

Computer system structure

Computer system can be used into four components:

- Hardware: provides basic computing resources.

CPU, memory, I/O devices.

- Operating system

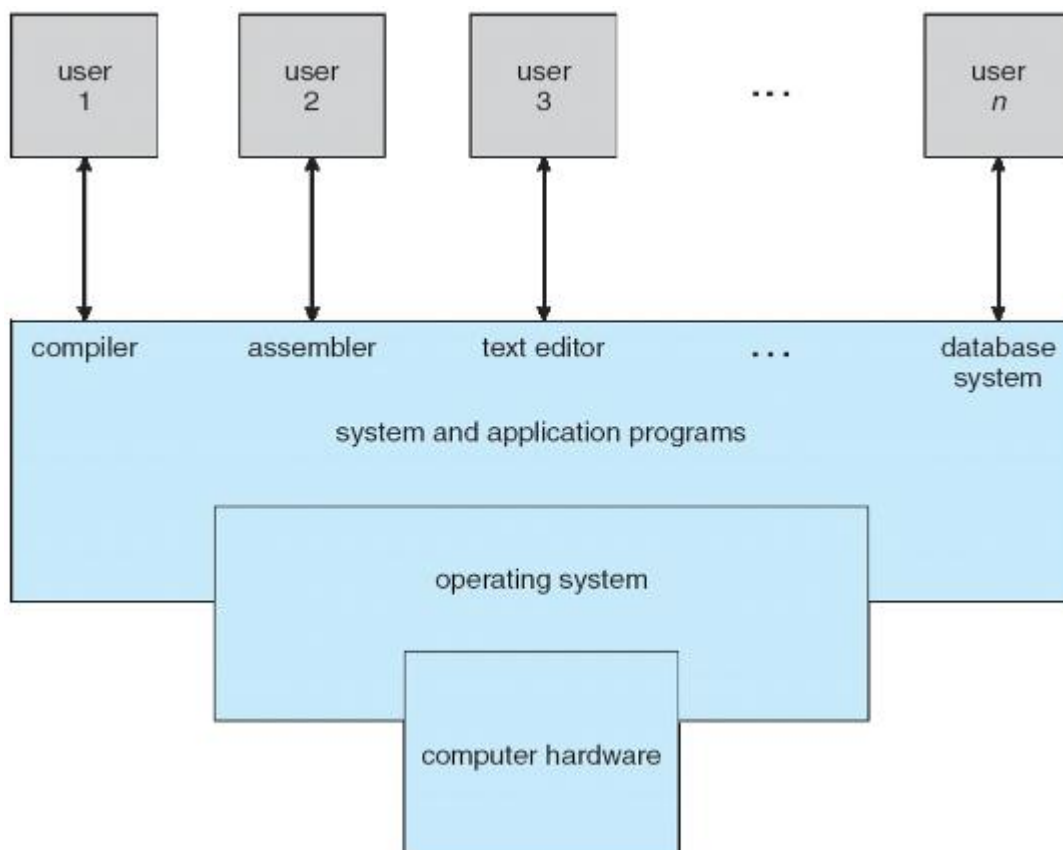
Software that controls and coordinates use of hardware among various applications and users.

- Application programs: software that uses the system resources to solve the computer problems of the users.

PPT, browsers, DB, word, Photoshop.

- Users

People, machines.



What is an operating system?

A program that acts as an intermediary between a user of a computer and the computer hardware.

OS goals:

- Execute user programs and makes solving user problems easier.
- Make the computer system convenient to use.
- Use the computer Hardware in an efficient manner.

An Operating System (OS) An operating system is a program that acts as an interface between the computer user and computer hardware, and controls the execution of programs. An operating system is a software which performs all the basic tasks like file management, memory management, process management, handling input and output, and controlling peripheral devices such as disk drives and printers.

No universally accepted definition.

- 1) The one program running at all the times on the computer, is the Kernel of the OS.

An operating system is software that enables applications to interact with a computer's hardware. The software that contains the core components of the operating system is called the kernel.

Excluding:

a system program(ships with the OS), or an application program).

- 2) Is a resource allocator
Manage all resources.

Decides between conflicting requests for efficient and fair resources use.

An Operating System is the low-level software that supports a computer's basic functions, such as scheduling tasks and controlling peripherals.

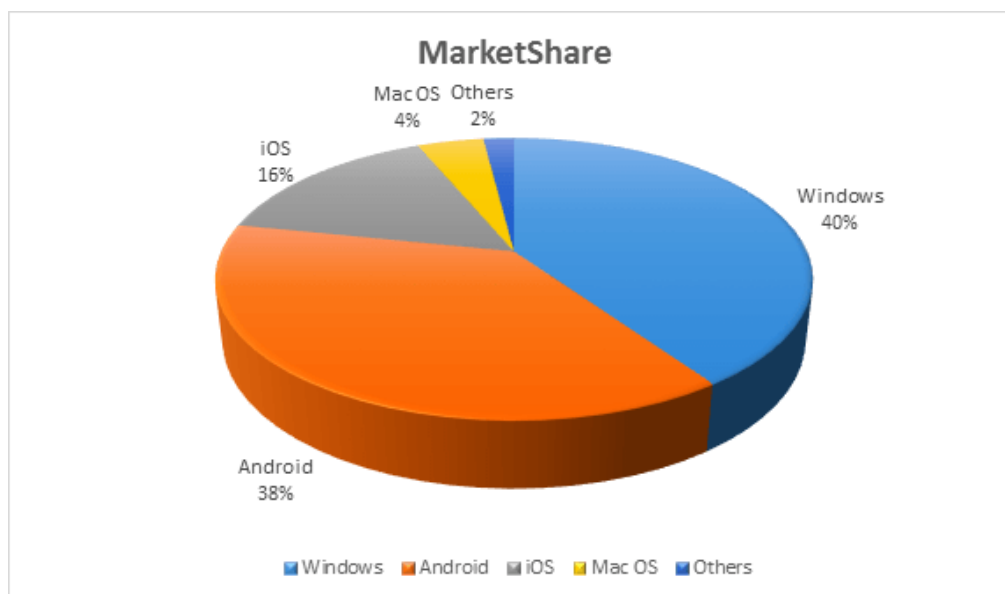
- 3) OS is a control program
Control execution of a programs to prevent errors and improper use of the computer.

Some popular Operating Systems include Linux Operating System, Windows Operating System, VMS, OS/400, AIX, z/OS, etc. Today, Operating systems is found almost in every device like mobile phones, personal computers, mainframe computers, automobiles, TV, Toys etc.

History Of OS

- Operating systems were first developed in the late 1950s to manage tape storage
- The General Motors Research Lab implemented the first OS in the early 1950s for their IBM 701
- In the mid-1960s, operating systems started to use disks
- In the late 1960s, the first version of the Unix OS was developed
- The first OS built by Microsoft was DOS. It was built in 1981 by purchasing the 86-DOS software from a Seattle company
- The present-day popular OS Windows first came to existence in 1985 when a GUI was created and paired with MS-DOS.

Examples of Operating System with Market Share



Two Views of Operating System

1. User's View
2. System View

Operating System: User View

The user view of the computer refers to the interface being used. Such systems are designed for one user to monopolize its resources, to maximize the work that the user is performing. In these cases, the operating system is designed mostly for ease of use, with some attention paid to performance, and none paid to resource utilization.

Operating System: System View

The operating system can be viewed as a resource allocator also. A computer system consists of many resources like - hardware and software - that must be managed efficiently. The operating system acts as the manager of the resources, decides between conflicting requests, controls the execution of programs, etc.

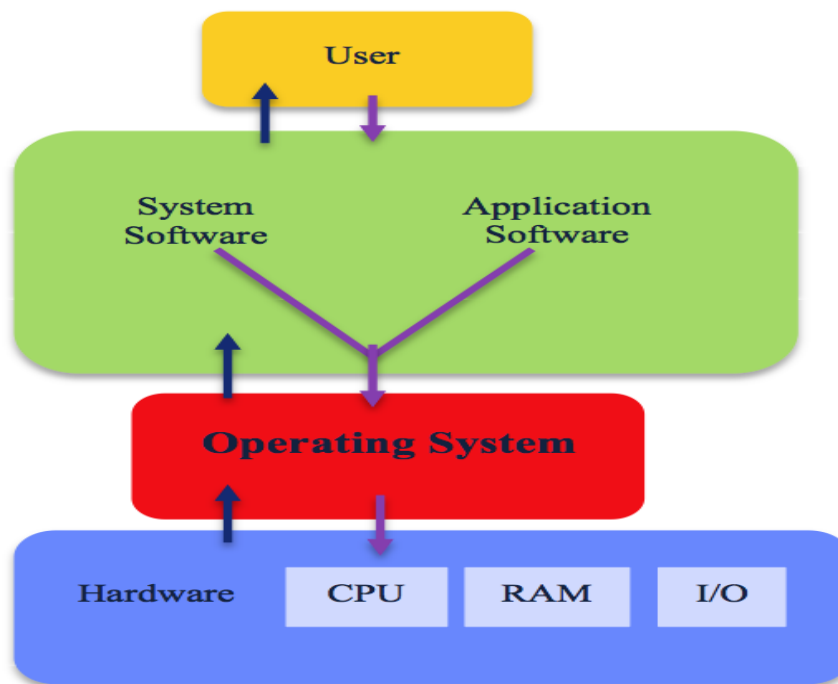
OS is mainly designed in order to serve two basic purposes:

1. The operating system mainly controls the allocation and use of the computing System's resources among the various user and tasks.
2. It mainly provides an interface between the computer hardware and the programmer that simplifies and makes feasible for coding, creation of application programs and debugging

The operating system's job

The operating system (OS) manages all of the software and hardware on the computer. It performs basic tasks such as file, memory and process management, handling input and output, and controlling peripheral devices such as disk drives and printers.

Most of the time, there are several different computer programs running at the same time, and they all need to access your computer's central processing unit (CPU), memory and storage. The operating system coordinates all of this to make sure each program gets what it needs



A computer system has many resources (hardware and software), which may be required to complete a task. The commonly required resources are input/output devices, memory, file storage space, CPU, etc. The operating system acts as a manager of the above resources and allocates them to specific programs and users, whenever necessary to perform a particular task. Therefore the operating system is the resource manager i.e. it can manage the resource of a computer system internally. The resources are processor, memory, files, and I/O devices. In simple terms, an operating system is an interface between the computer user and the machine.

It is very important for you that every computer must have an operating system in order to run other programs. The operating system mainly coordinates the use of the hardware among the various system programs and application programs for various users.

An operating system acts similarly like government means an operating system performs no useful function by itself; though it provides an environment within which other programs can do useful work.

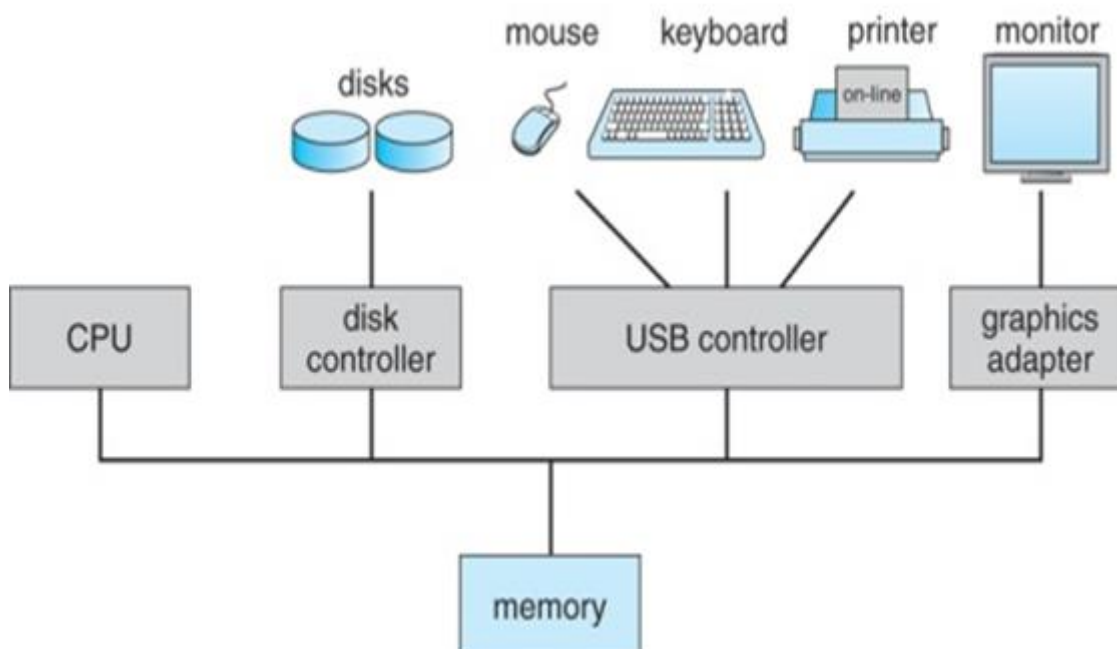
In the above picture:

- The Computer Hardware contains a central processing unit(CPU), the memory, and the input/output (I/O) devices and it provides the basic computing resources for the system.
- The Application programs like spreadsheets, Web browsers, word processors, etc. are used to define the ways in which these resources are used to solve the computing problems of the users. And the System program mainly consists of compilers, loaders, editors, OS, etc.

- The Operating System is mainly used to control the hardware and coordinate its use among the various application programs for the different users.
- Basically, Computer System mainly consists of hardware, software, and data.

Computer-System Operation

Computer system consists of one or more CPUs and a number of device controllers connected through a common bus that provides access to shared memory.



Computer system Operation

- Input output devices and the CPU can execute concurrently.
- Each device controller is in charge of a particular device type.
- Each device controller has a local buffer.
- CPU moves data form/ to main memory to/from local buffers.
- I/O is from the device to local buffer of controller.
- Device controller informs CPU that it has finished its operation by causing an interrupt.

Each device controller is in charge of a specific type of device. The CPU and the device controllers can execute concurrently, competing for memory cycles. To ensure orderly access to the shared memory, a memory controller is provided whose function is to synchronize access to the memory.

Hardware may trigger an interrupt at any time by sending a signal to the CPU, usually by way of the system bus. Software may trigger an interrupt by executing a special operation called a system call (also called a monitor call).

The data buffer controller performs the following operations: Manages the read and write access to the data buffers.

I/O is really slow, for the output part, having a buffer lets the CPU send the info to the device and pretend that it is finished so that it can move onto the next thing without wasting time sitting around to feed the information to the device at the proper speed.

Computer startup

Bootstrap program is loaded at power-up or reboot.

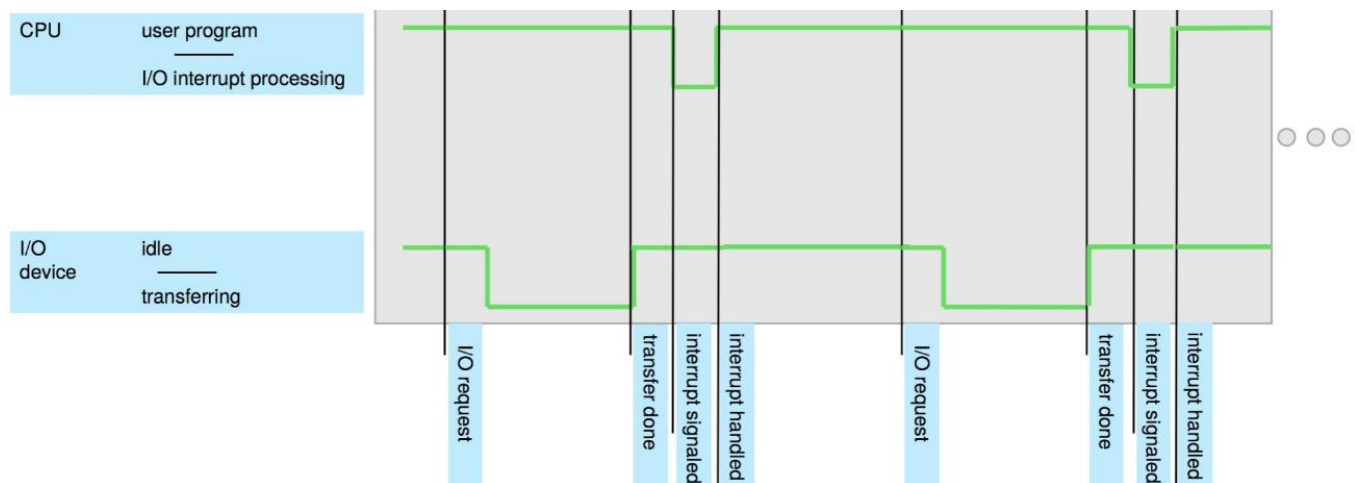
- Typically stored in ROM or EPROM, generally known as firmware.
- Initialize all aspects of system.
- Load operating system kernel and executing, it can start providing services to the system and its users.

Once the Kernel is loaded and executing, it can start providing services to the system and its uses.

Some services are provided outside of the kernel, by system programs that are loaded into memory at boot time to become system processes, or system daemons.

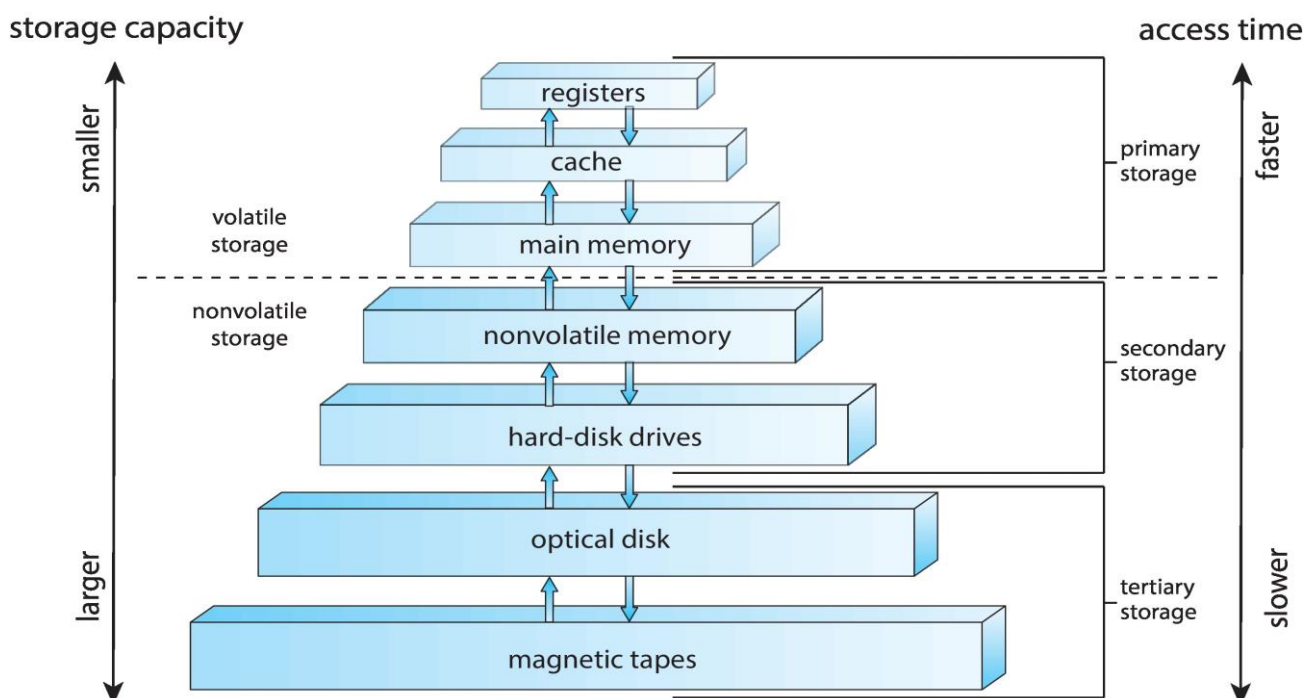
Interrupts

- An OS is interrupt driven
- Hardware or software may trigger an interrupt at any time.
- It is a signal to the CPU.
- The CPU stops what it is doing and starts executing the interrupt service routine.
- Software may trigger an interrupt by executing a special operation called a system call or a monitor call.



Storage Structure

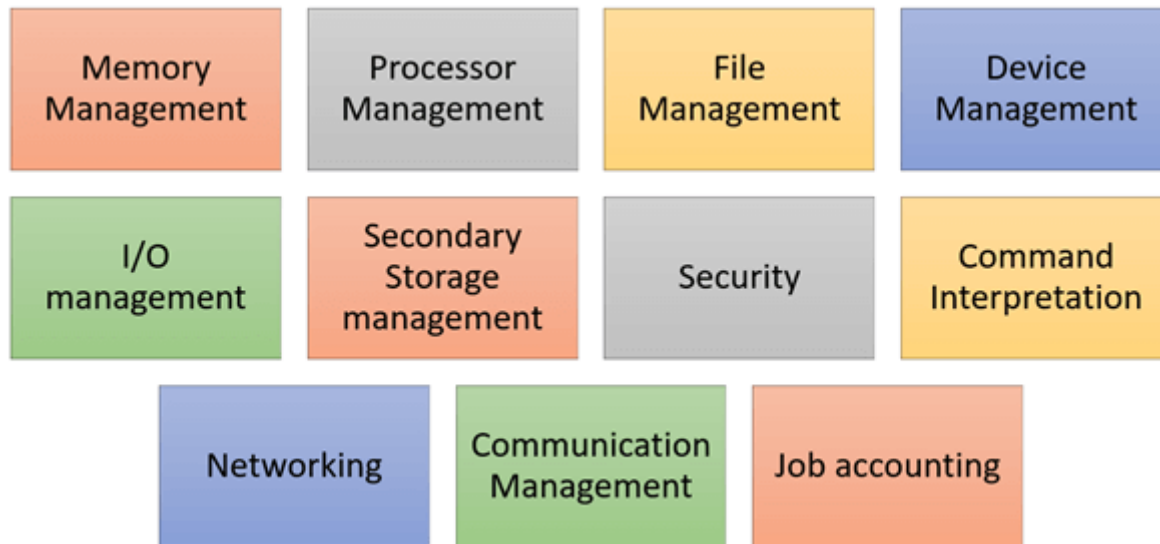
- Modern computers utilize storage hierarchies, in which each level of memory functions as a back-up for the levels above it, and as a cache for the levels below it.
- Main memory is the only storage media that the CPU can access.
- Random access memory (typically volatile)
- The forms of memory in the upper levels are typically fast, but expensive and volatile.
- Non-volatile memory is required for cost-effective permanent storage of large amounts of programs and data.



Storage –device Hierarchy

Functions of Operating System

Below are the main functions of Operating System:



In an operating system software performs each of the function:

1. **Process management:** Process management helps OS to create and delete processes. It also provides mechanisms for synchronization and communication among processes.
2. **Memory management:** Memory management module performs the task of allocation and de-allocation of memory space to programs in need of this resources.
3. **File management:** It manages all the file-related activities such as organization storage, retrieval, naming, sharing, and protection of files.
4. **Device Management:** Device management keeps tracks of all devices. This module also responsible for this task is known as the I/O controller. It also performs the task of allocation and de-allocation of the devices.
5. **I/O System Management:** One of the main objects of any OS is to hide the characteristics of that hardware devices from the user.
6. **Secondary-Storage Management:** Systems have several levels of storage which includes primary storage, secondary storage, and cache storage. Instructions and data must be stored in primary storage or cache so that a running program can reference it.

7. Security: Security module protects the data and information of a computer system against malware threat and authorized access.
8. Command interpretation: Command interpreters have a large range of commands and queries available for different operations. Also, it is much faster to type than to click as is done using graphical user interfaces
9. Networking: A distributed system is a group of processors which do not share memory, hardware devices, or a clock. The processors communicate with one another through the network.
10. Job accounting: Keeping track of time & resource used by various job and users.
11. Communication management: Coordination and assignment of compilers, interpreters, and another software resource of the various users of the computer systems.

Functions of Operating System

1. It boots the computer
2. It performs basic computer tasks e.g. managing the various peripheral devices e.g. mouse, keyboard
3. It provides a user interface, e.g. command line, graphical user interface (GUI)
4. It handles system resources such as the computer's memory and sharing of the central processing unit(CPU) time by various applications or peripheral devices.
5. It provides file management which refers to the way that the operating system manipulates, stores, retrieves, and saves data.
6. Error Handling is done by the operating system. It takes preventive measures whenever required to avoid errors.

Advantages of Operating System

- The operating system helps to improve the efficiency of the work and helps to save a lot of time by reducing the complexity.
- The different components of a system are independent of each other, thus failure of one component does not affect the functioning of another.
- The operating system mainly acts as an interface between the hardware and the software.
- Users can easily access the hardware without writing large programs.
- With the help of an Operating system, sharing data becomes easier with a large number of users.

- We can easily install any game or application on the Operating system easily and can run them
- An operating system can be updated easily.
- There are various operating systems that are accessible in open source. Example: Unix/Linux these can easily run on the personal computer with no cost that means Free.
- An operating system is mainly used to hide the complexity of the hardware.
- An operating system easily manages the computer as programming becomes easier.
- With the help of an operating system, multitasking becomes easier.

Following are the popular types of OS (Operating System):

- Batch Operating System
- Multitasking/Time Sharing OS
- Multiprocessing OS
- Real Time OS
- Distributed OS
- Network OS
- Mobile OS

Batch Operating System

Some computer processes are very lengthy and time-consuming. To speed the same process, a job with a similar type of needs are batched together and run as a group.

The user of a batch operating system never directly interacts with the computer. In this type of OS, every user prepares his or her job on an offline device like a punch card and submit it to the computer operator.

Multi-Tasking/Time-sharing Operating systems

Time-sharing operating system enables people located at a different terminal(shell) to use a single computer system at the same time. The processor time (CPU) which is shared among multiple users is termed as time sharing.

Multiprocessor Systems

A Multiprocessor system consists of several processors that share a common physical memory. Multiprocessor system provides higher computing power and speed. In multiprocessor system all

processors operate under single operating system. Multiplicity of the processors and how they do act together are transparent to the others.

Real time OS

A real time operating system time interval to process and respond to inputs is very small. Examples: Military Software Systems, Space Software Systems are the Real time OS example.

Distributed Operating System

Distributed systems use many processors located in different machines to provide very fast computation to its users.

Network Operating System

Network Operating System runs on a server. It provides the capability to serve to manage data, user, groups, security, application, and other networking functions.

Mobile OS

Mobile operating systems are those OS which is especially that are designed to power smartphones, tablets, and wearables devices.

Some most famous mobile operating systems are Android and iOS, but others include BlackBerry, Web, and watchOS