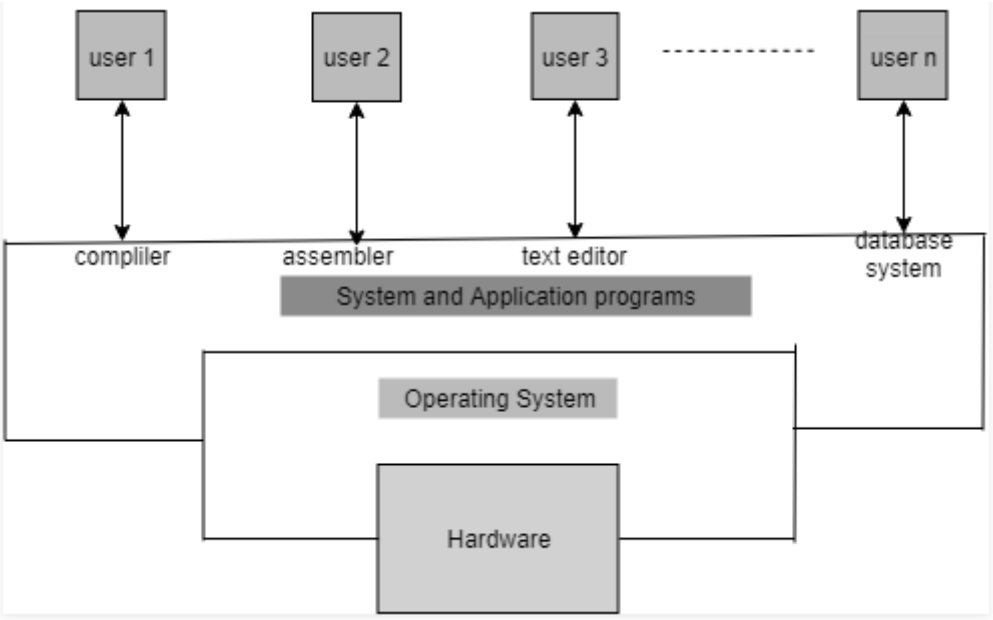
Contents

Unit 1: Introduction

1.1 Introduction to Operating System

- An operating system (OS) is system software that manages computer equipment and software resources and gives normal services to computer programs.
- The Operating System is a software with the accompanying highlights −
    - An operating system is a program that goes about as an interface between the software and the computer hardware.
    - It is a coordinated set of particular programs used to manage overall resources and operations of the computer.
    - It is a specific programming that controls and monitors the execution of every single other program that reside in the computer, including application programs and other system software.
- It tends to be thought of as having three objectives:
    - **Convenience:** An OS makes a PC progressively advantageous to utilize.
    - **Efficiency:** An OS permits the PC system resources to be utilized in a proficient way.
    - **Ability to evolve:** An OS ought to be built so as to allow the successful improvement, testing and presentation of new system capacities without interfering with administration.
- The application programs utilize the operating system by making requests for services through a characterized application program interface (API).
- Furthermore, users can interact straightforwardly with the operating system through a user interface, for example, a command line or a graphical user interface (GUI).



1.1.1 Need of Operating System

- **Operating system as a platform for Application programs:** Operating system gives a stage, over which, different programs, called application programs can run. These application programs help the users to play out a particular assignment effectively. It goes about as an interface between the computer and the user. It is planned in such a way, that it works, controls and executes different applications on the computer.
- **Managing Input-Output unit:** Operating System likewise enables the computer to deal with its own resources, for example, memory, monitor, keyboard, printer and so on. Management of these resources is required for a compelling utilization. The operating system controls the different system input-output resources and allots them to the users or programs according to their prerequisite.
- **Consistent user interface:** Operating System gives the user a simple to-work user interface, so the user doesn't need to get familiar with a different UI unfailingly and can concentrate on the data and be gainful as fast as would be possible. Operating System gives layouts, UI segments to make the working of a computer, really simple for the user.
- **Multitasking:** Operating System manages memory and enable different programs to keep running in their very own space and even communicate with one another through shared memory. Performing multiple tasks gives users a good experience as they can play out a several tasks on a computer at once.

1.1.2 The Operating System as a User/Computer Interface

- The structure of a system can be viewed as a layered or hierarchical structure having hardware and software for providing applications to a user.
- The end user sees a computer system as far as a lot of applications. An application can be communicated in a programming language and is created by an application programmer.
- To build up an application program user need some set of machine instruction that is totally in charge of controlling the computer equipment known as system programs.
- A portion of these programs are known as utilities or library programs.
- The most significant collection of system program contains an operating system.
- It go as a mediator between user and interface making it simpler for the programmer and for application programs to survey and utilize those facilities and services.
- OS regularly give benefits in the accompanying zones
    - Program development- The OS gives an assortment of facilities and administrations, for example, editors and debuggers to help the programmer in making programs (in types of utility programs).
    - Program execution- Various steps should be performed to execute a program. Guidelines and data must be stacked into primary memory, I/O devices and file must be initialised, and different resources must be ready. The operating system handles the planning obligations for the user.

- Access to I/O devices- I/O devices required arrangement of instruction for control signals which OS gives. Operating system conceal these details with the goal that program can help search devices utilizing straightforward read and write.
- Controlled access to files- For file access, the OS must comprehend the structure of the data contained in the files on the storage medium. The OS additionally give security instrument to control access to the files.
- System access- The system access feature helps in security of resources and data from unapproved user and least clashes for resource conflict.
- Error detection and response. The OS must give a response that clears the error condition with minimal effect on running applications.
- Accounting- A decent OS will gather utilization insights for different resources and monitor execution parameters, for example, response time.

1.1.3 Operating System as a Resource Manager

- Present day computers comprise of processors, memories, timers, disks, mice, network interfaces, printers, and a wide assortment of different devices.
- In the elective view, the activity of the operating system is to provide an organized and controlled allocation of the processors, memories, and input/output devices among the different programs access them.
- At the point when a computer (or network) has various users, the requirement for managing and ensuring the memory, input/output devices, and different resources is considerably more prominent, since the users may some way or another interface with each other.
- What's more, users frequently need to share hardware, yet data (files, databases, and so forth.) too.
- To keep it simple, this perspective on the operating system holds that its primary task is to monitor which programs are utilizing which resources, to allow resource requests, to aacount for use, and to intervene clashing solicitations from various programs and users.
- Resource management incorporates multiplexing (sharing) resources in two different ways: In time and in space.
    - At the point when a resource is time multiplexed, various programs or users do alternate utilization. Initial one of them gets the chance to utilize the resource, then another, and etc. For instance, with just a single CPU and various programs that need to keep running on it, the operating system initially assigns the CPU to one program, at that point after it has run long enough, another gets the chance to utilize the CPU, then another, and afterward inevitably the first once more.
    - The other sort of multiplexing is space multiplexing. Rather than the clients do alternate utilization, everyone gets some portion of the resource. For instance, primary memory is ordinarily split among a few running programs, so everyone can be occupant simultaneously. Accepting there is sufficient

memory to hold numerous programs, it is increasingly proficient to hold a few programs in memory on the double instead of give one of all of it, particularly on the off chance that it just needs a little portion of the aggregate.

1.2 Operating System Functions

In an operating system software plays out every one of the following function:

1. **Process management:-** Process management causes OS to create and delete processes. It likewise gives mechanisms for synchronization and communication among processes.
2. **Memory management:-** Memory management module plays out the role of assignment and de-allotment of memory space to programs needing the resources.
3. **File management:-** It deals with all the file-related task, for example, storage organization, recovery, naming, sharing, and protection of files.
4. **Device Management:-** Device management keeps tracks of all the devices. This module is in charge of the task also known as the I/O controller. It additionally plays out the undertaking of designation and de-distribution of the devices.
5. **I/O System Management:** One of the primary objects of any OS is to conceal the identity of that hardware devices from the user.
6. **Secondary-Storage Management:** Systems have a few degrees of storage which incorporates primary storage, secondary storage, and cache storage. Instructions and data must be put away in primary storage or cache so a running program can reference it.
7. **Security:-** Security module ensures the data and information of a computer system against malware danger and authorized access.
8. **Command interpretation:** This module is interpreting directions given by the acting system and assign resources to process that directions.
9. **Networking:** A distributed system is a collection of processors which don't share memory, hardware devices, or a clock. The processors speak with each other through the network.
10. **Job accounting:** Keeping track of time and resource utilized by different job and users.
11. **Communication management:** Manage the coordination and task of compilers, interpreters, and other software resource of the different users of the computer systems.

Evaluation of Operating System

- The advancement of operating systems is straightforwardly subject to the improvement of computer systems and how users use them.

1 Serial Processing

- These are early computers from late 1940s to the mid 1950s.
- The programmer interact legitimately with computer equipment, there was no OS.
- These computers were kept running from a console comprising of display lights, toggle switches, some type of input output devices and a printer.
- Programs in machine code were stacked by the input output device (for instance of a card reader).
- In the event that a error ended the program, the error condition was shown by the lights.
- On the other hand if the program continued to a normal completion, the output showed up on the printer.
- There are two fundamental issues scheduling and setup.
    - Scheduling- Utilized signup sheet to save machine time. A user may signup an hour yet completes his activity in 45 minutes. This would bring about wasted computer inactive time, additionally the user may keep running into the issue not complete his activity in alloted time.
    - Setup- Single program called an occupation, could include stacking the compiler in addition to the abnormal state language program into memory, sparing the incorporate program and afterward stacking and connecting together the item program and capacities. A lot of time was spent in setting up the program to run.
- This method of operation could be term serial processing, mirroring the way that the users approach the compiler in series.
- Overtime, different system programming tools were created to endeavor to make sequential processing increasingly proficient.
- These incorporate libraries of basic functions, linkers and loaders and I/P driver schedules that were accessible as normal programming for all users.

2 Simple Batch System

- To accelerate processing, jobs with same needs are bunched together and keep running as a group.
- In this manner, the programmers will leave their programs with the administrator. The administrator will sort programs into batches with similar necessities.
- The issues with Batch Systems are:
    - Absence of interaction between the user and job.
    - CPU is idle most of the time, on the grounds that the speed of the mechanical I/O devices are more slow than CPU.

- For conquering this issue, there is one technique which is used known as the Spooling Technique.
- Spool is a buffer that holds output for a device, for example, printer, that can not acknowledge interleaved data streams.
- That is the point at which the activity demands the printer to output a line, that line is duplicated into a system buffer and is kept in touch with the disk.
- When the activity is finished, the output is printed.
- Spooling procedure can keep both the CPU and the I/O devices working at a lot higher rates.

3 Multiprogrammed Batch System

- This sort of OS is utilized to execute more than one job at the same time by a single processor.
- It builds CPU by sorting out jobs with the goal that the CPU consistently has one job to execute.
- The idea of multiprogramming is depicted as pursues:
- Every one of the job that enter the system are kept in the job pool(in a disk). The operating system stacks a lot of jobs from job pool into main memory and starts to execute.
- During execution, the job may need to wait for some task, for example, an I/O operation, to finish. In a multiprogramming system, the operating system basically changes to another activity and executes. At the point when that job needs to wait, the CPU is changed to another job, etc.
- At the point when the first job completes the process of waiting and it recovers the CPU.
- For whatever length of time that in any event one job needs to execute, the CPU is never idle.
- Multiprogramming operating systems utilize the component of job scheduling and CPU scheduling.

4 Time-Sharing System

- Time-sharing systems are not accessible in 1960s.
- Time-sharing or performing multiple tasks is a legitimate expansion of multiprogramming. That is processors time is shared among numerous users at the same time is called time-sharing.
- The primary contrast between Multiprogrammed Batch Systems and Time-Sharing Systems is, in Multiprogrammed batch systems its goal is expand processor use, while in Time-Sharing Systems its goal is minimize respoonse time.
- Numerous jobs are executed by the CPU by switching between them, however the switches happen in such a less time, so that the user can gets a prompt response.

- For instance, in an transaction processing, processor execute every user program in a short burst or quantum of calculation.
- That is if n users are available, every user can get time quantum.
- At the point when the user presents the instruction, the response time is seconds all things considered.
- Operating system utilizes CPU scheduling and multiprogramming to give every user a little part of a time.
- Computer systems that were structured essentially as batch systems have been altered to time-sharing systems.
- For instance IBM's OS/360.

Different types of Operating System

An Operating System plays out all the fundamental duties like managing file, process, and memory. In this way operating system goes about as administrator of the considerable number of resources, i.e resource manager. In this manner operating system turns into an interface among user and machine. Some of the generally utilized operating systems are as per the following-

1. Batch Operating System
2. Time-Sharing Operating System
3. Distributed Operating System
4. Network Operating System
5. Real-time operating System
6. Parallel Operating System

1 Batch Operating System

- This kind of operating system does not collaborate with the computer legitimately. There is an administrator which takes comparable jobs having same prerequisite and gathering them into batches.
- In this kind of system, there is no direct connection among user and the computer.
- The client needs to present work (composed on cards or tape) to a computer administrator.
- At that point computer administrator puts a batch of a several jobs on an input device.
- Jobs are batched together by sort of language and necessity.
- At that point an exceptional program, the monitor, deals with the execution of each program in the batch.
- The monitor is consistently in the primary memory and accessible for execution.

Advantages of Batch Operating System:

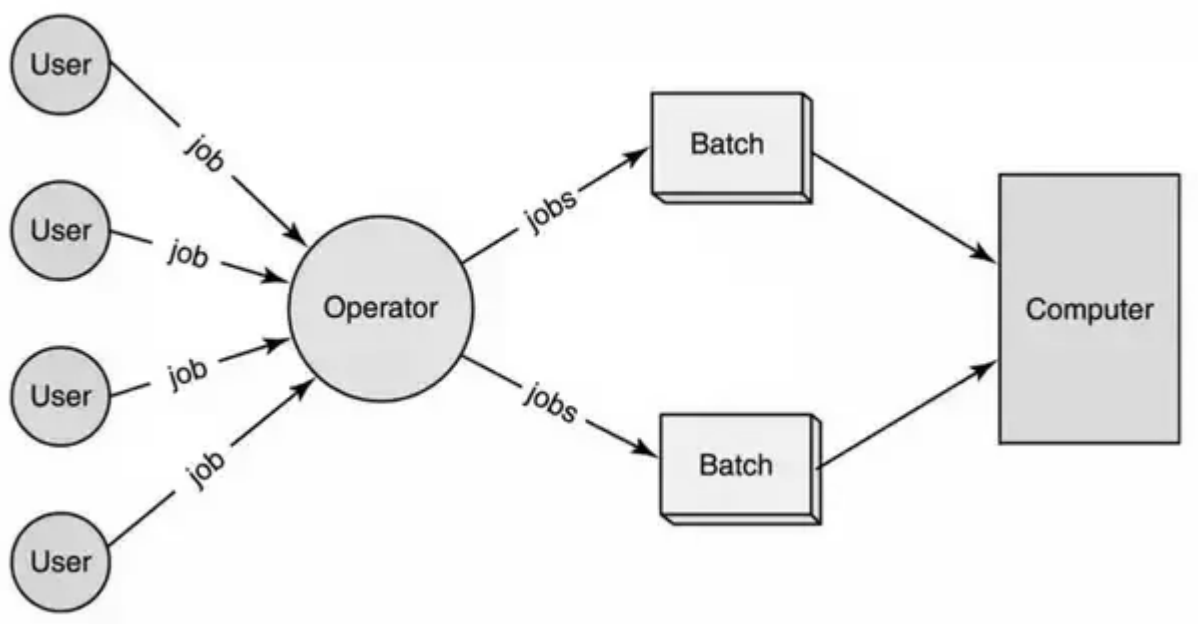
- It is exceptionally hard to estimate or realize the time required by any job to finish. Processors of the batch systems realize to what extent the job would be when it is in line.

- Various users can share the batch systems
- The inert time for batch system is extremely less
- It is easy to oversee huge work more than once in batch systems

Disadvantages of Batch Operating System:

- The computer administrators should have complete information with batch systems
- Batch systems are difficult to debug
- It is at some point expense
- Different jobs should sit tight for an obscure time if any jobs fail

Examples of Batch based Operating System: Payroll System, Bank Statements etc.



Batch Operating System

2 Time-Sharing Operating System

- As the name itself recommends, in a time-sharing system or performing various tasks system, different jobs can be executed on a system simultaneously by sharing the CPU time among them.
- It is viewed as an logical expansion of multiprogramming on the grounds that the two does synchronous execution yet vary in their prime aims.
- The fundamental goal of time-sharing systems is to limit reaction time yet not boosting the processor use(which is the target of multiprogramming systems).
- The time sharing systems were created to give an intuitive utilization of the computer system.
- A time shared system utilizes CPU planning and multiprogramming to give every user a little segment of a period shared computer.

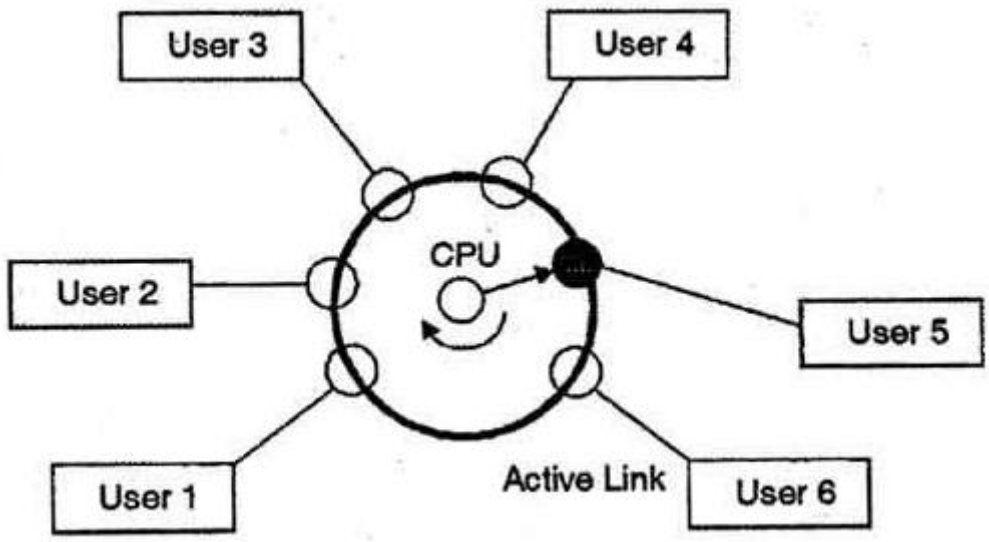
- It enables numerous users to share the computer resources all the while. As the system switches quickly from one user to the next, a brief timeframe opening is given to every user for their executions.
- The time sharing operating system guarantees that every one of the assignments get the chance to get to the CPU individually and for a fixed little interval of time. This interval is known as the time quantum.
- Eg: Unix Systems

Advantages of Time-Sharing OS:

- Each user gets an equivalent chance
- Less chances of duplication of programming
- CPU inert time can be diminished

Disadvantages of Time-Sharing OS:

- Unwavering quality issue
- One must need to deal with security and respectability of user programs and information.
- Information correspondence issue



Time-Sharing Operating System

3 Distributed Operating System

- Distributed Operating System is where distributed applications are running on different computers connected by interchanges.
- A distributed operating system is an augmentation of the network operating system that supports more elevated amounts of correspondence and integration of the machines on the network.
- This system looks to its users like a ordinary centralized together operating system yet keeps running on multiple, independent central processing units (CPUs).

- The processors communicate with each other through different correspondence lines, (for example, high-speed buses or telephone lines). These are referred as loosel coupled systems or distributed systems.
- Processors in a distributed system may fluctuate in size and function. These processors are referred as sites, nodes, computers, etc.

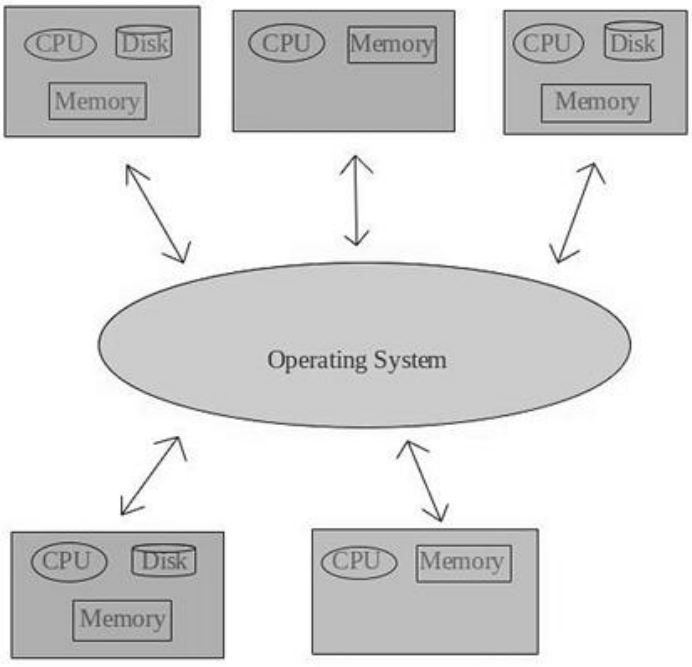
Advantages of distributed operating systems:

- With resource sharing facility, a user at one site might almost certainly utilize the resources accessible at another.
- Speedup the exchange of information with each other by means of electronic mail.
- In the event that one site fails in a distributed system, the rest of the sites can possibly keep operating.
- Better support to the clients.
- Decrease of the load on the host computer.
- Decrease of delays in data processing.

Disadvantages of Distributed Operating System:

- Failure of the home network will stop the whole correspondence
- To set up distributed systems the language which are utilized are not very much characterized at this point
- These sorts of systems are not promptly accessible as they are over the top expensive. Not just that the basic programming is exceptionally complex and not able to understand yet.

Examples of Network Operating System are: Microsoft Windows Server 2003, Microsoft Windows Server 2008, UNIX, Linux, Mac OS X



Distributed Operating System

4 Network Operating System

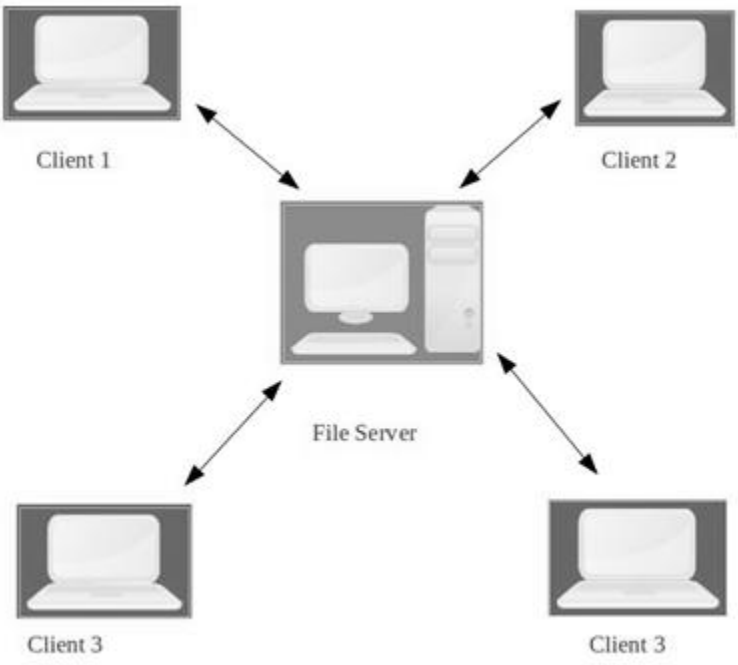
- A Network Operating System keeps running on a server and gives the server the ability to manage data, users, groups, security, applications, and other networking capacities.
- The main role of the network operating system is to permit shared file and printer access among numerous computers in a network, commonly a local area network (LAN), a private network or to different networks.
- One progressively significant part of Network Operating Systems is that every one of the users are very much aware of the fundamental arrangement, of every other user inside the network, their individual associations and so on and that is the reason these computers are famously known as tightly coupled systems.

Advantages of Network Operating System:

- Highly steady centralized servers
- Security concerns are taken care by servers
- New technology and hardware up-gradation can be easily done to the system
- Server can be access remotely from various areas and kinds of systems

Disadvantages of Network Operating System:

- Servers are expensive
- User needs to rely upon central location for generally tasks
- Support and updates are required consistently



Network Operating System

5 Real-Time Operating System

- A real-time operating system (RTOS) is an operating system that ensures a specific capability within a predetermined time requirement. For instance, an operating system may be intended to guarantee that a specific item was accessible for a robot on a mechanical production system.
- Real time system implies that the system is exposed to real time, i.e., reaction ought to be ensured inside a predetermined planning requirement or system should fulfill the predefined time constraint.
- Real-time systems are utilized when there are inflexible time necessities on the activity of a processor or the progression of information and real-time systems can be utilized as a control device in a devoted application.
- A real-time operating system must have well-characterized, fixed time requirements, generally the system will come up short. For instance, Scientific tests, medical imaging systems, industrial control systems, weapon systems, robots, aviation authority systems, and so on.
- There are two kinds of real-time operating systems.
    - Hard real-time systems: Hard real-time systems ensure that basic undertakings complete on time. In hard real-time systems, secondary storage is constrained or missing and the information is stored in ROM. In these systems, virtual memory is never found.
    - Soft real-time systems: Soft real-time systems are less prohibitive. A basic real-time task gets need over different task and holds the need until it finishes. Soft real-time systems have constrained utility than hard real-time systems. For instance, multimedia, virtual reality, Advanced Scientific Projects like undersea investigation and planetary wanderers, and so on.

6 Parallel Operating System

- Parallel Processing Systems are intended to accelerate the execution of programs by isolating the program into numerous pieces and processing those fragments simultaneously.
- Such systems are multiprocessor systems called as tightly coupled systems.
- Parallel systems manage the synchronous utilization of numerous computer resources that can incorporate a single computer with various processors, various computers associated by a network to frame a parallel processing cluster or a blend of both.
- Parallel systems are more hard to program than computers with a single processor in light of the fact that the engineering of parallel computers fluctuates appropriately and the procedures of numerous CPUs must be composed and synchronized.
- A few models for interfacing processors and memory modules exist, and every topology requires an alternate programming model.
- The three models that are most regularly utilized in structuring parallel computers incorporate synchronous processors each with its very own memory, asnchronous processors each with its own memory and asynchronous processors with a typical, shared memory.

- Parallel operating systems are essentially worried about dealing with the resources of parallel machines.
- This task faces numerous difficulties: application software engineers request all the performance possible, numerous equipment configurations exist and change all around quickly, yet the operating system should progressively be good with the standard adaptations utilized in computers.
- Today, new applications emerge and request faster computers. Business applications are the most utilized on parallel computers.
- A computer that runs such an application; ought to have the option to process enormous amount of data in modern ways. These applications incorporate designs, virtual reality, and decision support, parallel databases, medical diagnosis, etc.
- We can say with almost certainly that business applications will characterize future parallel computers design however scientific applications will stay significant users of parallel processing innovation.