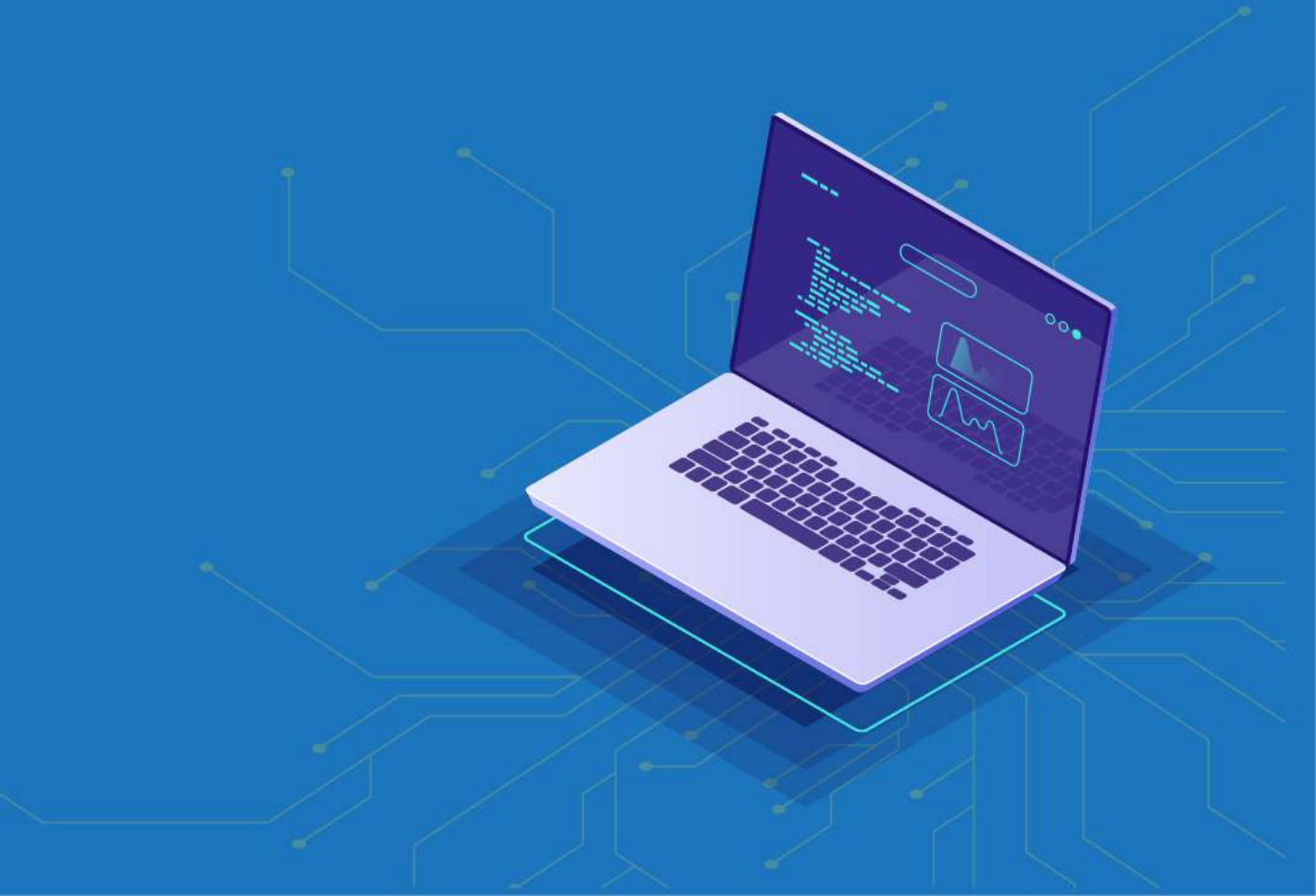
Swipe >>>

Operating System



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OPERATING SYSTEM #1 **Introduction to OS**

1. An operating system (OS) is a collection of software that manages computer hardware resources and provides common services for computer programs.

2. An operating system can perform basic tasks like :

- File Management
- Process Management
- Memory Management
- Handling Input and Output
- Controlling Peripheral Devices

3. Some Common Operating Systems are :

 Windows OS

 Android OS

 Linux OS

 Apple OS

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OPERATING SYSTEM #2 Applications of OS

Security :
By means of password and similar other techniques, it prevents unauthorized access to programs and data.

Control over system performance :
Recording delays between request for a service and response from the systems.

Job accounting :
Keeping track of time and resources used by various jobs and users.

Error detecting aids :
Production of dumps, traces, error messages, and other debugging and error detecting aids.

Coordination between softwares and users :
Coordination and assignment of compilers, interpreters, assemblers and other software to the various users of the computer systems.

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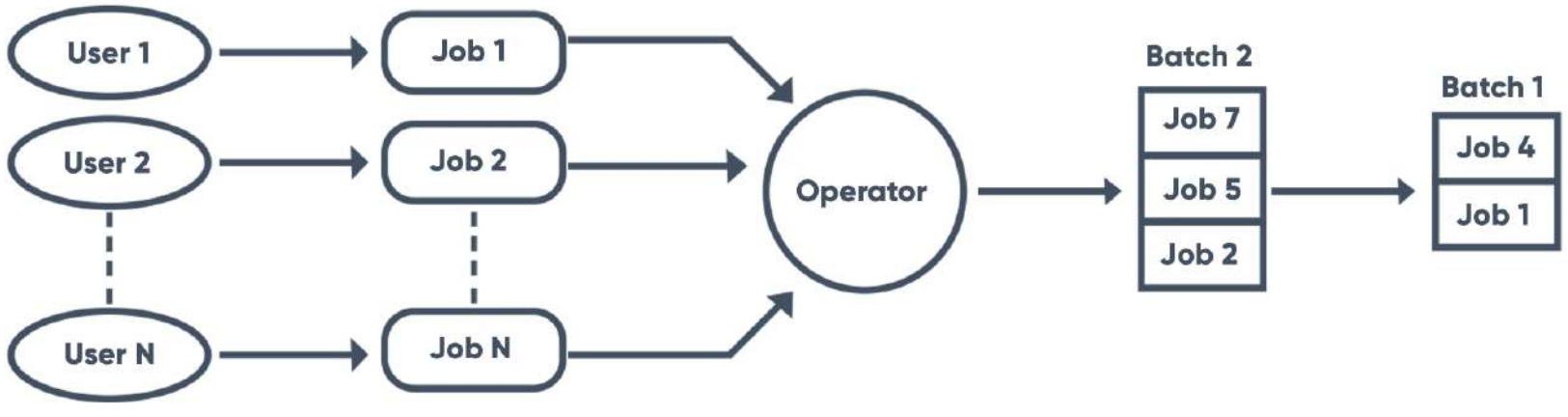
OPERATING SYSTEM #3 **Types Of OS**

The Operating System is broadly categorised into five different types. They are:

- Batch operating system
- Time-Sharing operating system
- Distributed operating system
- Network operating system
- Real-Time operating system

1. Batch operating system :

Batch operating system does not interact with the computer directly. There is an operator which takes similar jobs having the same requirement and group them into batches.



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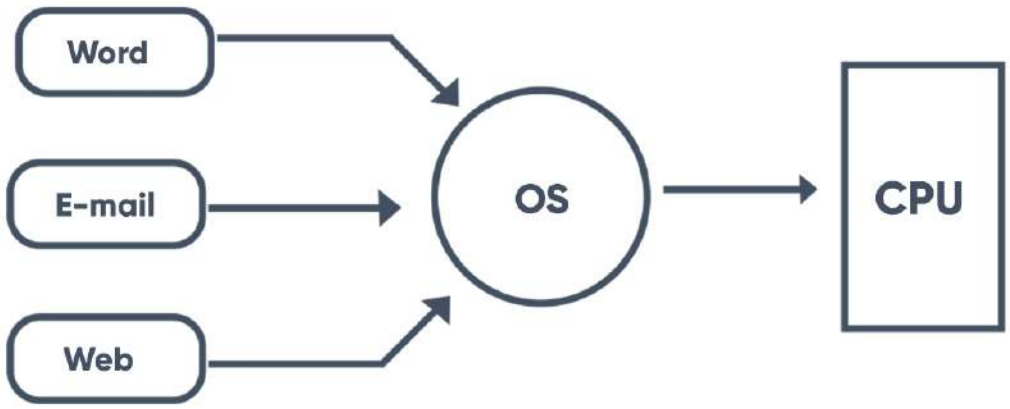
OPERATING SYSTEM #4 **Types Of OS**

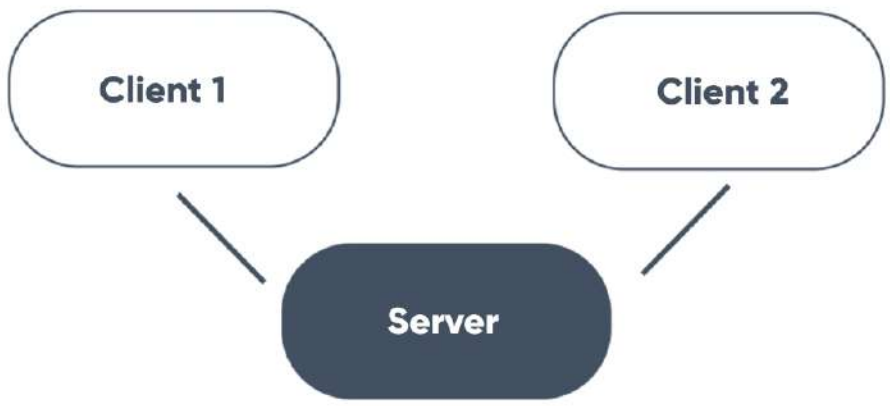
2. Time-Sharing Operating Systems :

Each task is given some time to execute so that all the tasks work smoothly and gets the time of CPU as they use a single system. This is also known as Multitasking Systems.



3. Network Operating System :

This type of OS runs on a server and provides the server the capability to manage data, users, security, applications, and other functions.



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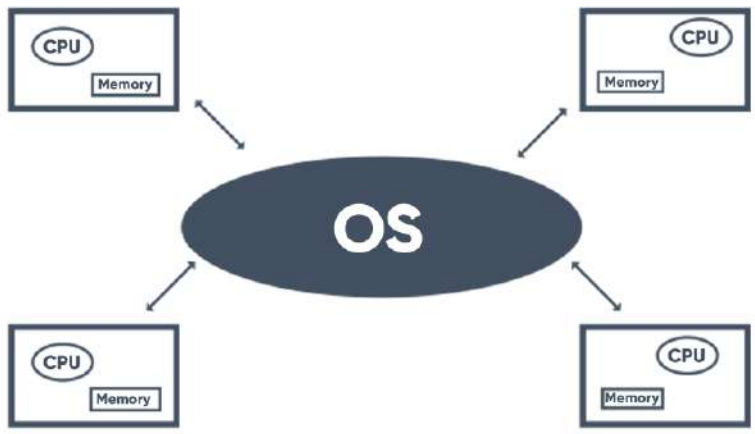
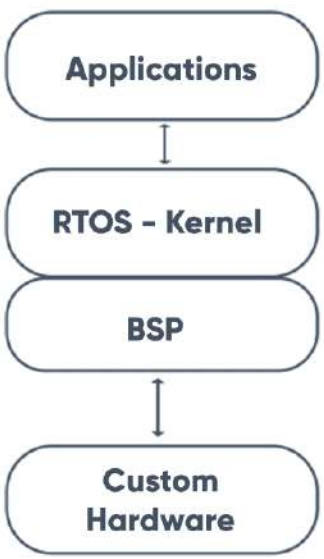
OPERATING SYSTEM #5 **Types Of OS**

4. Distributed Operating System :

Distributed systems use multiple central processors to serve multiple real-time applications and multiple users.



5. Real-Time Operating System :



These types of OS serve real-time systems. RTOS are used when there are time requirements that are very strict.

Examples:

I. Air Traffic Control Systems

II. Networked Multimedia Systems

III. Command Control Systems

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OPERATING SYSTEM #6 **OS Services**

An Operating System provides services to both the users and to the programs. Some Common Services provided by OS are :

1. Program execution :

- Loads and execute a program into memory.
- Handles program's execution.
- Provides a mechanism for synchronization and communication

2. I/O Operation :

- I/O operation means read or write operation with any file or any specific I/O device.
- The OS provides the access to the required I/O device when required.

3. File system manipulation :

- File handling portion of operating system allows users to create and delete files by specific name along withextension, search for a given file and / or list file information.

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OPERATING SYSTEM #7 **OS Services**

4. Communication System :

- Processes executing on same computer system or on different computer systems can communicate using operating system support.

5. Error handling :

- The OS constantly checks for possible errors.
- It takes an appropriate action to ensure correct and consistent computing.

6. Resource Management :

- The OS manages all kinds of resources using schedulers.
- CPU scheduling algorithms are used for better utilization of CPU.

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OPERATING SYSTEM #8 **OS Services**

7. Protection :

- The OS ensures that all access to system resources is controlled.
- The OS ensures that external I/O devices are protected from invalid access attempts.
- The OS provides authentication features for each user by means of passwords.

8. Accounting :

- This service of the operating system keeps track of which users are using how much and what kinds of computer resources have been used for accounting or simply to accumulate usage statistics.

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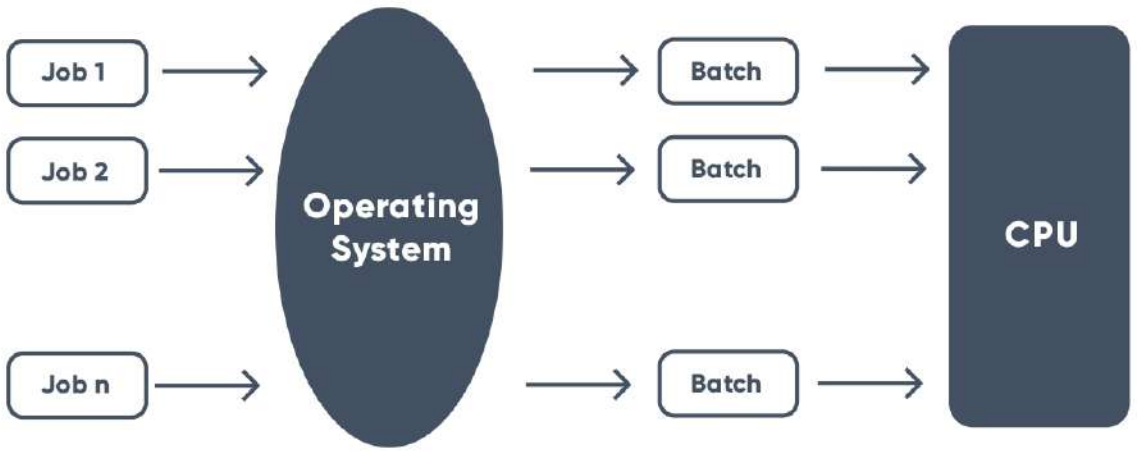
OPERATING SYSTEM #9 **OS Properties**

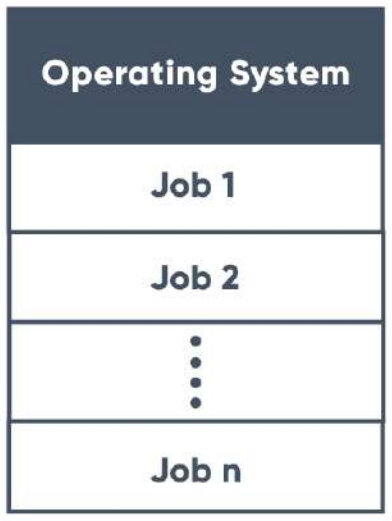
1. Batch processing :

- The OS identifies a job or sets of jobs that are further assigned to a sequence of commands, programs, and data within a single unit.
- Most of the jobs in OS are processed in the order they have been submitted, i.e., first come first serve (FCFS) manner.



2. Multiprogramming :

- Sharing the processor, when multiple programs reside in memory at a single time, is termed as multi-programming.
- This concept is implemented to amplify CPU utilization.



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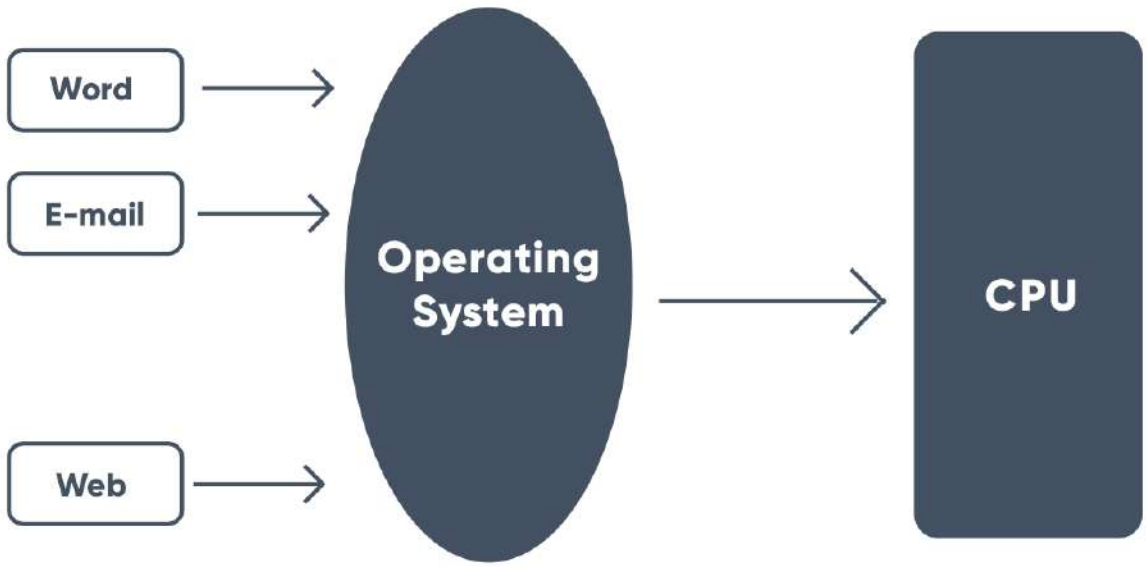
OPERATING SYSTEM #10 **OS Properties**

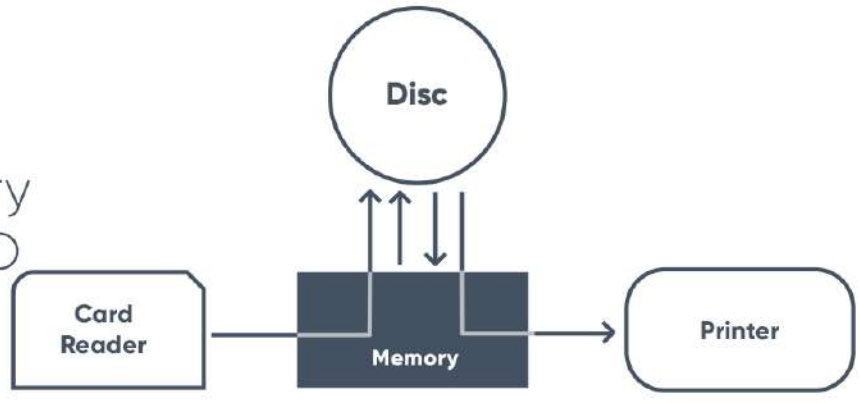
3. Multitasking :

- Multitasking is when multiple jobs are executed by the CPU simultaneously by switching between them.
- The OS used for multitasking is called as Time-sharing systems.



4. Spooling :

- Spooling means to put data of various I/O jobs in a buffer.
- This buffer is a special area in memory or hard disk which is accessible to I/O devices.



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OPERATING SYSTEM #11 **Process Life Cycle**

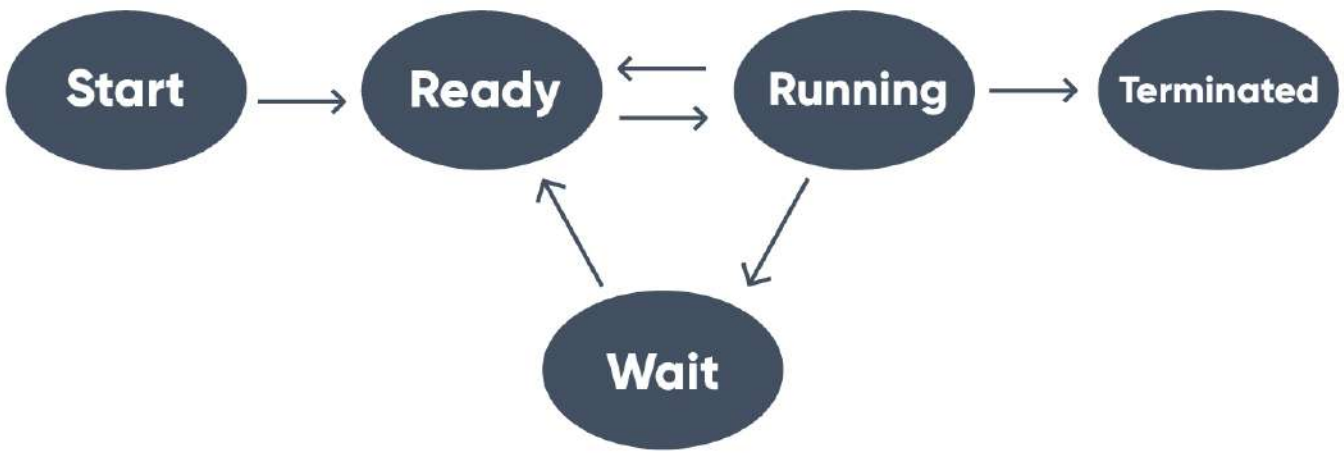
Start : This is the initial state when a process is first started/created.

Ready : Ready processes are waiting to have the processor allocated to them by the operating system so that they can run.

Running : Once the process has been assigned to a processor by the OS scheduler, the process state is set to running and the processor executes its instructions.

Waiting : Process moves into the waiting state if it needs to wait for a resource.

Terminated : Once the process executed or it is terminated, it is moved to the terminated state where it waits to be removed from main memory.



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OPERATING SYSTEM #12 **Process Control Block**

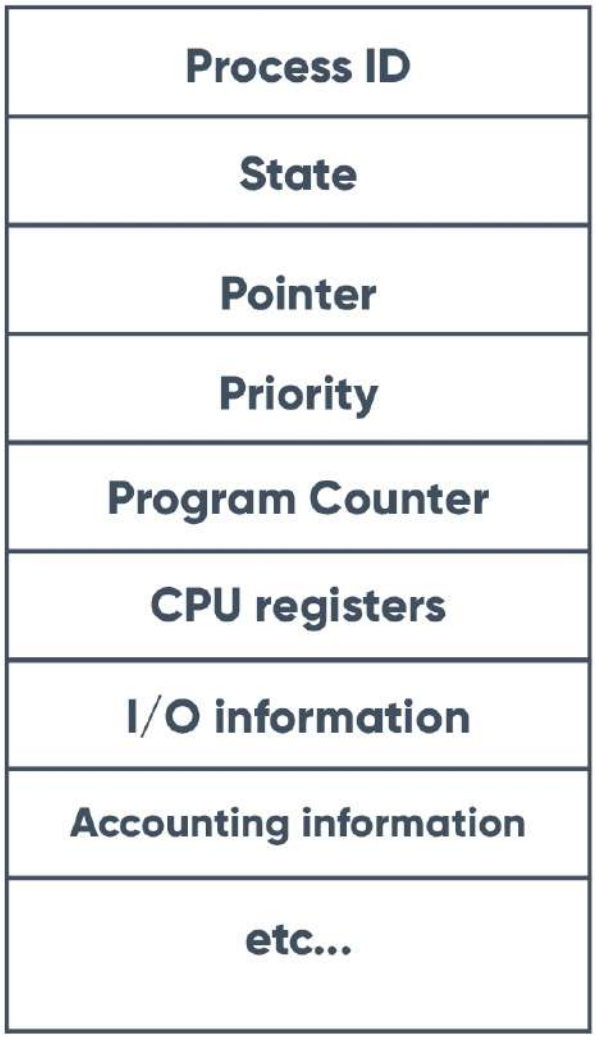
Process State :
Current state of the Process is called Proess State.

Process privileges :
It is required to allow/disallow access to system resources.

Process ID :
Unique identification for each of the process in the operating system.

Pointer :
A pointer to parent process.

Program Counter :
Program Counter is a pointer to the address of the next instruction to be executed of the process.



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OPERATING SYSTEM #13 **Process Control Block**

CPU registers :

CPU registers are places where process need to be stored for execution for running state.

CPU Scheduling Information :

Process priority and scheduling information which is required to schedule the process.

Memory management information :

This includes the information of page table, memory limits, Segment table depending on memory used by the operating system.

Accounting information :

This includes the amount of CPU used for process execution, time limits, execution ID etc.

I/O status information :

This includes a list of I/O devices allocated to the process.

Process ID
State
Pointer
Priority
Program Counter
CPU registers
I/O information
Accounting information
etc...

COMPUTER SCIENCE FUNDAMENTALS

OPERATING SYSTEM #14 Process Scheduling Queues

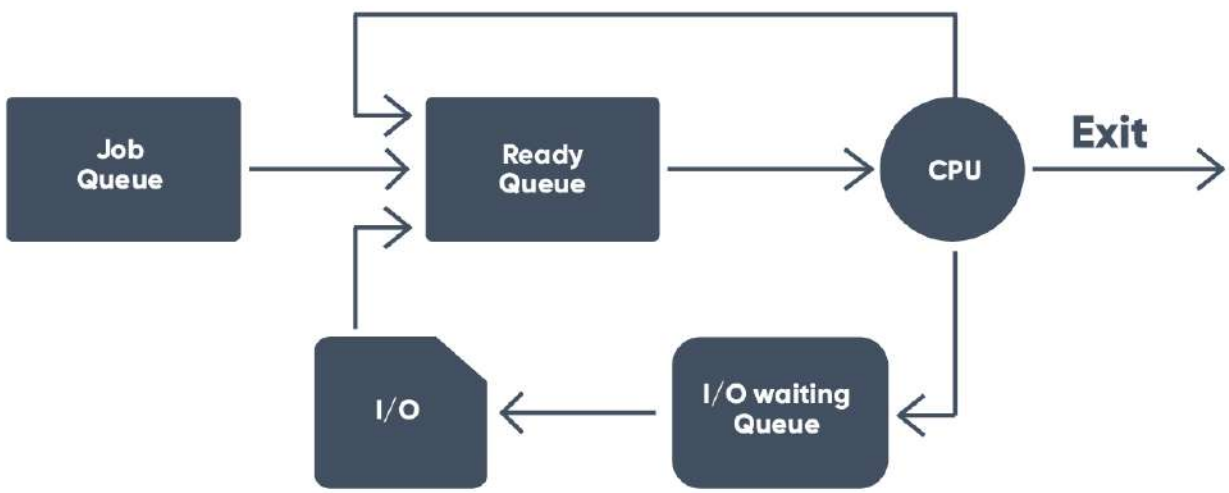
Operating System maintains a separate queue for each of the process states and PCBs of all processes in the same execution state are placed in the same queue.

The Operating System maintains the following important process scheduling queues –

Job queue : This queue keeps all the processes in the system.

Ready queue : This queue keeps a set of all processes residing in main memory, ready and waiting to execute.

Device queue : The processes which are blocked due to unavailability of an I/O device constitute this queue.



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OPERATING SYSTEM #15 **OS Schedulers**

Schedulers are special system software which handle process scheduling in various ways. Schedulers are of three types –

1.Long Term Scheduler :

- A long-term scheduler determines which programs are admitted to the system for processing.
- It is also called a job scheduler.

2.Short Term Scheduler :

- The main objective of Short term scheduler is to increase system performance in accordance with the chosen set of criteria.
- It is also called a CPU scheduler.

3.Medium Term Scheduler :

- The Medium term scheduler removes the processes from the memory and reduces the degree of multiprogramming.
- It is a part of Swapping.

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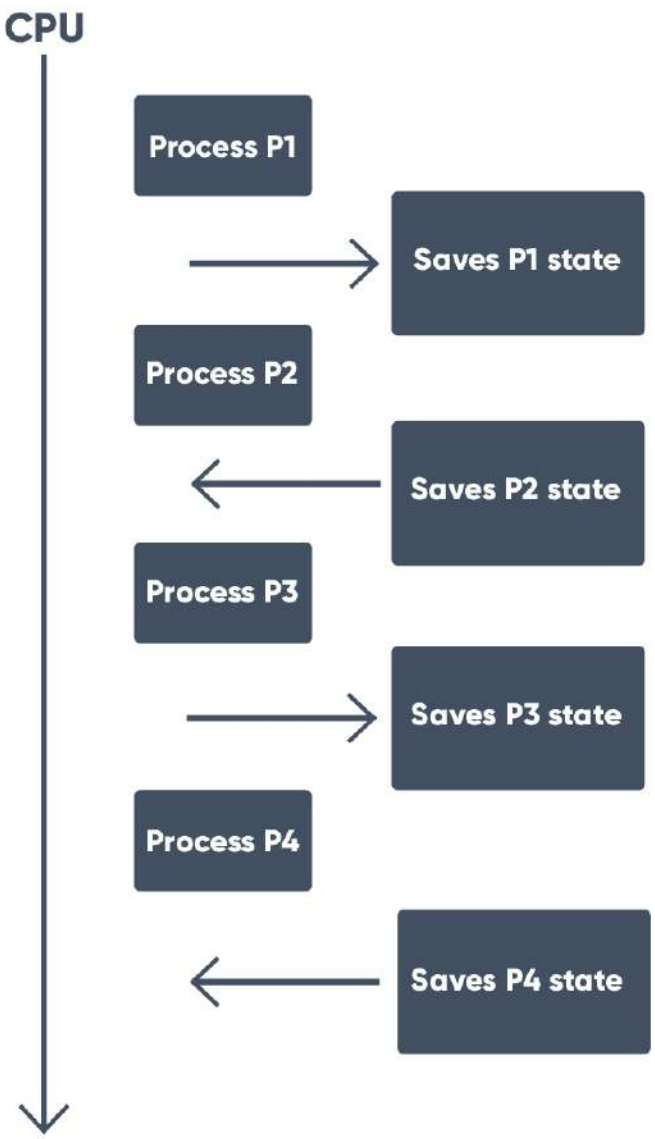
OPERATING SYSTEM #16 Context Switch

- A context switch is the mechanism to store and restore the state of a CPU in Process Control block.
- It is an essential part of a multitasking operating system features.
- When the scheduler switches from one process to another, the state from the current process is stored into the PCB.
- In order to avoid context switching time, some hardware systems employ two or more set of processor registers.



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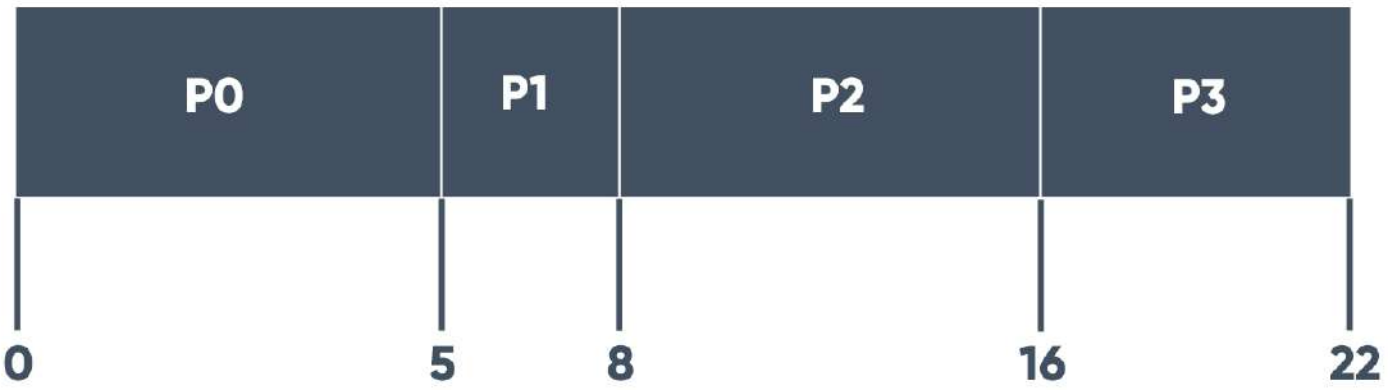
OPERATING SYSTEM #17 **Scheduling Algorithms**

1.First Come First Serve (FCFS) :

- Jobs are executed on first come, first serve basis.
- It is a non-preemptive, pre-emptive scheduling algorithm.
- The performance is poor as average wait time is high.



2.Shortest Job Next (SJN) :

- This is also known as shortest job first, or SJF
- It is a non-preemptive, pre-emptive scheduling algorithm.
- It is the best approach to minimize waiting time and implemented when CPU time is known in advance.

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OPERATING SYSTEM #18 **Scheduling Algorithms**

3.Priority Based Scheduling :

- Priority scheduling is a non-preemptive algorithm and one of the most common scheduling algorithms.
- Process with highest priority is to be executed first and so on.
- Processes with same priority are executed on first come first served basis.

4.Shortest Remaining Time(SRT) :

- It is the preemptive version of the SJN algorithm.
- The processor is allocated to the job closest to completion but it can be preempted by a newer ready job with shorter time to completion.
- It is impossible to implement in interactive systems having unknown CPU time.

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OPERATING SYSTEM #19 **Scheduling Algorithms**

5.Round Robin Scheduling :

- Round Robin is the preemptive process scheduling algorithm.
- Each process is provided a fix time to execute,called quantum.
- When the process is executed for a time period, it is pre-empted and other process executes for a given time period.

6.Multiple-Level Queues Scheduling :

- Multiple-level queues depends on other Scheduling algorithms
- Multiple queues are maintained for processes with common characteristics.
- Each queue can have its own scheduling algorithms and priority.

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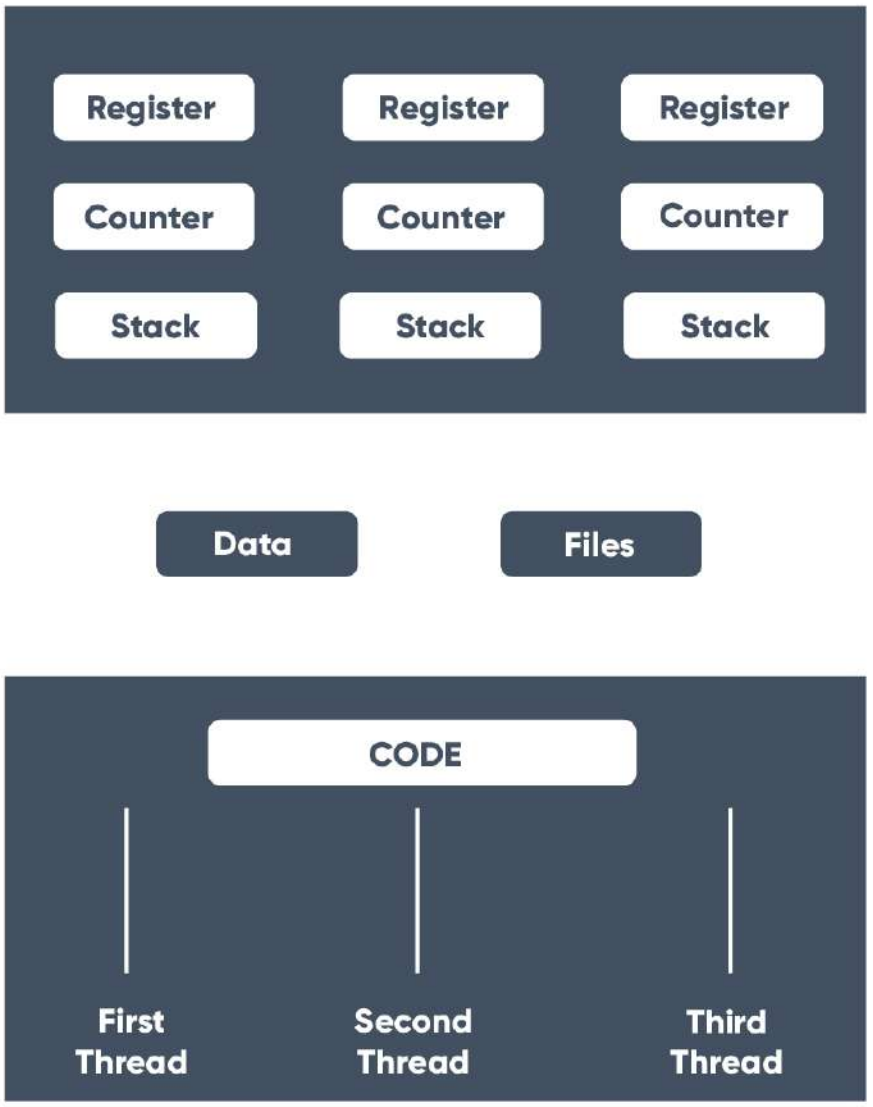
OPERATING SYSTEM #20 Thread

A thread is a path of execution within a process.
A process can contain multiple threads.



Advantages :

- It minimize the context switching time.algorithm.
- Use of threads provides concurrency within a process.
- It is more economical to create and context switch threads.
- It is used in efficient communication.

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OPERATING SYSTEM #21 **Types of Thread**

Threads are implemented in following two ways :

1.User Level Threads :

- In this level of threading, the thread management kernel is not aware of the existence of threads.
- These can run on any OS.
- User level threads are fast to create and manage.

2.Kernel Level Threads :

- Kernel can simultaneously schedule multiple threads from the same process on multiple processes.
- Kernel threads are supported directly by the OS.
- Kernel routines themselves can be multithreaded.

COMPUTER SCIENCE FUNDAMENTALS

OPERATING SYSTEM #22 **Process VS Thread**

Processor

- Process is heavy weight or resource intensive.
- Process switching needs interaction with operating system.
- Multiple processes without using threads use more resources.
- In multiple processes each process operates independent of the others.

Thread

- Thread is light weight, taking lesser resources than a process.
- Process switching does not needs interaction with operating system.
- Multiple threaded processes use fewer resources.
- One thread can read, write or change another thread's data

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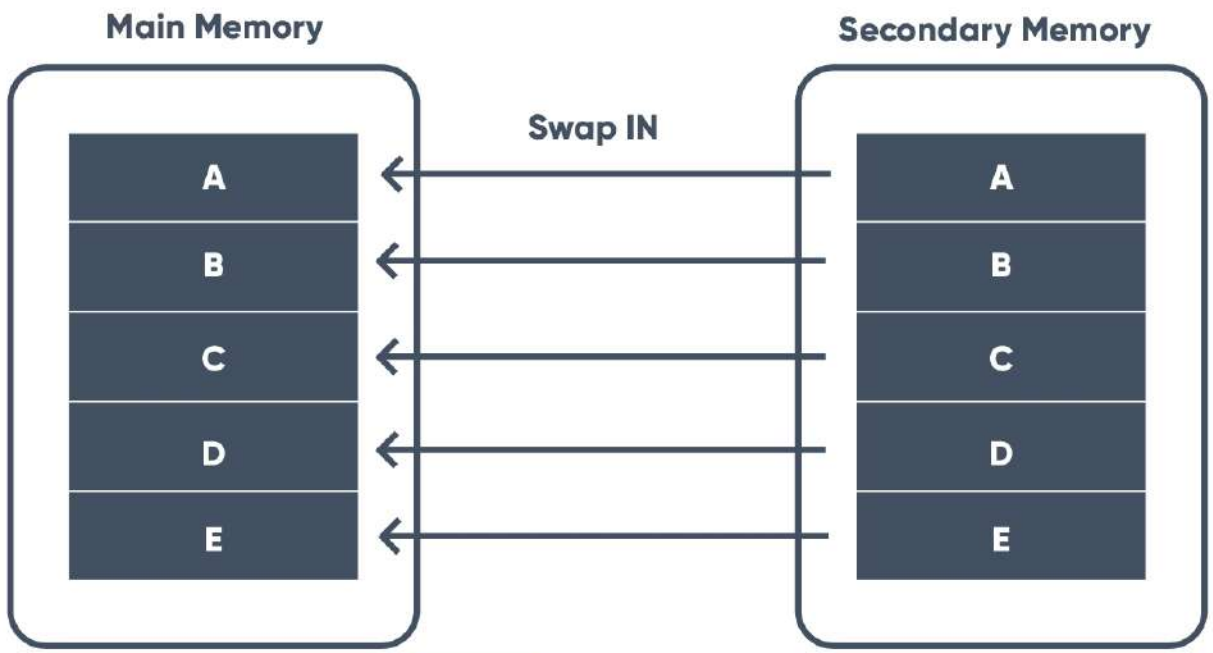
OPERATING SYSTEM #24 **Virtual Memory**

- A computer can address more memory than the amount physically installed on the system which is called virtual memory.
- Virtual memory is commonly implemented by **demand paging**, **segmentation system**, **Demand segmentation**.

Demand Paging :

A demand paging system is quite similar to a paging system with swapping where processes reside in secondary memory and pages are loaded only on demand, not in advance.



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OPERATING SYSTEM #25 Page Replacement Algorithm

- Page replacement algorithms are the techniques using which an OS decides which memory pages to swap out.
- **First In First Out (FIFO) algorithm:** Oldest page in main memory is the one which will be selected for replacement.
- **Optimal Page algorithm:** It has the lowest page-fault rate of all algorithms.
- **Least Recently Used (LRU) algorithm:** Page which has not been used for the longest time in main memory is the one which will be selected for replacement.
- **Least frequently Used(LFU) algorithm:** The page with the smallest count is the one which will be selected for replacement.
- **Most frequently Used(LFU) algorithm:** This algorithm is based on the argument that the page with the smallest count was probably just brought in and has yet to be used.

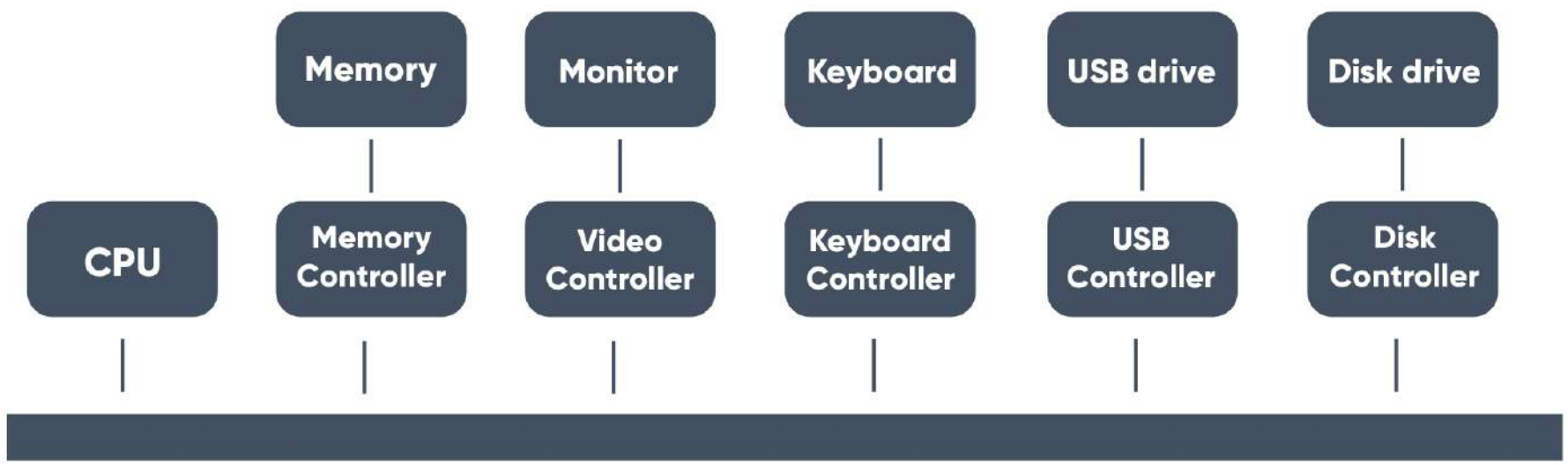
COMPUTER SCIENCE FUNDAMENTALS

OPERATING SYSTEM #26 **I/O Hardware**

- An I/O system is required to take an application I/O request and send it to the physical device.
- **Block devices:** A block device is one with which the driver communicates by sending entire blocks of data.
- **Character devices:** A character device is one with which communicates by sending and receiving single characters.

Device Controllers :

- Operating System takes help from device drivers to handle all I/O devices.



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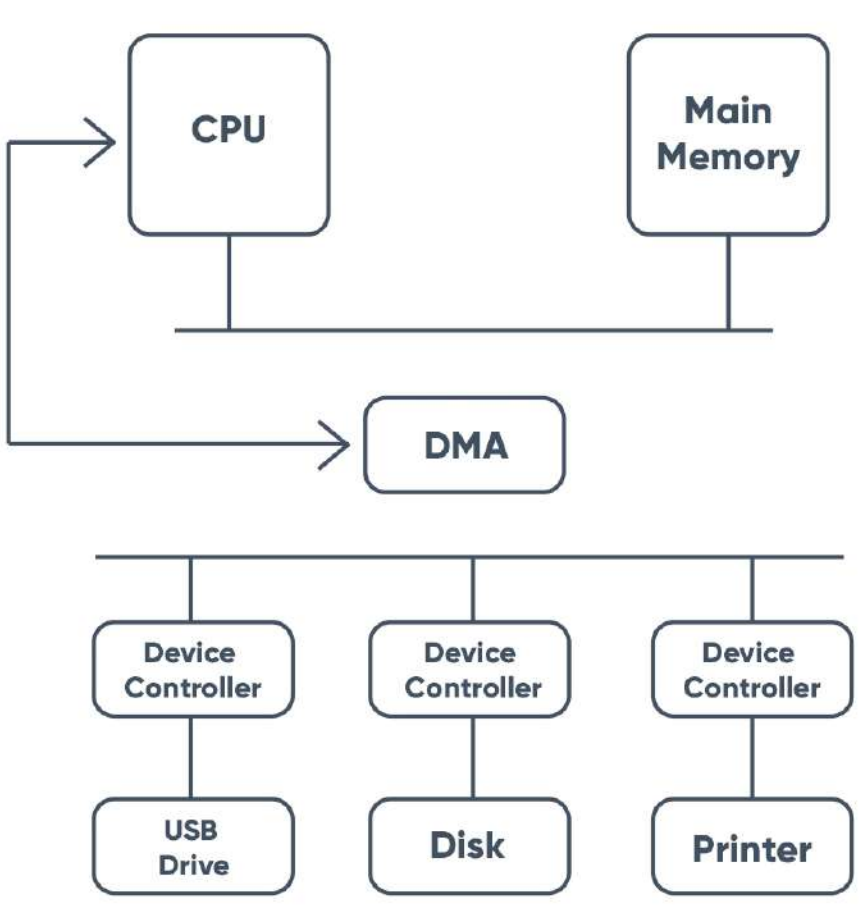
OPERATING SYSTEM #27 **I/O Hardware**

Communication to I/O Devices :

- **Special Instruction I/O :** These instructions typically allow data to be sent to an I/O device or read from an I/O device.
- **Memory-mapped I/O :** When using memory-mapped I/O, the same address space is shared by memory and I/O devices.

Direct Memory Access (DMA) :

- Direct Memory Access (DMA) means CPU grants I/O module authority to read from or write to memory without involvement.
- Direct Memory Access needs a special hardware called DMA controller (DMAC) that manages the data transfers.



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OPERATING SYSTEM #28 **Polling vs Interrupts I/O**

Polling I/O :

- Polling is the simplest way for an I/O device to communicate with the processor.
- The I/O device simply puts the information in a Status register, and the processor must come and get the information.
- This is an inefficient method and much of the processors time is wasted on unnecessary polls.

Interrupts I/O :

- An interrupt is a signal to the microprocessor from a device that requires attention.
- When the interrupting device has been dealt with, the CPU continues with its original task as if it had never been interrupted.

COMPUTER SCIENCE FUNDAMENTALS

OPERATING SYSTEM #29 I/O Softwares

I/O software is often organized in the following layers –

- **User Level Libraries:** This provides simple interface to the user program to perform input and output.
- **Kernel Level Modules:** This provides device driver to interact with the device controller.
- **Hardware:** This layer includes actual hardware and hardware controller.

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OPERATING SYSTEM #30 **I/O Softwares**

Device Drivers:

- It accepts request from the device independent software above to it.
- It Interacts with the device controller to take and give I/O and perform required error handling

Interrupt handlers:

- It is a callback function in a device driver, whose execution is triggered by the reception of an interrupt.
- The interrupt mechanism accepts a number that selects a specific interrupt handling routine/function from a small set.

Device-Independent I/O Software:

- The basic function of the device-independent software is to perform the I/O functions that are common to all devices and to provide a uniform interface to the user-level software.

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OPERATING SYSTEM #31 **I/O Softwares**

Kernel I/O Subsystem:

- **Scheduling:** It schedules a set of I/O requests to determine a good order in which to execute them.
- **Buffering:** It maintains a memory area known as buffer that stores data while they are transferred between two devices or between a device with an application operation.
- **Caching:** It maintains cache memory which is region of fast memory that holds copies of data
- **Error Handling:** An OS that uses protected memory can guard against many kinds of hardware and application errors.
- **Spooling and Device Reservation:** A spool is a buffer that holds output for a device, that cannot accept interleaved data streams.

COMPUTER SCIENCE FUNDAMENTALS

OPERATING SYSTEM #32 File System

File Structure :

- A file has a certain defined structure according to its type.
- An object file is a sequence of bytes organized into blocks that are understandable by the machine.
- The OS contains the code to support these file structure.

File Type :

- **Ordinary files :**These are the files that contain user information.
- **Directory files :**These files contain list of file names and other information.
- **Special files :**These files represent physical device like disks, terminals, printers,etc.
- **Character special files -** data is handled character by character as in case of terminals or printers.
- **Block special files -** data is handled in blocks as in the case of disks and tapes.

COMPUTER SCIENCE FUNDAMENTALS

OPERATING SYSTEM #33 **Security**

Authentication :

- Authentication refers to identifying each user of the system and associating the executing programs with those users.
- **Username / Password :** User need to enter a registered user-name and password with OS to login into the system.
- **User card/key :** User need to punch card in card slot, or enter key generated by key generator with OS to login into the system.
- **User attribute :** User need to pass his/her attribute with OS to login into the system.

One Time passwords :

- One-time passwords provide additional security along with normal authentication.
- OTP is a unique password is required every time user tries to login into the system.

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OPERATING SYSTEM #34 **Security**

Program Threats :

- If a user program made these process do malicious tasks, then it is known as Program Threats.
- **Trojan Horse :** It traps user login credentials and stores them to send to malicious user
- **Trap Door :** A security hole in its code and perform illegal action.
- **Virus :** They are highly dangerous and can modify/delete user files, crash systems.

System Threats :

- System threats refers to misuse of system services and network connections to put user in trouble.
- **Worm :** Worm is a process which can choked down a system performance.
- **Port Scanning :** Port scanning is a mechanism or means by which a hacker can detects system vulnerabilities.

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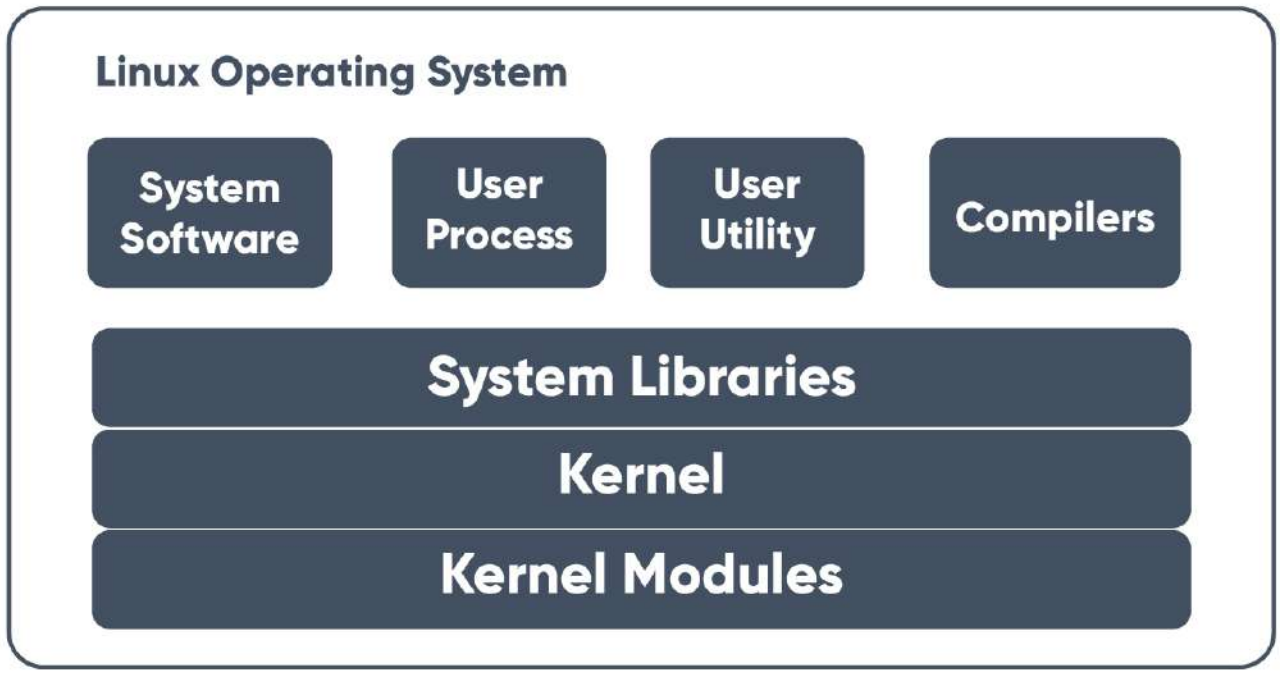
OPERATING SYSTEM #35 **Linux**

Linux is one of popular version of UNIX operating System. It is open source as its source code is freely available. It has 3 components:

- **Kernel:** It is responsible for all major activities of this operating system.
- **System Library:** These are special functions using which application or system utilities accesses Kernel's features.
- **System Utility:** System Utility programs are responsible to do specialized, individual level tasks.



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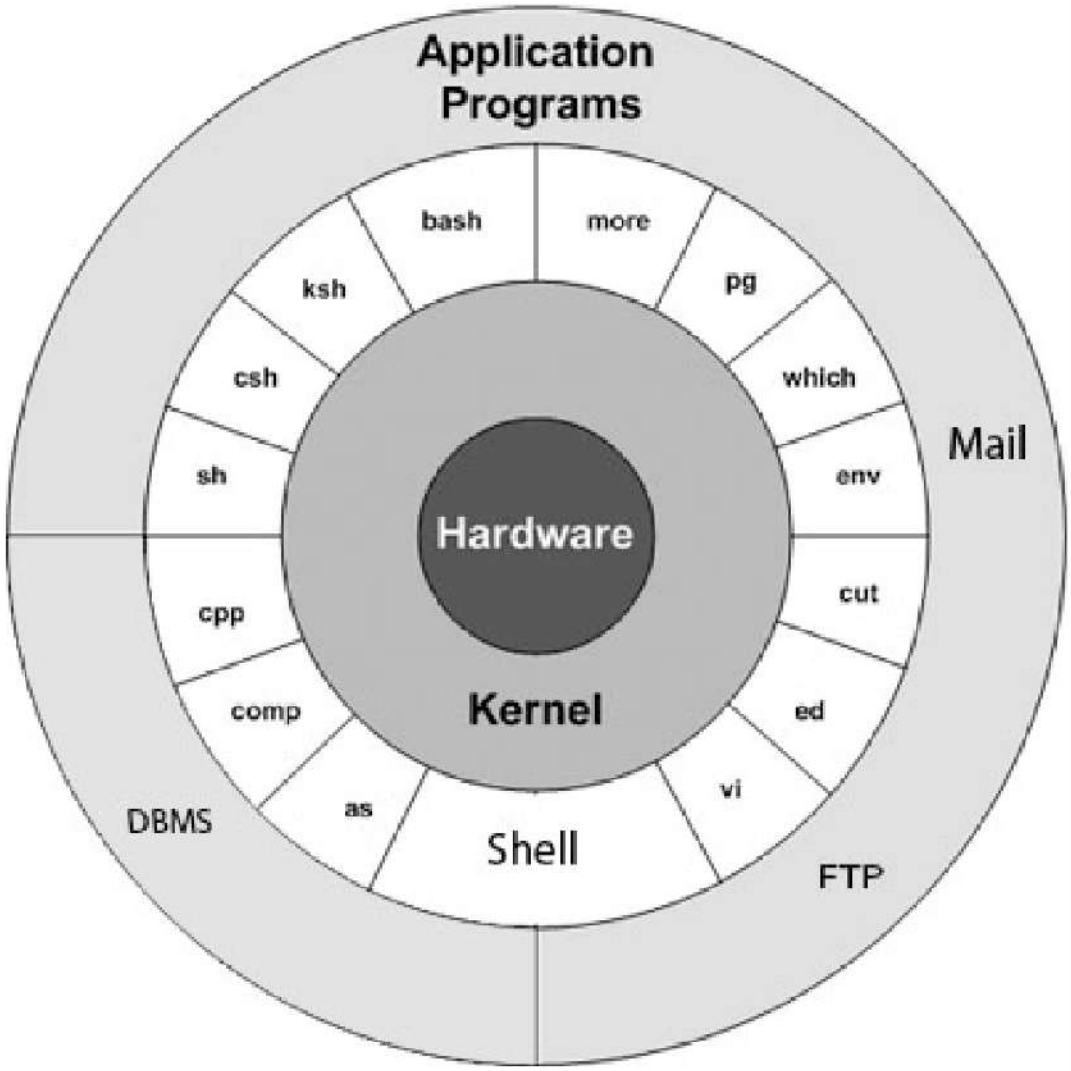
OPERATING SYSTEM #36 **Architecture of Linux**

- **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.

- **Shell:** It is an interface to kernel, hiding complexity of kernel's functions from users.

- **Utilities:** Utility programs that provide the user most of the functionalities of an operating systems.



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