

Unit-1

Introduction to Operating System

Operating System

An operating system acts as an intermediary between the user of a computer and computer hardware. The purpose of OS is to provide an environment in which a user can execute programs conveniently and efficiently.

An OS is concerned with the allocation of resources and services such as memory, processors, devices and information. The OS correspondingly includes programs to manage these resources, such as traffic controller, a scheduler, a memory management module, I/O programs and a file system.

History of OS

Generation	Year	Electronic device used	Types of OS devices
First	1945-55	Vacuum Tubes	Plug Boards
Second	1955-65	Transistors	Batch Systems
Third	1965-80	Integrated Circuits	Multiprogramming
Fourth	Since 1980	Large Scale Integration	PC

Functionalities of OS (Important)

1) Resource Management -

When parallel accessing happens in the OS means when multiple users are accessing the system, the OS works as Resource Manager. Its responsibility is to provide hardware to the user. It decreases the load in the system.

2) Process Management

It includes various tasks like scheduling and termination of the process. It is done with the help of CPU scheduling algorithms.

3) Storage Management

The file system mechanism used for the management of the storage. NIFS, CIFS, CFS, NFS etc are some of the file systems.

All the data is stored in various tracks of Hard disk that are all managed by the storage manager.

It includes Hard Disk.

4) Memory Management

Refers to the management of primary memory. The OS has to keep track of how much memory has been used and by whom. It has to decide which

process needs memory space and how much. OS also has to allocate and deallocate the memory space.

5) Security/Privacy Management

Privacy is also provided by the OS using password so that unauthorised applications can't access program or data. For example - Windows uses Kerberos authentication to prevent unauthorised access to data.

Characteristics of OS

1) Device Management

The OS keeps track of all the devices. So, it is called the I/O controller that decides which process gets the device, when and for how much time.

2) File Management

It allocates and deallocates the resources and also ~~decides who will store the mapping.~~ ^{It means which} it look after how the files will be stored and how files will be fetched.

3) Job accounting

It keeps track of time and resource used by various jobs or users.

4) Error detecting aids

These contains methods that include the production of dumps, traces, error messages and debugging.

5) Memory Management

It keeps track of the primary memory, like what part of it is in use by whom, or what part is not in use. It also allocates the memory when a process or program requests it.

6) Processor Management

It allocates the processor to a process and then deallocates the processor when it is no longer required or the job is done.

7) Control on system performance

It records the delay between the request for a service and the system.

8) Security

It prevents unauthorized access to programs and data using passwords or some kind of protection technique.

9) Convenience

An OS makes a computer more convenient to use.

10) Efficiency

An OS allows the computer system resources to be used efficiently.

11) Ability to evolve -

An OS should be constructed in such a way as to permit the effective development, testing and introduction of new system functions at the same time without interfering with service.

12) Throughput

An OS should be constructed so that it can give maximum throughput (number of tasks per unit time).

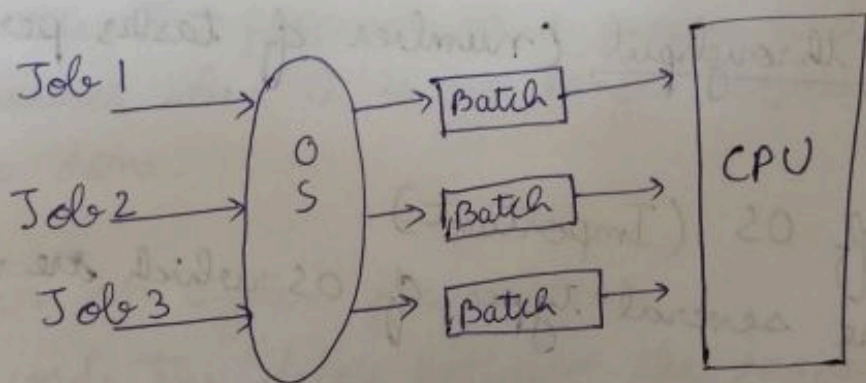
Types of OS (Important)

There are several types of OS which are mentioned below:

- 1) Batch operating system
- 2) Multi-programming operating system
- 3) Multi-tasking operating system/Time sharing
- 4) Real Time operating system
- 5) Distributed operating system
- 6) Clustered operating system
- 7) Embedded operating system

1) Batch operating system

This type of OS does not interact with the computer directly. There is an operator which takes similar jobs having the same requirement and group them into batches. It is the responsibility of the operator to sort jobs with similar needs.



Advantages

- 1) It is very difficult to guess or know the time required for any job to complete.
- 2) Multiple users can share the batch system.
- 3) The idle time for the batch system is very less.
- 4) It is easy to manage large work repeatedly in batch systems.

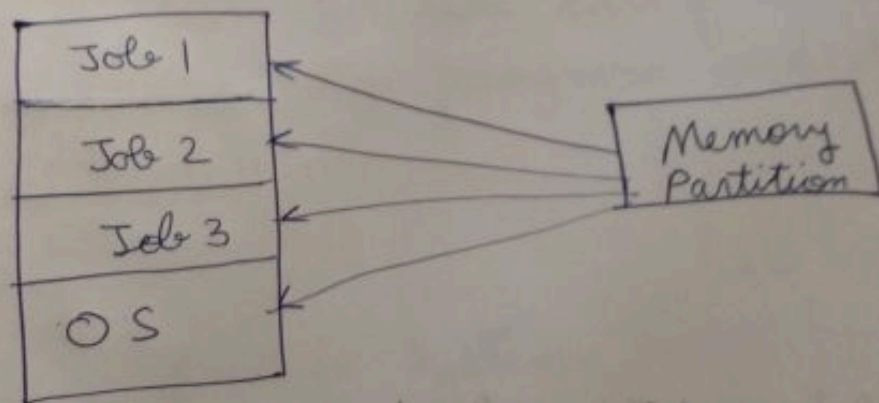
Disadvantages

- 1) These are hard to debug.
- 2) The other jobs will have to wait for an unknown time if any job fails.

Example - Payroll systems, Bank statements etc.

2> Multi-programming OS

A multi-programming OS runs multiple programs on a single processor computer. This is of non-preemptive type. The CPU should not remain idle. This is basically used for better execution of resources.



1) Advantage

- 1> ~~It increases the response time.~~
- 1> It increases the throughput of the system.
- 2> It helps in reducing the response time.

Disadvantages

- 1> Prior knowledge of scheduling is required.
- 2> Memory Management is needed in the OS because all types of tasks are stored in the main memory.

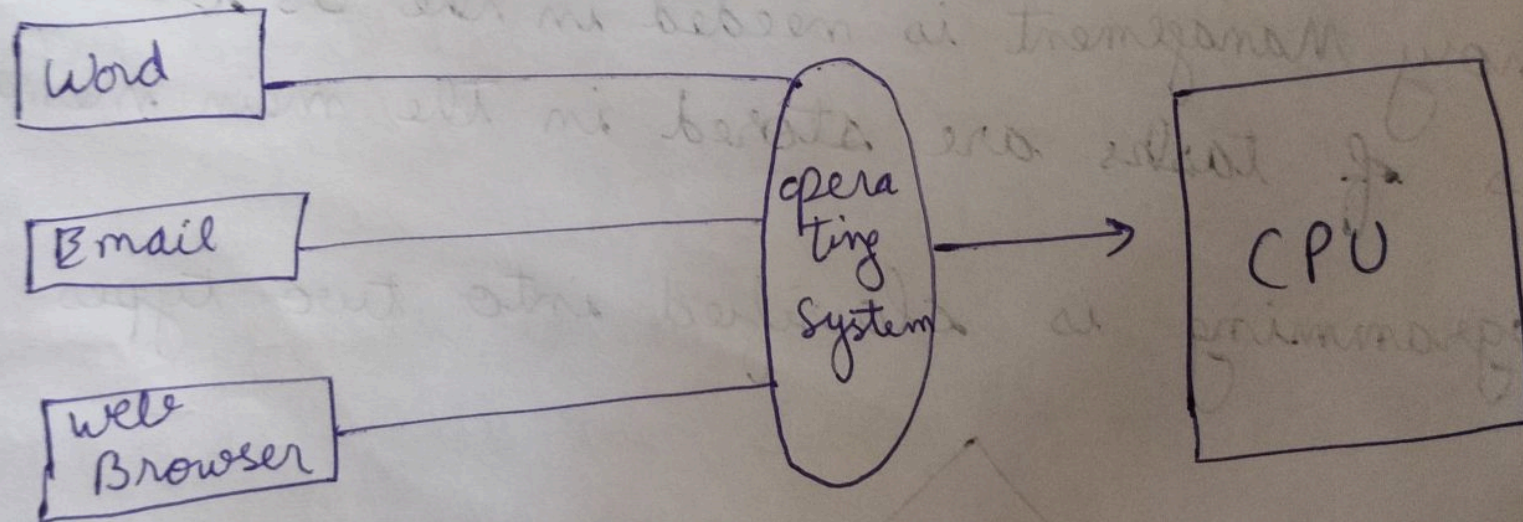
Multiprogramming is classified into two types

Multi user OS

Multi-tasking OS

2> Multitasking OS / Time sharing OS

In this each task is given same time to execute so that all the tasks work smoothly. Each user gets the time of CPU as they use a single system. The task can be from a user (single) or different users.



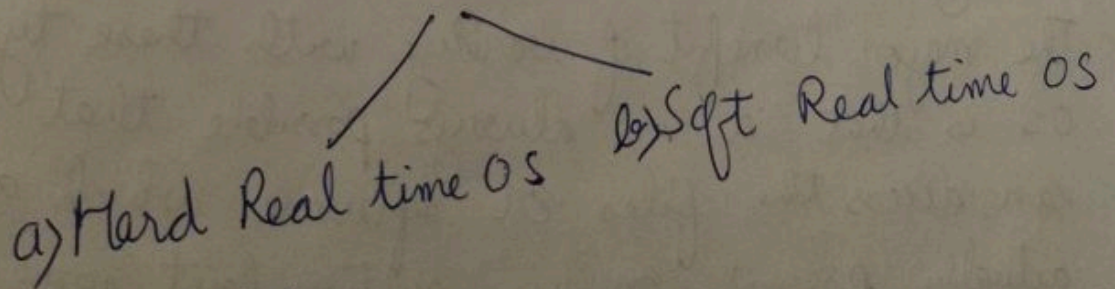
Advantages

- 1) Each task gets an equal opportunity.
- 2) Fewer chances of duplication of software.
- 3) CPU idle time can be reduced.
- 4) Resource sharing.
- 5) Improved productivity.

Disadvantages

- 1) Reliability Problem.
 - 2) One must have to take care of the security and integrity of user programs and data.
 - 3) High overhead.
 - 4) Security risk.
- 4) Real time Operating System
- These system are used in environment where a large ~~number~~ number of events, mostly external to the computer system, must be accepted and processed in a short time or within certain deadline.

Real time OS



a) Hard real time OS

These OS guarantee that critical tasks be completed within

a range of time. For example - Rocket launching.
e.g.) Soft real time operating system
These OS provide some relaxation in the time limit.
For example - Multimedia systems.

Advantages

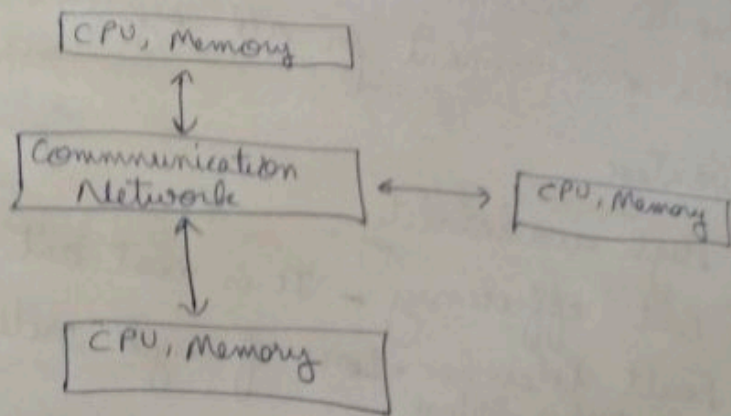
- 1) Maximum utilisation of devices and system.
- 2) These types of systems are error free.
- 3) Memory allocation is best managed in these type of systems.

Disadvantage

- 1) Limited task.
- 2) Use heavy system resources.
- 3) complex algorithm.
- 5) Distributed Operating System

In this OS, various autonomous interconnected computer communicate with each other using a shared communication network. Independent systems possess their own memory unit and CPU.

The major benefit of working with these types of the OS is that it is always possible that one user can access the files or software which are not actually present on his system but some other system connected within the network i.e. remote access is enabled within the devices connected in that network.



Advantage

- 1> Failure of one will not affect the other network communication, as all system are independent of each other.
- 2> Electronic mail increase the data exchange speed.
- 3> Load on host computer reduces.

Disadvantage

- 1> Failure of main network will stop the entire communication.
- 2> These Types of systems are not readily available as they are very expensive.

Example - LOCUS etc.

6> Clustered operating system

Cluster OS are a combination of software and hardware clusters. Hardware cluster aid in the sharing of high performance disks among all

computer systems, while software cluster give a ~~better~~ better environment for all systems to operate.

Advantage

- 1) High availability.
- 2) Cost efficiency - It is most cost effective and cheaper.
- 3) Fault tolerance - Loss of single node does not result in system failure.
- 4) Performance -
- 5) Processing speed -

The processing speed is also similar to mainframe system and other types of supercomputers on the market.

Disadvantage

- 1) Required resources
It requires the use of additional server and hardware making monitoring and maintenance difficult.

- 2) Maintenance

It requires a lot of maintenance / it is not easy to maintain.

- 7) Embedded operating system

An embedded operating system is a computer OS designed for use in embedded computer systems.

These OS are designed to be small, resource-efficient, dependable and reduce many features that aren't required by specialized applications.

The embedded OS improves overall efficiency by controlling all hardware resources and minimizing response times for specific tasks for which devices were built.

Services of operating system

- 1> Program execution
- 2> Input Output operations
- 3> Communication between process
- 4> File Management
- 5> Memory Management
- 6> Process Management
- 7> Security and Privacy
- 8> Resource Management
- 9> User Interface
- 10> Networking
- 11> Error handling
- 12> Time Management

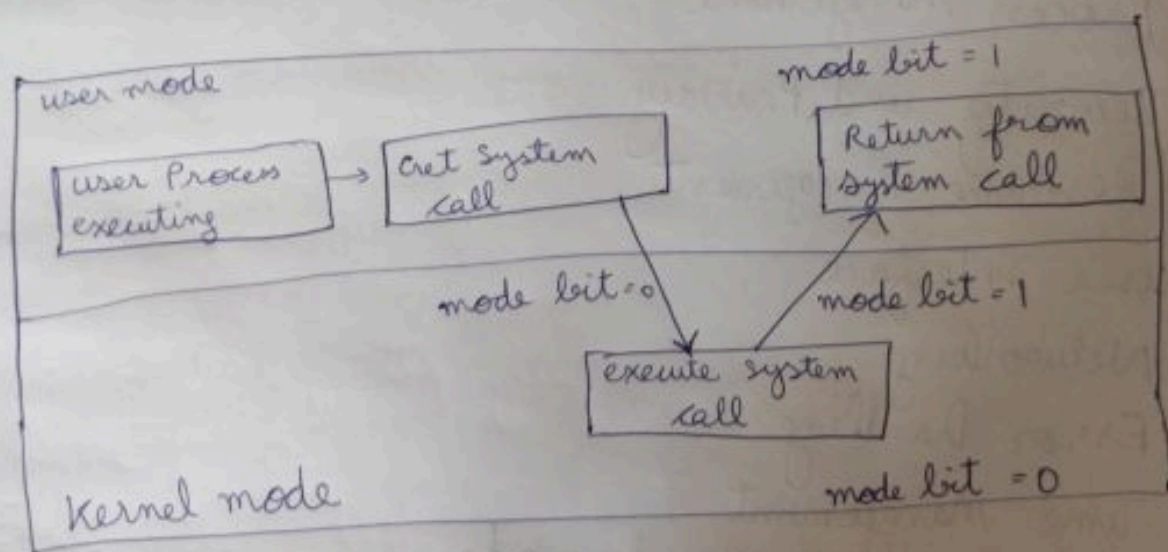
User mode vs Kernel mode

1> User mode

There are two modes of operation in the OS to make sure it works correctly. These are user mode and kernel mode.

The system is in user mode when the OS is running a user application such as handling a text editor. The transition from user mode to kernel mode occurs when the application requests the help of OS or an interrupt or a system call occurs.

The mode bit is set to 1 in the user mode. It is changed from 1 to 0 when switching from user mode to kernel mode.



2> Kernel mode

The system starts in kernel mode when it boots and after the OS is loaded, it executes applications in user mode.

The mode bit is set to 0 in the kernel mode. It is changed from 0 to 1 when switching from kernel

mode to user mode.

In the diagram, the user process executes in the user mode until it gets a system call. Then a system call is generated and the mode bit is set to zero. The system call gets executed in kernel mode.

After the execution is completed, again a system call is generated and the mode bit is set to 1. The system control returns to kernel mode and the process execution continues.

System Call

A system call is a way for programs to interact with the OS. A computer program makes a system call when it makes a request to the OS kernel.

System call provides the services of the OS to the user programs via API (Application program Interface).

Type of system call

- File Related \Rightarrow open(), Read(), write(), close(), create file()
- Device Related \Rightarrow Read, write, reposition
- Information \Rightarrow getpid, attributes, get system time and date
- Process control \Rightarrow Load, execute, abort, Allocate
- Communication \Rightarrow Pipe(), create/delete connections

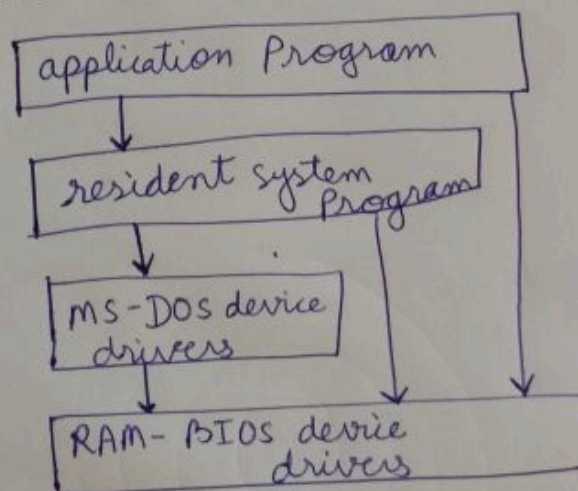
Operating System Structure

The OS can be implemented with the help of various structures. The structure of OS depends mainly on how the various standard components of the OS are interconnected and melded into the Kernel.

Depending on this, we have the following structure in the OS.

- 1> Simple structure
- 2> Monolithic
- 3> Layered approach
- 4> Micro kernel
- 5> Modules

1> Simple Structure



- a> Simple structure do not have well defined structure.
- b> These are simple, small and limited systems.
- c> Example - MS-DOS.

Advantages -

- 1> Each layer can be defined independently and when necessary can interact with one another.

27 It is simple to design, manage and update
 37 simple structure.

Disadvantage

- 1) when user program fails, OS fails.
 - 2) No security.
 - 3) Data tampering.
- 2) ~~Non~~ Monolithic Structure

User mode		
Signal terminal handling	File system	CPU scheduling
Character I/O system	swapping block I/O system	Page replacement
terminal drivers	disk and tape drivers	demand paging
		virtual memory
Hardware		

Monolithic operating system^{is} in which the kernel acts as a manager by managing all things like file management, memory management, device management and operational processes of the OS.

The kernel is the heart of OS computer. It serves as the primary interface between the OS and the hardware.

Advantage -

- 1) Layering is unnecessary as kernel alone is responsible for managing all operations, it is easy to design and

Disadvantage

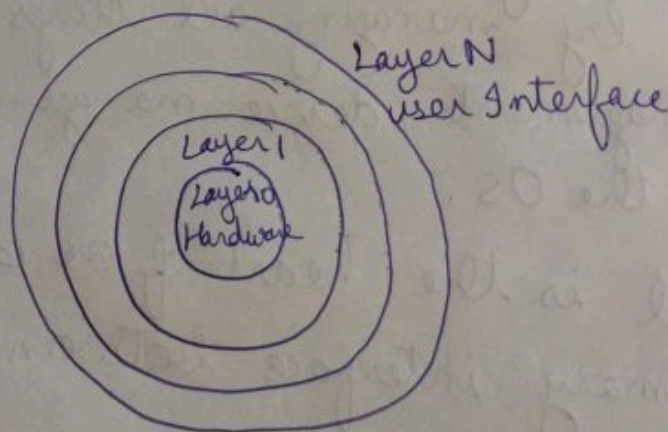
1) The monolithic kernel services are interconnected in one address space and have an impact on one another, so if any of them malfunction, the entire system does as well.

2) It is not adaptable. Therefore, launching a new service is difficult. Example - UNIX.

3) Layered Structure

The OS is divided into a number of layers, each built on top of lower layers. The bottom layer is the hardware and the highest is the user interface.

The operations can be invoked by higher-level layers. The layer itself can invoke operations on lower level layers.



Advantage -

1) Layered approach provides modularity. With modularity, layers are selected such that each layer uses functions and services of only lower level layers.

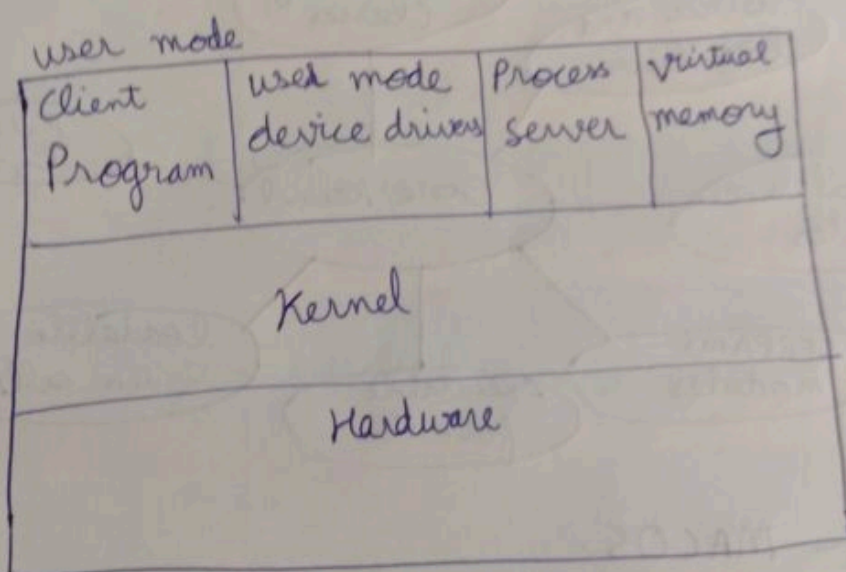
3) Debugging is easier.

Disadvantage -

1) It takes careful planning to construct the layers since higher layers only utilize the function of lower layers.

4) Micro-kernel structure

In this structure, remove all non-essential components from the kernel and implementing them as system and user level programs.



Advantage

- 1) Each micro-kernel is made independent and is isolated from other micro-kernel.
- 2) If any micro-kernel fails, then the remaining OS remains untouched and works fine.

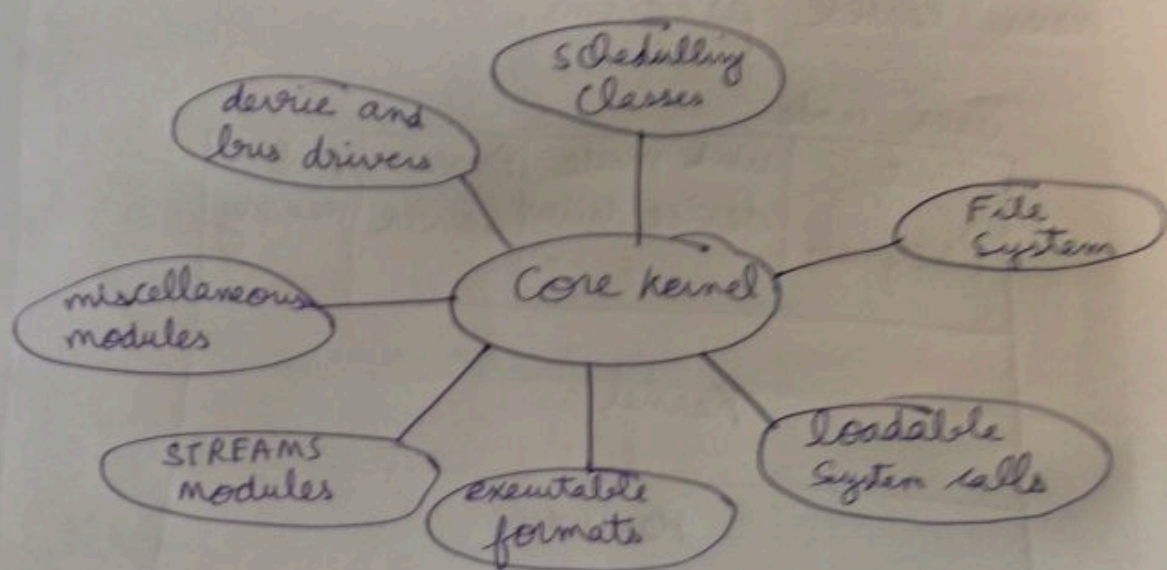
Disadvantage

- 1) System is complex to be constructed.
- 2) Processing time is increased.

Example - Windows NT.

5) Modular Structure

The kernel has only set of core components and other services are added as dynamically loaded modules to the kernel either during run time or boot time. A layer can communicate with each other with the help of kernel.



Example - MACOS.

Advantage -

- 1) Each module can interact with one another using function call.
- 2) A Module is loaded only when needed dynamically.