuntu.com/advantage  
  
System information as of Wed Sep 14 13:44:27 IST 2022  
  
System load:      0.52          Processes:          7  
Usage of /home:   unknown      Users logged in:   0  
Memory usage:    86%           IPv4 address for eth1: 192.168.56.1  
Swap usage:      1%            IPv4 address for wifi0: 10.212.9.229  
  
0 updates can be applied immediately.  
  
The list of available updates is more than a week old.  
To check for new updates run: sudo apt update  
  
This message is shown once a day. To disable it please create the  
/home/cdac_kh/.hushlogin file.  
cdac_kh@DESKTOP-1I7VS4V:~$
```





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**Username:**

**The username can be anything that you have given to your system**

**Hostname:**

**Hostname helps identify a computer over a network .**

**In server environment Host name is important**

- 
- `:` - this is separator
  - `~` - it shows that the user is working in working directory. If we change the directory this sign will vanish .
  - `$` - signs suggest that you are working as regular user in Linux.
  - `#` - this signs suggest that you are working as root user in Linux
  - `/` - sign for root

# What Is A Path?

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A path is a unique location to a file or a folder in a file system of an OS. A path to a file is a combination of / and alpha-numeric characters.

- it is an unique location of any file in a filesystem structure that can be represented in a string format i.e. in sequence of chars format seperated filenames/sub-dir names by delimiter char or delimiter.

e.g. `"/home/sep22/dbda/linux_command.txt"`

It consists of directories with their directory paths, beginning from the root. PATH is a colon-separated list. Each directory with its path is separated from the preceding directory with its path by a colon. The shell looks for commands in these directories.

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1. slash ("/") -- In Linux

2. backslash ("\") -- In Windows

3. colon (":") -- In Linux as well as in Windows



# View your PATH

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```
cdac_kh@DESKTOP-1I7VS4V:~$ echo $PATH
/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/mnt/c/Program Files/WindowsApps/CanonicalGroupLimited.Ubuntu20.04onWindows_2004.2022.8.0_x64__79rhkp1fndgsc:/mnt/c/Program Files (x86)/Common Files/Oracle/Java/javapath:/mnt/c/Windows/system32:/mnt/c/Windows:/mnt/c/Windows/System32/Wbem:/mnt/c/Windows/System32/WindowsPowerShell/v1.0:/mnt/c/Windows/System32/OpenSSH:/mnt/c/Program Files/dotnet:/mnt/c/Program Files/Microsoft SQL Server/Client SDK/ODBC/170/Tools/Binn:/mnt/c/Program Files/Microsoft SQL Server/150/Tools/Binn:/mnt/c/Program Files/Java/jre1.8.0_321/bin:/mnt/c/Program Files/Microsoft SQL Server/130/Tools/Binn:/mnt/c/Users/admin/Downloads/apache-cassandra-3.11.12-bin/apache-cassandra-3.11.12/bin:/mnt/c/Program Files/Java/jdk1.8.0_321/bin:/mnt/c/Python27:/mnt/c/Program Files/Java/jdk1.8.0_202/bin:/mnt/c/Program Files/Java/jre1.8.0_202/bin:/mnt/c/Users/admin/AppData/Local/Microsoft/WindowsApps:/mnt/c/Users/admin/AppData/Local/Programs/Microsoft VS Code/bin:/mnt/c/Users/admin/.dotnet/tools:/mnt/c/Program Files/JetBrains/PyCharm Community Edition 2021.3.3/bin:/snap/bin
cdac_kh@DESKTOP-1I7VS4V:~$
```

---

Here you can see that different directories are already stored in the \$PATH.

This is what allows us to run so many command by default without specifying their full location in terminal

# Relative and Absolute Paths

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**Absolute Path:-** the specifying the location of a file or directory from the root directory(/). In other words we can say absolute path is a complete path from start of actual filesystem from / directory.

path of any file/dir with respect to root directory ("/") i.e. it is a full path of any file/dir which starts with root dir ("/").

Example:

/etc/samba.smb.conf

/boot/grub/grub.conf



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An absolute path is defined as the specifying the location of a file or directory from the root directory(/).

To write an absolute path-name:

- Start at the root directory ( / ) and work down.
- Write a slash ( / ) after every directory name (last one is optional)
- if the first character of a pathname is /, the file's location must be determined with respect to root. When you have more than one / in a pathname, for each such /, you have to descend one level in the file system like in the above kt is one level below home, and thus two levels below root.

# Relative Path

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Relative path is defined as the path related to the present working directory(pwd). It starts at your current directory and never starts with a / .

path of any file/dir with respect to the current working dir

---

A shortcut in the relative pathname– that uses either the current or parent directory as reference and specifies the path relative to it. A relative path-name uses one of these cryptic symbols:

.(a single dot) - this represents the current directory.

..(two dots) - this represents the parent directory.

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## Moving one level up (moving to parent directory)

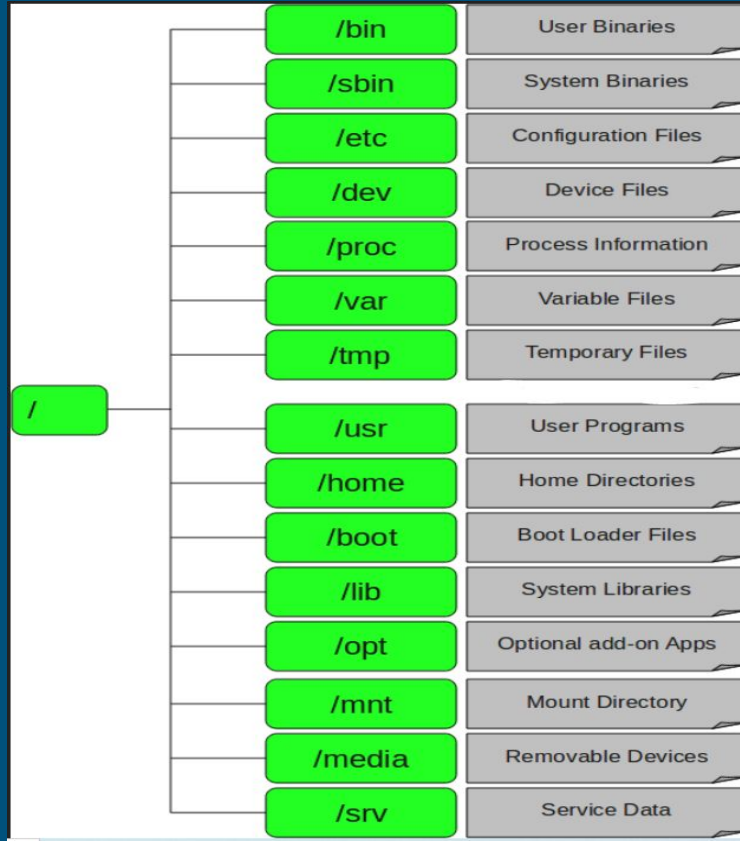
```
cdac_kh@DESKTOP-1I7VS4V:~$ cd ..  
cdac_kh@DESKTOP-1I7VS4V:~/home$
```

---

## Moving two level up (moving to parent directory)

```
cdac_kh@DESKTOP-1I7VS4V:/home$ cd .  
cdac_kh@DESKTOP-1I7VS4V:/home$ cd ../../..  
cdac_kh@DESKTOP-1I7VS4V:/$
```

# Linux Filesystem Structure:



# Linux Filesystem Structure:

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In a Linux system, all files are stored on file systems. A file-system hierarchy is the organization of these files into a single inverted tree of directories. The tree of directories is said to be inverted since its root is at the top of the hierarchy, and the branches of directories and sub-directories stretch below the root.

# Linux File System Hierarchy Content types

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These are the major types of content stored in a Linux filesystem.

**Persistent** – These are the contents which should be persistent after a reboot, e.g system and applications configuration settings.

**Runtime** – Content generated by a running process; usually deleted by a reboot

**Variable / Dynamic** – These content may be appended or modified by processes running in the Linux system.

**Static content** – This remains unchanged until explicitly edited or reconfigured.



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**/etc :-** Contains configuration files used by system services. contains host specific system configuration files - it is like a "control panel" in windows. In computing configuration files (or config files ) are files used to configure the parameters and initial settings for some computer programs. They are used for user applications, server processes and operating system settings

- Contains configuration files required by all programs.
- This also contains startup and shutdown shell scripts used to start/stop individual programs.
- For example: `/etc/resolv.conf`, `/etc/logrotate.conf`

# /root :

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/root :- This is a home directory for the Linux superuser account, root

- Every single file and directory starts from the root directory.
- Only root user has write privilege under this directory.
- Please note that /root is root user's home directory, which is not same as /

# /boot

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/boot :- Contains all the files needed to start the boot process.

- it contains information about booting the system
- it contains linux kernel by the name vmlinuz.

# /usr :-

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This directory contains shared libraries, installed software, and read-only program data.

Some of the important subdirectories include:

1. /usr/bin: Mostly user commands are located here.
2. /usr/sbin: Hosts System administrative commands that required privilege escalation to run.
3. /usr/local: For locally customized software.
4. Contains binaries, libraries, documentation, and source-code for second level programs.
5. /usr/bin contains binary files for user programs. If you can't find a user binary under /bin, look under /usr/bin. For example: at, awk, cc, less, scp
6. /usr/sbin contains binary files for system administrators. If you can't find a system binary under /sbin, look under /usr/sbin. For example: atd, cron, sshd, useradd, userdel
7. /usr/lib contains libraries for /usr/bin and /usr/sbin
8. /usr/local contains users programs that you install from source. For example, when you install apache from source, it goes under /usr/local/apache2

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**/run :-** The processes started since the last boot stores their runtime data here, e.g. process ID files and lock files. These contents are recreated on reboot.

**"/bin":** contains user commands in a binary format, e.g. commands like ls, cat, cp, mv etc..

- Contains binary executables.
- Common linux commands you need to use in single-user modes are located under this directory.
- Commands used by all the users of the system are located here.
- For example: ps, ls, ping, grep, cp.

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**/dev :- This contains special device files used by the system to access hardware.**

- **Contains device files.**
- **These include terminal devices, usb, or any device attached to the system.**
- **For example: /dev/tty1, /dev/usbmon0**

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"/sbin": contains admin/system commands in a binary format, e.g. lscpu, adduser, deluser, mkfs etc...

- Just like /bin, /sbin also contains binary executables.
- But, the linux commands located under this directory are used typically by system administrator, for system maintenance purpose.
- For example: iptables, reboot, fdisk, ifconfig, swapon

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**/var :- Has variable data that is required to persist between boots – databases, log files, mails, cache directories, Web data e.t.c.**

- **var stands for variable files.**
- **Content of the files that are expected to grow can be found under this directory.**
- **This includes – system log files (/var/log); packages and database files (/var/lib); emails (/var/mail); print queues (/var/spool); lock files (/var/lock); temp files needed across reboots (/var/tmp);**



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**/home :-** This is where standard users store their personal configurations and data such as Documents, Videos, Music e.t.c contains home dir's of all users for multi-user system. - for any user on its creation of an account by default subdir by the name of the user got created by the operating system, in which that user can store data, user can have read, write as well execute perms in that dir.

- Home directories for all users to store their personal files.
- For example: /home/john, /home/nikita

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**/tmp :- Stores temporary files. All Linux users can write to this directory. Files older than 10 days are deleted automatically.**

- **Directory that contains temporary files created by system and users.**
- **Files under this directory are deleted when system is rebooted.**

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**"/mnt": contains temporarily mounted filesystems**

**"/media": mount point for removable media such as CDRoms.**

**"/opt": contains optional application software packages.**

- **opt stands for optional.**
- **Contains add-on applications from individual vendors.**
- **add-on applications should be installed under either /opt/ or /opt/ sub-directory.**

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**"/proc": virtual filesystem provides process and kernel information as a files. In Linux , corresponds to a procfs mount. Generally automatically generated and populated by the system, on the fly.**

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Other directories that may be symlinks to other:

- */bin* and */usr/bin*
- */sbin* and */usr/sbin*
- */lib* and */usr/lib*
- */lib64* and */usr/lib64*

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Linux considers/treats everything as a file, i.e. from UNIX point of view (as Linux is UNIX like/based OS ) there are 7 types of files in UNIX/Linux:

1. regular file ( - ) : linux treats all text files, source files, audio files video files, image files etc.... as a regular files.
2. directory file ( d ) : directory file is a special type of file whose contents are name of files and sub dir's.

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3. character special device file ( c ) : devices from which data gets transferred character by character i.e. byte by byte are called as character devices, UNIX/Linux treats all char devices as a character special device files. e.g. KBD, Monitor, Printer, serial ports & parallel ports etc...

4. block special device file ( b ) : devices from which data gets transefered block by block i.e. sector by sector are called as block devices, UNIX/Linux treats all block devices as block special device files. e.g. all storage devices are block devices - Information of device files gets loaded into "/dev" while booting.

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5. socket file ( s ) : this is a special type of file can be used for an IPC.

6. named pipe file ( p ) : this file can be used for an IPC by pipe( ) system call internally.

7. linkable file ( l ) : this is a special type of file which contains info about another file. It is same as short cut files in Windows