

UNIT - I

IM Questions

1. Define OS?
- A: Operating systems act as an interface between a computer or mobile user and computer hardware or mobile hardware.
2. List out the versions of windows OS?
A: There are multiple versions of windows OS they are windows 10, windows 7, windows 8, windows 10.
3. List out the types of OS?
A:
 1. Batch Operating System
 2. multi-Programming operating System
 3. Time - Shared operating System
 4. Parallel operating system & Distributed operating system
 5. Personal computer
4. Define uni-Programming System?
A: Uni programming refers to computer OS that uses one thread at a time. It implies one program sits in the primary memory at once.
5. Define system call?
A: It is a function that a user program uses to ask the OS for a particular service.
6. Define thread?
A: A Thread is a single sequential flow of control within a Program. It is a lightweight process.

3 MARKS

1. Explain about RTOS (Real-Time Operating System) and its types?

- RTOS is a special-purpose OS used in computers that has strict time constraints for any job to be performed. RTOS are designed to handle multiple processes at one time, ensuring that these processes respond to events within a predictable time limit.
- Processing in RTOS occurs within defined time constraints.
- An RTOS is also able to make changes to task priority.

Ex: Airline Traffic control systems, Airlines reservation system.

→ RTOS are often used in embedded systems such as Robotics, medical devices, industrial control and aerospace applications where reliability, performance and safety are critical.

There are two types of RTOS they are

1. Hard RTOS
2. Soft RTOS

Hard RTOS:

In Hard RTOS, all critical tasks must be completed within the specified time duration i.e. within the given deadline. Not meeting the deadline would result in critical failures such as damage to equipment or even loss of human life.

Soft RTOS: It accepts a few delays via the means of the OS. In this kind of RTOS, there may be a closing date assigned for a particular job, but a delay for a small amount of time is acceptable.

Q: Define a Process? Explain Process control Block?

A: A Program in execution is called a Process. There may exist more than one Process in the system which may require the same resource at the same time. Therefore, the OS has to manage all the processes and the resources in a convenient and efficient way.

PCB (Process control Block): As the OS supports multi-programming, it needs to keep track of all the processes. For this task, the PCB is used to track the process execution status. Each block of memory contains information about the process state, program counter, stack pointer, status of opened files, scheduling algorithms etc. A PCB contains information about the process, i.e. registers, quantum, priority etc.

Pointers
Process state
Process Number
Program counter
Registers
memory limits
Open files list.

Pointers: It is a stack pointer that is required to be saved when the process is switched from one state to another to retain the current position of the process.

Process state: It stores the respective state of the process.

Process number: Every process is assigned a unique id known as Process ID or PID which stores the process identifier.

Program counter: It stores the counter ; which contains the address of the next instruction that is to be executed by the process.

Register: These are the CPU registers which include the accumulator, base, registers, and general-purpose registers.

Memory limits: This field contains the information about memory management system used by the OS. This may include Page tables, segment tables etc.

Open files list: This information includes the list of files opened by a process.

Q: Explain in detail about System calls?

A: → A system call is a way for a user program to interface with the OS. The program requests several services and the OS responds by invoking a series of system calls to satisfy the request.

→ A system call can be written in assembly language or high-level language like C or Pascal.

→ When a computer program needs to access the OS kernel it makes a system call.

Need of System calls in OS

1. It must require when a file system wants to create or delete a file.
2. New connections require the system calls to sending and receiving data packets.
3. System calls are used to create and manage new processes.

Types of system calls:

There are five types of system calls

1. Process control
2. File management
3. Device management
4. Information maintenance
5. communication.

Process control: It is the system call that is used to direct the processes. Some process control examples include creating, load, abort, end, execute, process, terminate the process, etc.

File management: It is system call that is used to handle the files. Some file management examples include creating files, delete files, open, close, read, write etc.

Device management: It is used to deal with devices. Some examples of device mgmt include read, write, get device attributes, release device etc.

Information maintenance: It is a system call that is used to maintain information. There are some examples of information maintenance, including getting system data, set time or date, get time or date, set system data, etc.

communication: It is system call that is used for communication. There are some examples of communication including create, delete communication connections, send, receive messages etc.

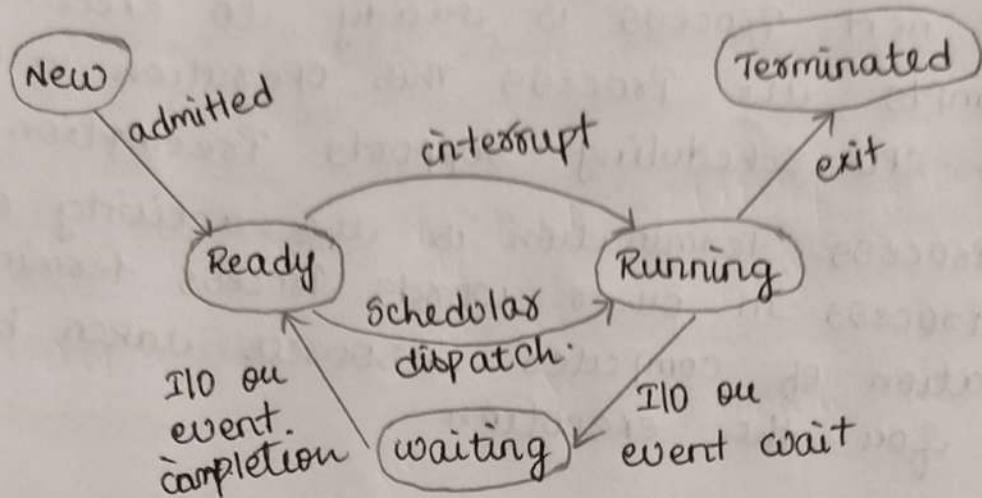
Process	Windows	UNIX
Process control	createProcess() ExitProcess() waitForSingleObject()	FORK() EXIT() wait()
File manipulation	createFile() ReadFile() WriteFile() closeHandle()	open() Read() write() close()
Device management	SetConsoleMode() ReadConsole() WriteConsole()	Ioctl() Read() Write()
Information maintenance	GetCurrentProcessID() SetTimer() Sleep()	Getpid() Alarm() Sleep()
communication	createPipe() CreateFileMapping() MapViewOfFile()	Pipe() Shmget() mmap()
Protection	SetFileSecurity() InitializeSecurityDescriptor() SetSecurityDescriptorGroup()	chmod() umask() chown()

4. Explain in detail about Process concept?

A. A program under execution is known as process.

There are different states of process

- 1) New - The process is being created.
- 2) Ready - The process is waiting to be assigned to a processor.
- 3) Running - Instructions are being executed.
- 4) Waiting - The process is waiting for some event to occur
- 5) Terminated - The process has finished execution.



Operations on a Process:

- 1) creation: This is the initial step of process execution activity. Process creation means the construction of a new process for the execution. This might be performed by system, user or old process itself.
- 2) scheduling / Dispatching: The event or activity in which the state of the process is changed from ready to running. It means the OS puts the process from ready state into the running state. Dispatching is done by OS when the resources are free or the process has higher priority than the ongoing process.
- 3) Blocking: When a process invokes an input-output system call that blocks the process and OS put it in block mode. Block mode is basically a mode where process waits for input-output. Hence, in process blocking operation, the OS puts the process in waiting state.

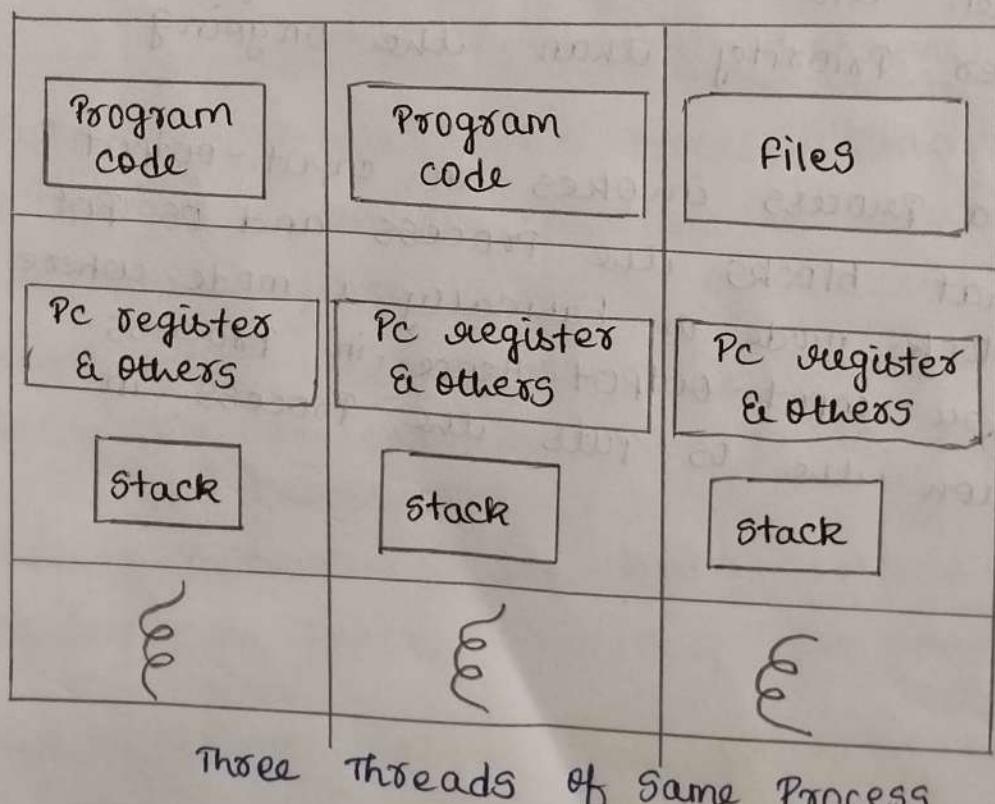
4) Pre-emption: when a timeout occurs that means the process hadn't been terminated in the allotted time interval and next process is ready to execute, then the OS Pre-empts the process. This operation is only valid where CPU scheduling supports Preemption.

5) Termination: Process termination is the activity of ending the process. In other words, Process termination is the relaxation of computer resources taken by the process from the execution.

5] Explain about Thread concept in detail?

A Thread:

- A thread is a single sequential flow of execution of tasks of a process so it is also known as thread of execution or thread of control.
- Each thread of the same process makes use of a separate program counter and a stack of activation records and control blocks.
- Thread is often referred to as lightweight process.



Need of Thread:

- It takes less time to create a new thread in an existing process than to create a new process.
- Threads can share the common data, they do not need to use Inter-Process communication.
- Context switching is faster when working with threads.
- It takes less time to terminate a thread than a process.

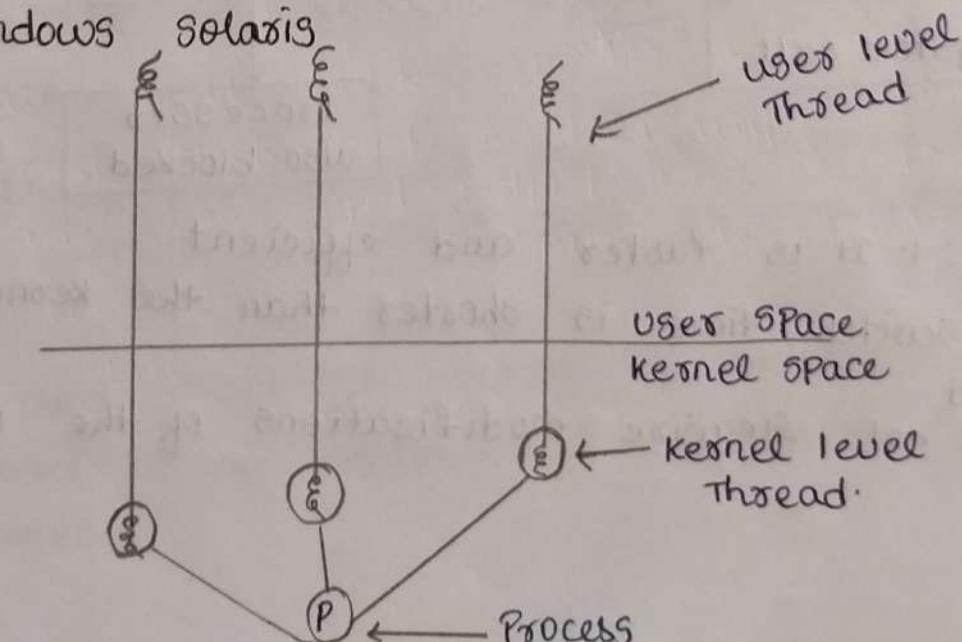
Types of Threads:

1. Kernel level Thread
2. User-level Thread.

Kernel level Thread:

- The kernel thread recognizes the OS. There is a thread control block and process control block in the system for each thread and process in the kernel-level thread.
- The kernel level thread is implemented by the OS.
- The kernel knows about all the threads and manages them.
- The kernel-level thread offers a system call to create and manage the threads from user-space. The implementation of kernel threads is more difficult than the user thread.
- context switch time is longer in the kernel thread.

Ex: windows Solaris



Advantages

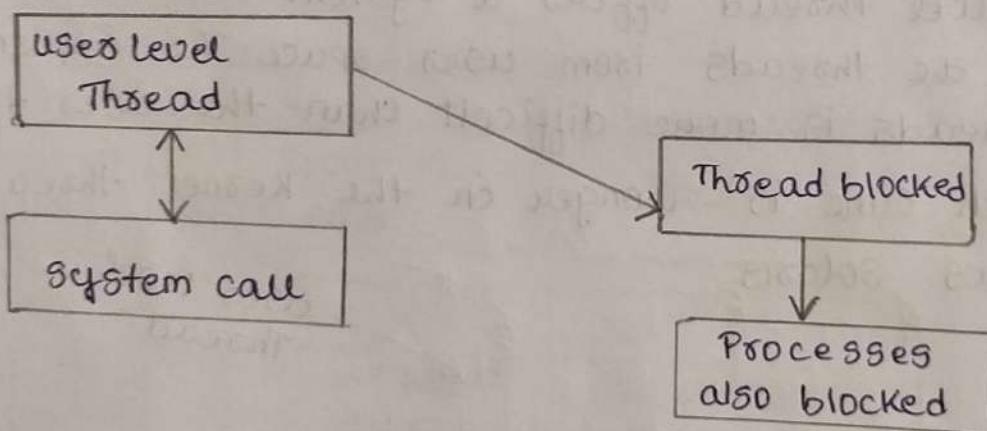
1. The Kernel-level thread is fully aware of all threads.
2. The kernel-level thread is good for those applications that block the frequency.

Disadvantages:

1. The kernel thread manages and schedules all threads.
2. The implementation of kernel threads is difficult than the user thread.

User-level Thread:

- User level threads are threads that the OS is not aware of. They exist entirely within a process, and are scheduled to run within that process's timeslice.
- User threads can be easily implemented and it is implemented by the user. If a user performs a user-level thread blocking operation, the whole process will be blocked.
- The kernel level thread manages user level threads as if they are single-threaded process.



Advantages: 1. It is faster and efficient

2. Context switch time is shorter than the kernel-level threads
3. It does not require modifications of the OS.

Disadvantages:

1. User-level threads lack coordination b/w the thread and the kernel
2. If a thread causes a Page fault, the entire process is blocked.

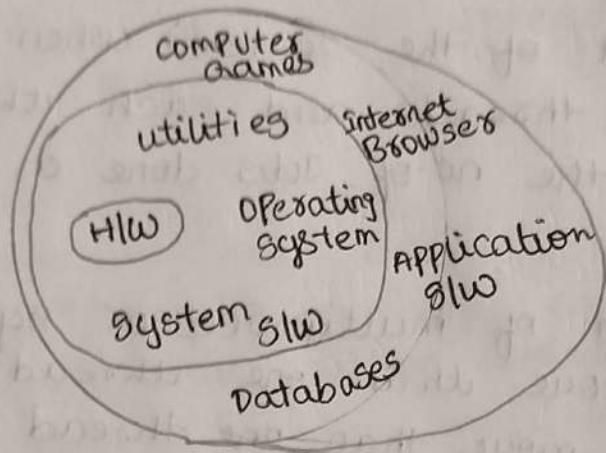
Benefits of Threads:

1. Enhanced Throughput of the System: when the Process is split into many threads, and each thread is treated as a Job, the no. of Jobs done in the unit time increases.
2. Effective utilization of multiprocessor system: when you have more than one thread in one process, you can schedule more than one thread in more than one processor.
3. Faster context switch: The context switching period b/w threads is less than the process context switching.
4. Responsiveness: when the Process is split into several threads, and when a thread completes its execution, that Process can be responded as soon as possible.
5. Communication: multiple-thread communication is simple because the threads share the same address space, while in process we adopt a few exclusive communication strategies.
6. Resource sharing: Resources can be shared b/w all threads within a process, such as code, data and files.
The stack and register cannot be shared between threads. There is a stack and register for each thread.

5marks:

1. Explain in detail about components of a computer system?

A: In computer system (comprises of HW and SW),
Hardware can only understand machine code



- we need a system which can act as an intermediary and manage all the processes and resources present in the system.
- An OS can be defined as an interface between user and HW. It is responsible for the execution of all the processes.
- A computer system consists of:
 - 1) Users (People who are using the computer)
 - 2) Application Programs (Compilers, Databases, Games, Browsers etc)
 - 3) System Programs (Shells, Editors, compilers etc)
 - 4) Operating System (A special program which acts as interface between user and HW)
 - 5) Hardware (CPU, Disks, memory etc)

Operating System: An OS is a program on which application programs are executed and acts as an interface between user and the computer hardware. The OS also includes programs to manage these resources, such as traffic controller, a scheduler, I/O programs and a file system.

Software: It is a set of instructions, data or programs used to operate computers and execute specific tasks.

Ex: Microsoft Windows, Linux, macOS

There are two types of software:

1. System Software: System software acts as the interface b/w the hardware and the end users.
System software includes macOS, GNU/Linux, Chrome OS, iOS
2. Application Software: It is a type of computer program that performs a specific personal, educational and business function.

Hardware: Hardware refers to the external and internal devices and equipment that enable you to perform major functions such as input, output, storage and communication.

Utilities: A utility program carries out some of the common tasks while using a computer. System utility software is also known as service program, service tool or utility routine.

Q Database:

A database is an organized collection of structured information, or data, typically stored in a computer system.

2) Explain in detail about memory management?

- A: In a multiprogramming computer, the OS resides in a part of memory, and the rest is used by multiple processes. The task of subdividing the memory among different processes is called memory management.
- memory management is a method in the OS to manage operations between main memory and disk during process execution
 - the main aim of memory management is to achieve efficient utilization of memory.

There are two types of memory management they are:

- 1. main memory management.
- 2. Secondary memory management.

Main memory management

- main memory is a volatile storage device which means it loses its contents in the case of system failure or as soon as system power goes down.
- The main motivation is to maximize memory utilization on the computer system.

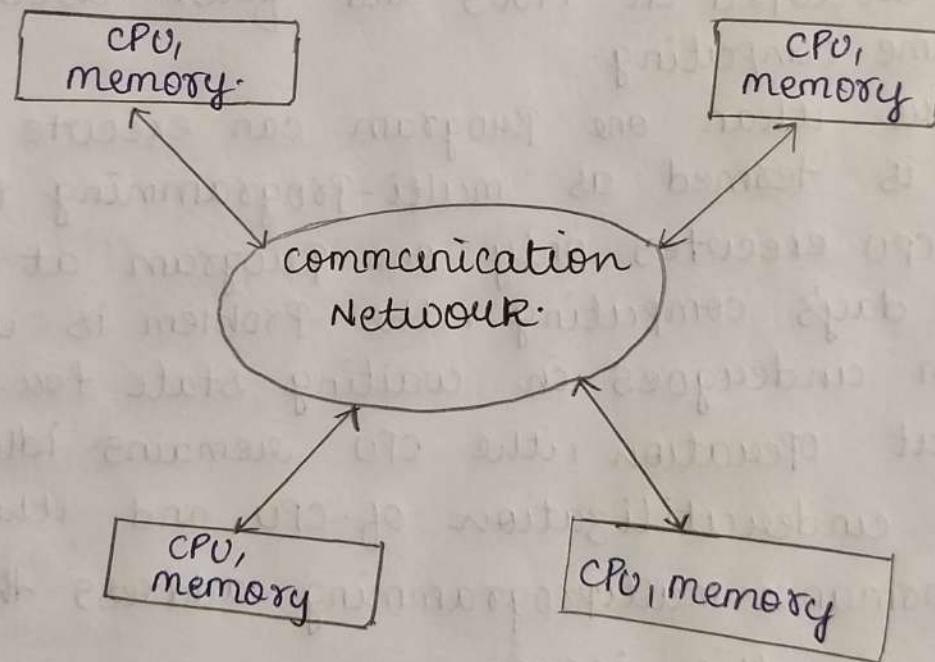
Secondary storage management

- Secondary storage area is any space, where data is stored permanently and the user can retrieve it easily.

Ex: CD-ROM / DVD drives

3. Explain in detail about distributed systems and its advantages?

- A: A distributed operating system (DOS) is an essential type of OS. Distributed systems use many central processors to serve multiple real-time applications and users. As a result, data processing jobs are distributed between the processors.
- It connects multiple computers via single communication channel. These CPUs communicate via high-speed buses or telephone lines.
- The major benefit of working with these types of 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 on some other system connected within this network. i.e. remote access is enabled within the devices connected in that network.



Advantages:

- Failure of one will not affect the other network communication, as all systems are independent from each other.
- Electronic mail increases the data exchange speed.

- since resources are being shared, computation is highly fast and durable
- load on host computer reduces.
- Delay in data processing reduces.

Disadvantages

- 1) Failure of the main network will stop the entire communication.
- 2) Language used to establish distributed systems are not well defined yet.
- 3) Explain in detail about multi-programming operating systems?

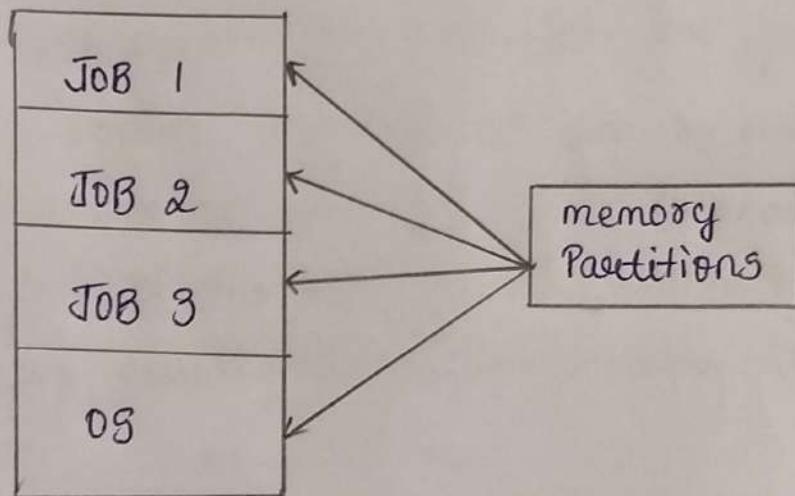
A:

- It was developed in 1950's and first used in main-frame computing.
 - when more than one program can execute in an OS then it is termed as multi-programming OS.
 - Earlier, CPU executes only one program at a time. In earlier days computing, the problem is that when a program undergoes in waiting state for an input/output operation, the CPU remains idle which leads to underutilization of CPU and thus poor performance. Multiprogramming address this issue and solves this issue.
 - The major task of multiprogramming is to maximize the utilization of resources.
- It is divided into two types:
- 1) multi-user OS
 - 2) multi-tasking OS

multi-tasking OS:

→ It is an OS that allows you to run more than one program simultaneously.

→ The OS does this by moving each program in and out of memory one at a time. When a program runs out of memory, it is temporarily stored on disk until it is needed again.



Features

- 1) Need single CPU for implementation
- 2) CPU idle time is reduced.
- 3) High resource utilization.
- 4) High Performance

multi-user OS:

It allows many users to share processing time on a powerful central computer on different terminals. The operating system does this by quickly switching between terminals, each receiving a limited amount of CPU time on central computer.

Q) Define OS and explain types of OS?

10marks

Definition: It is an interface between user and hardware.

It is also known as system software. This performs basic types of operation.

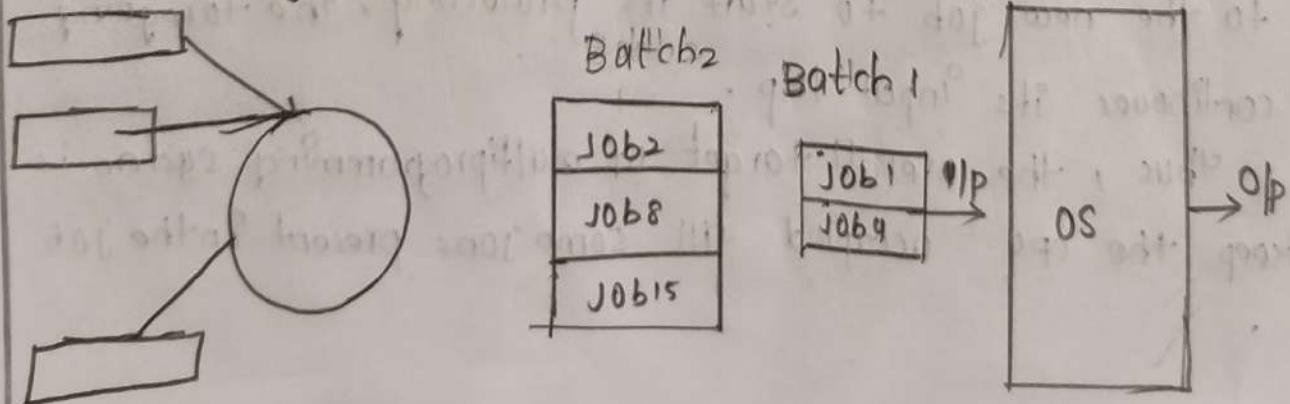
Types of operating system:

1. Simple batch system:

In a batch system the similar jobs are grouped together. In to batches are executed one by one. For example let us assume we have 10 programs to execute. The important task of the batch operating system is to automatically keep executing the job in to batches to reduce the setup time.

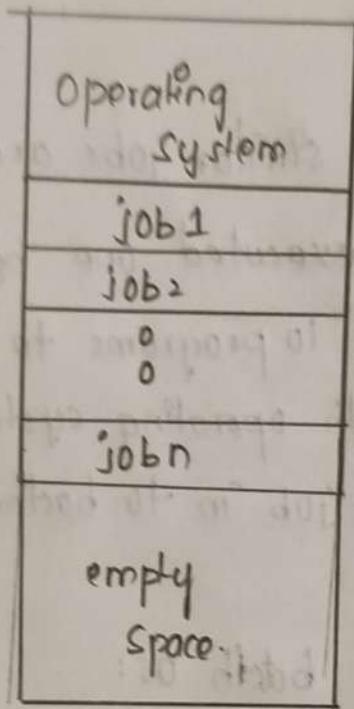
The steps required for simple batch OS:

- 1 - Using punch cards the user prepares his job
- 2 - After that user submit the job to the programmer
- 3 - The programmer collects the job from different users and sort the jobs into batches
- 4 - finally the programmer submits the batch to the processor one by one.
- 5 - All the jobs of a single batch are executed together



Multiprogramming operating systems:

To execute multiple programs multiple-programming system is used. This is a type of operating system is capable of executing more than one program on the CPU. Because of this, the system is completely utilized.



When a system is running, multiple process wait to get performed i.e. if they wait for their chance to utilize the CPU and start execution. sometimes the process called as jobs.

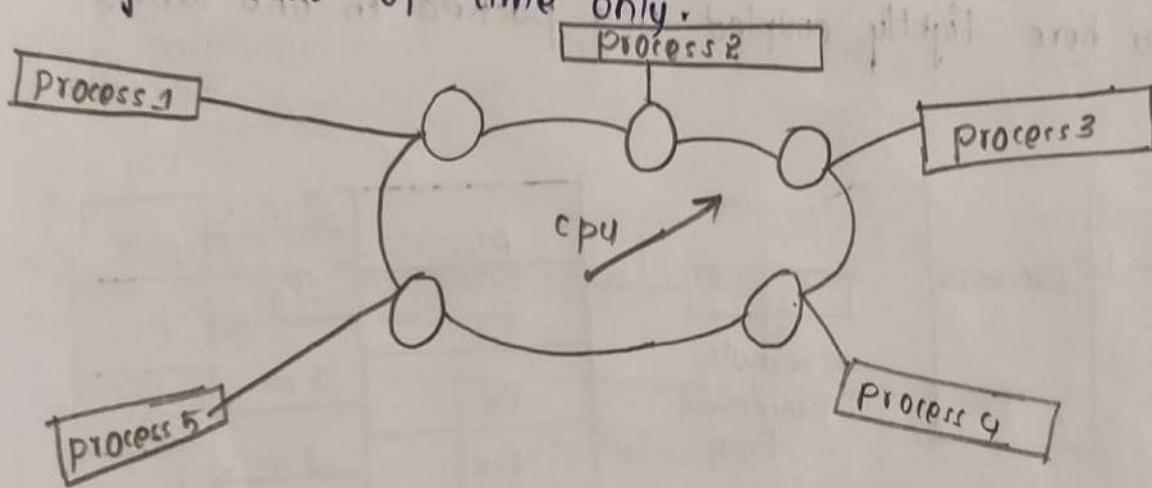
Working of multi-program system

In this job proceeds for the task the OS pauses the job and select an additional job from the job pool and gives the CPU to the new job to start its processing. The foregoing job continues its input I/O.

Thus, the overall target of multiprogramming system is to keep the CPU occupied till some jobs present in the job pool.

3) Time sharing operating system:

In a multi-tasking operating system, more than one process are being executed at a particular time with the help of the time sharing concept. So in the time sharing environment we decide a time that is called time quantum and when the process starts its execution and execution continues for the only amount of time only.



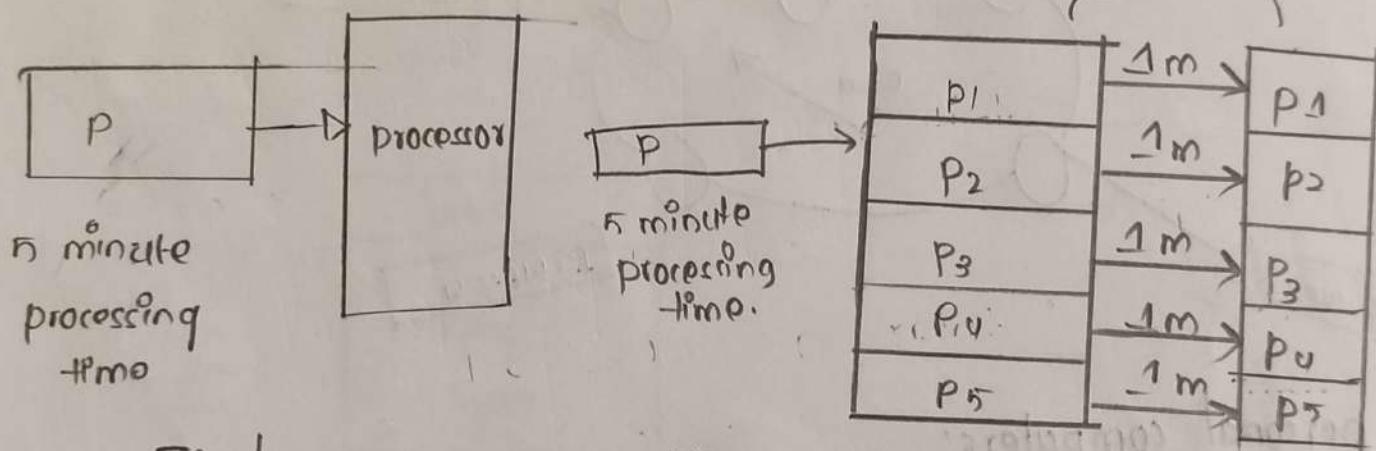
4) personal computers:

personal computer operating system provides a good interface to a single user. personal computer operating system are widely used for word processing, spreadsheets and internet access. personal computer operating system are made only for personal, you can laptops, computer systems, tablets, etc. are your personal purposes, for and the operating system such as windows 7, windows 10, android, etc are your personal computer operating system.

5 Parallel processing:

- Parallel processing requires multiple processor and all the processes works simultaneously in the system. Here, the task is divided in to sub parts and those sub parts are then distributed among the available processor in the system. parallel processing completes the job on the shortest possible time.

All the processor here tightly coupled and packed in one racing



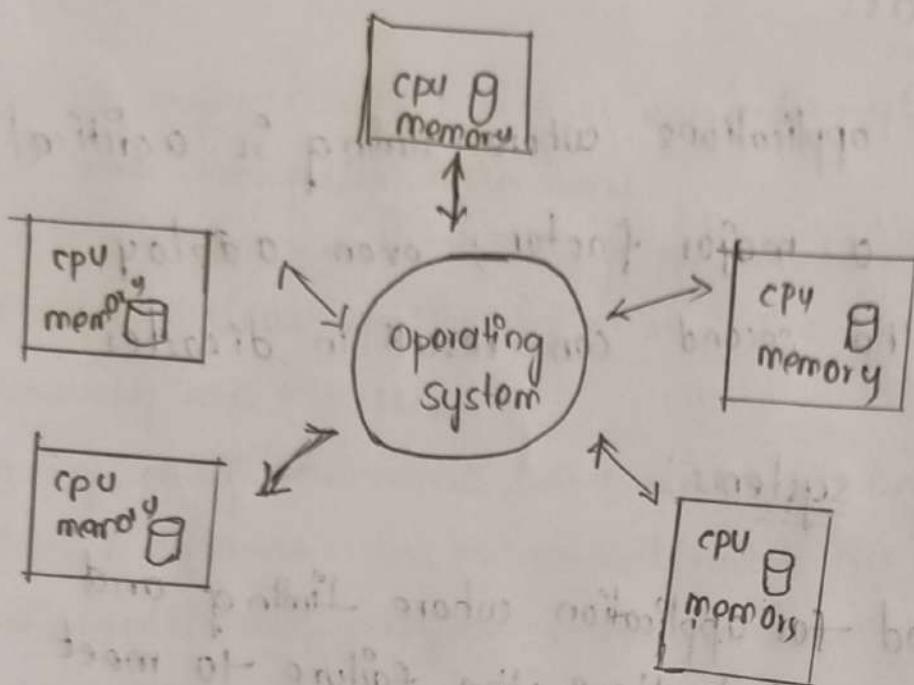
Single processor vs multiprocessing in parallel processing

6 Distributed operating system:

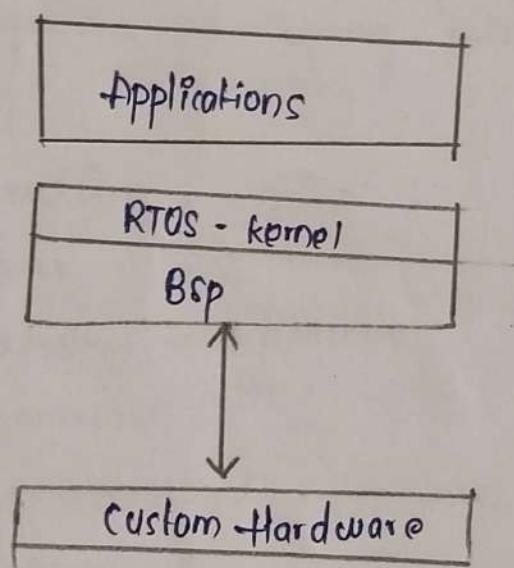
These types of the operating system is a recent advancement in the world of computer technology and being widely accepted all over the world, that too with a great pace.

Various autonomous interconnected computer communicate with each other using a shared communication network.

Independent system processes their own memory unit and CPU



Real-time Operating systems:



* It is developed for real-time applications where data should be processed in a fixed, small duration of time. It is used in an environment where multiple processes are supposed to be accepted and processed in short time. RTOS require a quick input and immediate response.

Hard Real time OS:

These are used applications where timing is critical

- (i) response time is a major factor; even a delay of a fraction of the second can result in disaster.

Soft Real time systems:

These are used for application where timing and response time is critical. Here the failure to meet the deadline may result in a degraded performance instead of a disaster.

Q: what are the services provided by the operating system (OS)?

A: OS services

OS is a software that act as an intermediary between the user and computer hardware.

It is a program with the help of which we are able to open or run various applications. It is the one program that is running all the time.

Every computer must have an OS to smoothly execute other programs. The OS co-ordinates the use of the hardware and application programs for various users.

It provides a platform for other app programs to work.

The OS is a set of special programs that run on a computer system that allows it to work properly. It controls I/O devices, execution of programs, managing files etc...

services

- ① program execution
- ② I/O operations
- ③ communication b/w process
- ④ file management
- ⑤ memory management
- ⑥ process management
- ⑦ security & privacy
- ⑧ resource management
- ⑨ user interface
- ⑩ Networking
- ⑪ error handling
- ⑫ time management

program Execution:

- OS manages how a program is going to be executed.
- it loads the program into memory after which it is executed.
the order in which they are executed depends on the CPU scheduling algorithm (ex: FCFS, SJFS, etc..)
- when the program is in execution, the OS also handles deadlocks (i.e) no 2 processes come for execution at the same time.
- The OS is responsible for smooth execution of both user and system programs.
- The OS utilizes various resources available for the efficient running of all functionalities.

I/O operations: OS manages the I/O operations & establishes communication between the user & device drivers.

→ Device drivers are software that is associated with hardware that is being managed by the OS so that the sync between the devices work properly. It also provides access to I/O devices to a program when needed.

Communication b/w processes: The OS manages the communication b/w processes communication b/w process includes data transfer among them. If the processes are not on the same computer hardware, then also their communication is managed by operating system.

File management: the OS helps in managing the files also. If a program needs access to a file, it is the OS that grants access. These permissions include read-only, read-write etc. It also provides a platform for the user to create & delete files.

- The OS is responsible for making decisions regarding the storage of all types of data on files i.e. floppy disk, hard disk, pen drive etc...
- The OS decides how the data should be manipulated & stored.

Memory management: Imagine a cricket team with limited number of players. The team manager (OS) decides whether the upcoming player will be playing in all 15 or not. It will not be included in team based on his performance.

In the same way OS first checks whether the program fulfills all requirements to get memory space or not. If all things good it checks how much memory space will be sufficient for program & then load the program into memory at certain location.

Process management: Our kitchen stove as the CPU where all cooking (execution) happens & the chef (OS) has a cook diff dishes (programs). The chef has to cook diff dishes so he ensures that any particular dish doesn't take long time & all dishes get a chance to cook (Execution). The chef (OS) basically schedules time for all dishes to run kitchen smoothly & thus cooked all different dishes efficiently.

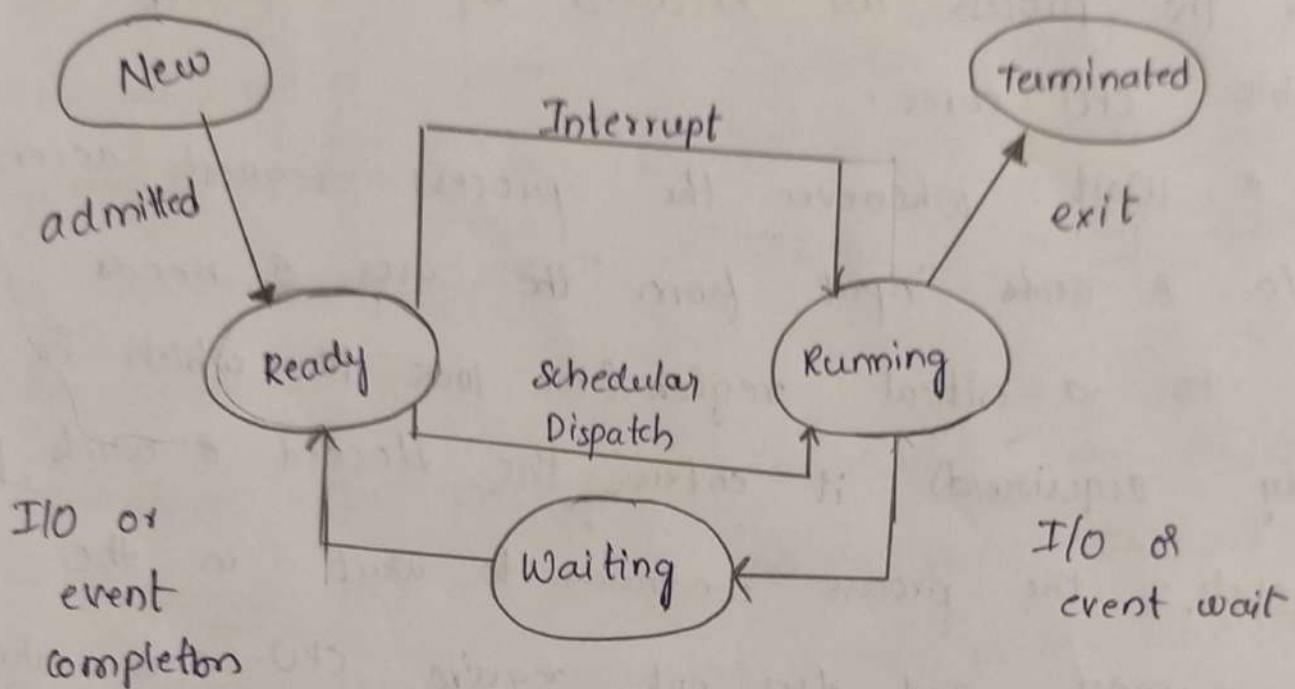
Security ; OS keeps our computer safe from an unauthorised user by adding security layer to it layers which protect computer from bad guys like viruses & hackers.

→ OS provide us defenses like firewalls & anti-virus soft ware & ensure good safety of computers & personal info

Privacy ; OS gives us facility to keep our essential info hidden like having a lock on our door, where only you can enter & others are not allowed. Basically it respect our secret & provides us facility to keep it safe.

Resource management : System resources are shared b/w various process. It is the OS that manages resource sharing. It also manages the CPU time among processes using CPU scheduling algorithms. It contains or controls I/O devices. The OS also ensures the proper use of all the resources available by deciding which resources to be used by whom us.

3) Explain Process concepts and scheduling :
A process : A process is a running program that serves as the foundation for all the computation.



Process status in Operating System :

- New (Create) : In this step, the process is about to be created but not yet created. It is the program that is present in secondary memory that will be picked up by OS to create the process.
- Ready : New → Ready to run. After the creation of a process, the process enters the ready state i.e., the process is loaded into the main memory. The process here is ready to run and is waiting to get the CPU time for its execution. Processes that are ready for execution by the CPU are maintained in a queue called ready queue queue for ready processes.

Run : the process is chosen from the ready queue by the CPU for execution and the instructions within the process are executed by any one of the available CPU cores.

Blocked & Wait : whenever the process requests access to I/O & needs input from the user or needs access to a critical region (the lock to which is already acquired) it enters the blocked & waits for the state. the process continues to wait in the main memory and does not require CPU. Once the I/O operation is completed the process goes to the ready state.

Terminated : Process is killed as well as PCB is deleted. The resources allocated to the process will be released & deallocated.

Process Scheduling is an important part of multiprogramming operating systems. It is the process of removing the running task from the process and selecting another task for processing.

If schedules a process into different states like ready, waiting and running.

Categories of scheduling in OS :

there are two categories in scheduling :

1. Non-preemptive : In non-preemptive, the resource can't be taken from a process until the process completes execution. the switching of resources occurs when the running process terminates & moves to a waiting state.

2. Preemptive: In preemptive scheduling, the OS allocates the resource to a process for a fixed amount of time. During resource allocation, the process switches from running state to ready state & from waiting state to ready state. This switching occurs as the CPU may give priority to other processes and replace the process with higher priority with the running process.

Process scheduling :

There are two types of process scheduling :

- 1) Independent process
- 2) Cooperating process.

In the next page, let's have a look on
cooperating process.

Independent Process: Independent processes are those processes whose task is not dependent on any other processes.

Cooperating Process: Cooperating processes are those processes that depend on other processes & processes. They work together to achieve a common task in an operating system.

These processes interact with each other by sharing the resources such as CPU, memory and I/O devices to complete the task.