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# Linux in a WINDOWS WORLD



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# Agenda

- **Linux**
- **It's Journey**
- **Some important features**
- **Applications**
- **Summary**

# Linux

- The most popular Operating Systems.
- It refers to the family of Unix-like computer operating systems that use the Linux kernel.
- Linux is an open source software and the Linux kernel is released under the GNU General Public License and hence can be freely created, modified and redistributed.
- Linux is actually just a kernel. Many people have put together distributions (often called flavors), that contain not just the kernel but also many other programming tools and utilities. The real power of Linux can be tapped by using its wide and powerful storehouse of commands that can be typed in the terminal. The reason behind this is the fact that Linux can trace its intellectual heritage.

# It's Journey

- Unix was developed much before GUI environments were dreamt of. Thus, Unix (and hence Linux) provides a wide array of flexible text-mode commands.
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# Basic Features

Following are some of the important features of Linux Operating System.

- **Portable** – Portability means software can work on different types of hardware in the same way. Linux kernel and application programs support their installation on any kind of hardware platform.
- **Open Source** – Linux source code is freely available and it is a community based development project. Multiple teams work in collaboration to enhance the capability of Linux operating system and it is continuously evolving.
- **Multi-User** – Linux is a multiuser system means multiple users can access system resources like memory/ ram/ application programs at the same time.
- **Multiprogramming** – Linux is a multiprogramming system means multiple applications can run at the same time.
- **Hierarchical File System** – Linux provides a standard file structure in which system files/ user files are arranged.
- **Shell** – Linux provides a special interpreter program which can be used to execute commands of the operating system. It can be used to do various types of operations, call application programs. etc.
- **Security** – Linux provides user security using authentication features like password protection/ controlled access to specific files/ encryption of data.

# Some well-known Distributors

- Red Hat Linux,
- Ubuntu,
- SuSE Linux, and
- Debian GNU/Linux.
- Fedora
- FreeBSD



# Applications

- Linux is now used in all major software projects undertaken by the Indian Government. Some of the examples are GST, Aadhar, and NEFT. Naturally, the employment potential of students who are good in Linux is very high.
- Major role in Research: **Linux** serves as an ideal system for biomedical **research** laboratories, where there is an abundance of PCs, strict limits on the allocation of **research** funds and a need for significant processing power in conjunction with straightforward and flexible system customization.
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# Things I learned, Why Linux ? ? ?

Microsoft Windows is still the most widely used family of computer operating systems. However, Linux offers also some important advantages over them, and thus its worldwide growth rate is much faster. These advantages include the facts that

- It is free
- It is extremely stable (i.e., it rarely *crashes*)
- It is highly resistant to computer viruses, spyware and other *malware*
- A large amount of high quality, completely free *application programs* are available for use on it and
- It can run on older computers that cannot accommodate the newer versions of Microsoft Windows.



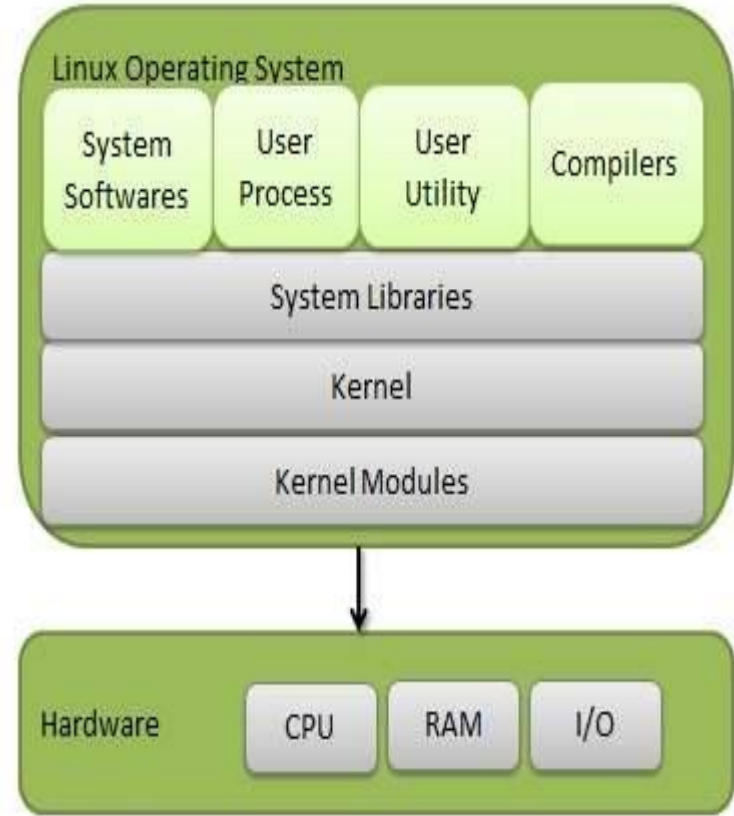


- Talking of contributions, Google, Intel, Huawei, Samsung, Red Hat, Canonical and Facebook are among the **top contributors to Linux kernel development** in recent years.
- **Android is the most successful operating system** on the planet — *bar none* — with over 2 billion active monthly users worldwide, [according to Google](#). And what does Android run on? Why the Linux kernel, of course!
- **9 out of top 10 public clouds run on Linux** [according to Red Hat](#) who probably know what they're talking about, what with being one of the most successful Linux companies in history!
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# Components of Linux System

Linux Operating System has primarily three components

- **Kernel** – Kernel is the core part of Linux. It is responsible for all major activities of this operating system. It consists of various modules and it interacts directly with the underlying hardware. Kernel provides the required abstraction to hide low level hardware details to system or application programs.
- **System Library** – System libraries are special functions or programs using which application programs or system utilities accesses Kernel's features. These libraries implement most of the functionalities of the operating system and do not requires kernel module's code access rights.
- **System Utility** – System Utility programs are responsible to do specialized, individual level tasks.



# Kernel Mode vs User Mode

Kernel component code executes in a special privileged mode called **kernel mode** with full access to all resources of the computer. This code represents a single process, executes in single address space and do not require any context switch and hence is very efficient and fast. Kernel runs each processes and provides system services to processes, provides protected access to hardware to processes.

Support code which is not required to run in kernel mode is in System Library. User programs and other system programs works in **User Mode** which has no access to system hardware and kernel code. User programs/ utilities use System libraries to access Kernel functions to get system's low level tasks.

# Installation

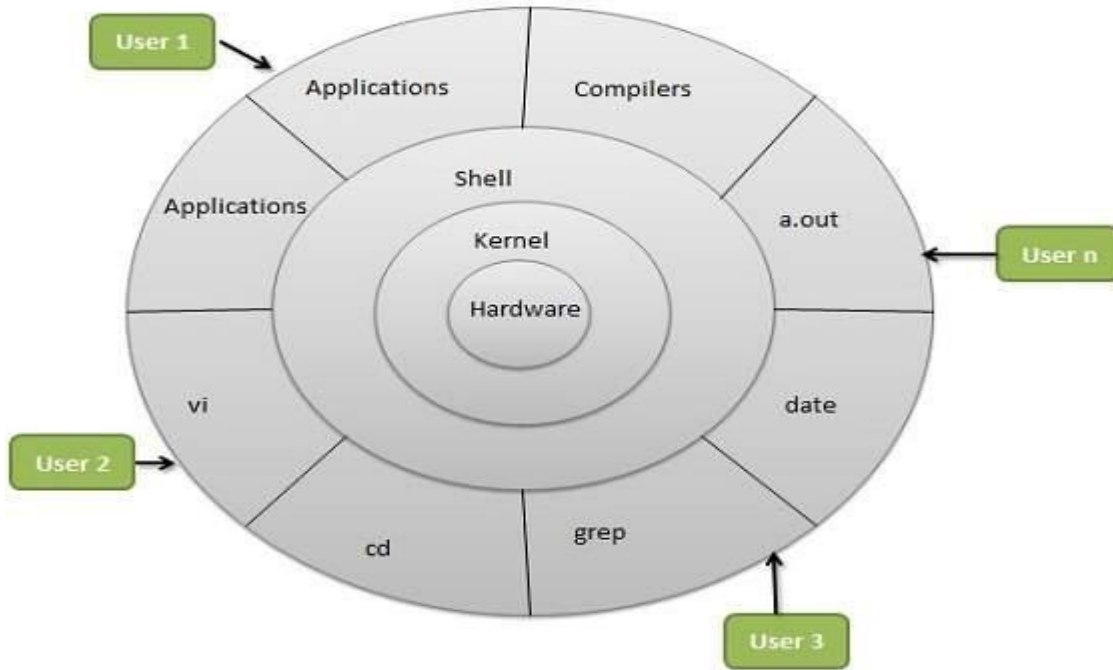
- Dual Boot
- Virtualbox: <https://iitk.ac.in/nt/faq/vbox.htm>

Sr. No.	Key	Linux	Unix
1	Development	Linux is open source and is developed by Linux community of developers.	Unix was developed by AT&T Bell labs and is not open source.
2	Cost	Linux is free to use.	Unix is licensed OS.
3	Supported File systems	Ext2, Ext3, Ext4, Jfs, ReiserFS, Xfs, Btrfs, FAT, FAT32, NTFS.	fs, gpfs, hfs, hfs+, ufs, xfs, zfs.
4	GUI	Linux uses KDE and Gnome. Other GUI supported are LXDE, Xfce, Unity, Mate.	Unix was initially a command based OS. Most of the unix distributions now have Gnome.
5	Usage	Linux is used in wide varieties from desktop, servers, smartphones to mainframes.	Unix is mostly used on servers, workstations or PCs.
6	Default Shell	Bash (Bourne Again SHell) is default shell for Linux.	Bourne Shell is default shell for Unix.
7	Target processor	Linux was initially developed for Intel's x86 hardware processors. Now it supports 20+ processor families.	CUnix supports PA-RISC and Itanium family.
8	Example	Ubuntu, Debian GNU, Arch Linux, etc.	SunOS, Solaris, SCO UNIX, AIX, HP/UX, ULTRIX etc.

# Difference between Linux and Windows

<https://docs.google.com/document/d/1AawVEKKbkYHN17MrIHuwHEtmVi6ZKVzd/edit?usp=sharing&ouid=106065842254332918475&rtpof=true&sd=true>

# Linux Architecture



The architecture of a Linux System consists of the following layers –

- **Hardware layer** – Hardware consists of all peripheral devices (RAM/ HDD/ CPU etc).
- **Kernel** – It is the core component of Operating System, interacts directly with hardware, provides low level services to upper layer components.
- **Shell** – An interface to kernel, hiding complexity of kernel's functions from users. The shell takes commands from the user and executes kernel's functions.
- **Utilities** – Utility programs that provide the user most of the functionalities of an operating systems

# Kernel

- A [microkernel delegates user processes](#) and kernel services in different address spaces.
- A *monolithic kernel* implements services in the same address space.
- A *hybrid kernel*, such as the Microsoft [Windows NT](#) and Apple XNU kernels, attempts to combine the behaviors and benefits of microkernel and monolithic kernel architectures.
- A *nanokernel* focuses on providing minimal services limited to low-level hardware management, delegating most other services to higher-level modules.
- An *exokernel* exposes hardware resources directly to applications, giving them more control over hardware.
- A *multikernel* uses multiple kernels to manage different hardware resources, commonly used in distributed environments.



# Types of Kernel

There are some of the important kernel types which are mentioned below:

- Monolithic Kernel
- Micro kernels:
- Exo kernels
- Hybrid kernels

## Micro kernels

Microkernels have all their services in separate address spaces from the kernel. Microkernels use message passing for their communication protocol, which sends data packets, signals and functions to the correct processes. Microkernels also provide greater flexibility than monolithic kernels; to add a new service, admins modify the user address space for a microkernel.

Because of their isolated nature, microkernels are more secure than monolithic kernels. They remain unaffected if one service within the address space fails.

A kernel where the kernel and user services are kept in separate address areas. MINIX 3 is an example of a microkernel.

## Monolithic kernels

Monolithic kernels are larger than microkernels because they house both kernel and user services in the same address space. Monolithic kernels use a faster system call communication protocol than microkernels to execute processes between the hardware and software. They're less flexible than microkernels and require more work; admins must reconstruct the entire kernel to support a new service.

Monolithic kernels pose a greater security risk to systems than microkernels because, if a service fails, the entire system shuts down. Monolithic kernels also don't require as much [source code](#) as a microkernel, which means they're less susceptible to [bugs](#) and need less debugging.

A single program that contains all the core functionality and peripheral services of the kernel.

Linux Kernel's uses monolithic kernel architecture

## Hybrid kernels

Apple developed the XNU OS kernel in 1996 as a hybrid of the Mach and Berkeley Software Distribution (BSD) kernels and paired it with an Objective-C application programming interface ([API](#)). Because it's a combination of the monolithic kernel and microkernel, it has increased modularity, and parts of the OS gain memory protection.

Hybrid kernels are used in most commercial OSes. They're similar to microkernels but include additional code in the kernel-space meant to increase performance. They also enable faster development for third-party software.

A mix of monolithic and microkernel designs that combines the performance of a monolithic kernel with the modularity of a microkernel. Windows NT and macOS (since version X) are examples of hybrid kernels.

## Exo kernels

Exokernels are unique in that they expose hardware resources directly to applications. Instead of abstracting hardware functionality like other kernel types, exokernels enable applications to implement their own abstractions and management policies. This means that application developers can make the most efficient use of resources for each program. Exokernels also come with library OSes, which can export different APIs.

Exokernels provide applications with better control and flexibility, which can add to performance gains.

## Hypervisors

A software package or kernel module extension that runs on a host OS and emulates hardware platforms for running guest OSes. VMware Workstation, Virtual Box, and QEMU are examples of hypervisors.

# Shell

A shell is a program through which users can interact with the Operating System.

Linux provides commonly 4 types of Shells

**The C Shell**

**The Bourne Shell**

**The Korn Shell**

**GNU Bourne-Again Shell(BASH)**

## The C Shell

Command full-path name is `/bin/csh`,

Non-root user default prompt is `hostname %`,

Root user default prompt is `hostname #`.

## The Bourne Shell(sh)

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

Non-root user default prompt is `$`,

Root user default prompt is `#`.

## The Korn Shell

Command full-path name is

`/bin/ksh`, Non-root user default prompt is `$`,

Root user default prompt is `#`.

## GNU Bourne-Again Shell

Command full-path name is `/bin/bash`,

Default prompt for a non-root user is `bash-g.gg$`

(`g.gg` indicates the shell version number like `bash-3.50$`),

Root user default prompt is `bash-g.gg#`.