Module1: Operating system overview

Q1:What is an Operating system?

Ans: An operating system is a program that manages the computer hardware.It also provides a basis for application programs and acts as an intermediary between the computer user and the computer hardware.

Q2: What are the main objectives of the operating system?

Ans:

The main objectives of the operating system are as follows: ● To make the computer system convenient to use in an efficient manner. ● To hide the details of the hardware resources from the users. ● To provide users a convenient interface to use the computer system. ● To act as an intermediary between the hardware and its users, making it easier for the users to access and use other resources.

● To manage the resources of a computer system.

● To keep track of who is using which resource, granting resource requests, and mediating conflicting requests from different programs and users. ● To provide efficient and fair sharing of resources among users and programs.

Q3: Discuss the functions of the Operating System.

Ans:

Functions of the operating system:

i) Memory Management

ii)Processor Management/Scheduling

iii) Device Management

iv) File Management

v)Security

vi)Accounting

vii)Other functions

i)Memory Management: It is the management of the main or primary memory.

ii)Processor Management/Scheduling: When more than one process runs on the system the OS decides how and when a process will use the CPU. Hence, the name is also CPU Scheduling.

iii)Device Management: Device management in an operating system means controlling the Input/Output devices like disk, microphone, keyboard, printer, magnetic tape, USB ports, camcorder, scanner, other accessories, and supporting units like supporting units control channels.

iv)File Management: A file management system is used for file maintenance (or management) operations.

v)Security: The term operating system (OS) security refers to practices and measures that can ensure the confidentiality, integrity, and availability (CIA) of operating systems.

vi)Accounting: The operating system keeps track of all the functions of a computer system. Hence, it makes a record of all the activities taking place on the system.

vii)Other functions: Some other functions of the OS can be:

- Error detection.
- keeping a record of system performance.
- Communication between different software etc.

Q4: Explain the various evolution of operating systems.

Ans:

The various evolution of an operating system are given below:

i)Serial Processing: It was developed from 1940 to 1950's programmers

incorporated the hardware components without the implementation of the operating system.

ii)Batch Processing: It is used by improving the utilization and application of computers. Jobs were scheduled and submitted on cards and tapes. Then sequentially executed on the monitors by using Job Control Language.

iii)Multiprogramming: Multiprogramming is a technique to execute a number of programs simultaneously by a single processor. In multiprogramming, a number of processes reside in the main memory at a time.

iv)Time-Sharing System: Time-sharing or multitasking is a logical extension of multiprogramming. Multiple jobs are executed by the CPU switching between **v)Parallel System:** There is a trend of multiprocessor systems, such systems having more than one processor in close communication, sharing the computer bus, the clock, and sometimes memory and peripheral devices. **vi)Distributed System:** In a distributed operating system, the processors cannot share a memory or a clock, each processor has its own local memory.

Q5: Classify the operating system based on structure.

Ans:

i)Simple structure: Such operating systems do not have a well-defined structure and are small, simple, and limited systems.

ii)Layered structure: The layered structure approach breaks up the operating system into different layers and retains much more control on the system. The bottom layer (layer 0) is the hardware, and the topmost layer (layer N) is the user interface.

iii)Micro-kernel: This structure designs the operating system by removing all non-essential components from the kernel and implementing them as system and user programs. This results in a smaller kernel called the micro-kernel.

iv)Monolithic Approach: Functionality of the OS is invoked with simple function calls within the kernel, which is one large program.

Q6: What is Linux Kernel?

Ans: The Linux kernel is the main component of a Linux operating system (OS) and is the core interface between a computer's hardware and its processes. It communicates between the two, managing resources as efficiently as possible.

Q7: What are the core subsystems of the Linux kernel?

Ans:

The Core Subsystems of the Linux Kernel are as follows:

- The Process Scheduler
- The Memory Management Unit (MMU)
- The Virtual File System (VFS)
- The Networking Unit
- Inter-Process Communication Unit

Q9:Define System calls.

Ans: A system call is a routine that allows a user application to request actions that require special privileges. Adding system calls is one of several ways to extend the functions provided by the kernel.

Q10:What are the categories of System calls?

Ans:

The followings are the main categories of System calls:

i) Process Control: A running program needs to be able to stop execution either normally or abnormally. When execution is stopped abnormally, often a dump of memory is taken and can be examined with a debugger.

ii)File Management: Some common system calls are created, delete, read, write, reposition, or closed. Also, there is a need to determine the file attributes – get and set file attributes. Many times the OS provides an API to make these system calls.

iii)Device Management: Processes usually require several resources to execute, if these resources are available, they will be granted and control returned to the user process.

iv)Information Management: Some system calls exist purely for transferring information between the user program and the operating system. An example of this is time or date.

v)Communication: There are two models of interprocess communication, the message-passing model and the shared memory model.

- Message-passing uses a common mailbox to pass messages between processes.
- Shared memory uses certain system calls to create and gain access to create and gain access to regions of memory owned by other processes. The two processes exchange information by reading and writing in the shared data.

Q11:What are the system calls used in OS?

Ans: **There are the following system calls used in OS:**

i)wait()

ii)fork()

iii)exec()

iv)kill()

v)exit()

Q12: What is the function of fork()?

Ans: Processes use fork() system call to create processes that are a copy of themselves. With the help of this system Call parent process creates a child process, and the execution of the parent process will be suspended till the child process executes.

Q13:What is kernel?

Ans: The kernel is a core component of an operating system and serves as the main interface between the computer's physical hardware and the processes running on it. The kernel enables multiple applications to share hardware resources by providing access to CPU, memory, disk I/O, and networking.

Q14:What are User Mode and Kernel Mode?

Ans:

User Mode: In User mode, the executing code has no ability to directly access hardware or reference memory. Code running in user mode must delegate to system APIs to access hardware or memory. Due to the protection afforded by this sort of isolation, crashes in user mode are always recoverable. Most of the code running on our computer will execute in user mode.

Kernel Mode: In Kernel mode, the executing code has complete and unrestricted

access to the underlying hardware. It can execute any CPU instruction and reference any memory address. Kernel mode is generally reserved for the lowest-level, most trusted functions of the operating system. Crashes in kernel mode are catastrophic; they will halt the entire PC.

Module 2: Process and process scheduling

Q1: What is a Program?

Ans: A program is a set of instructions that a computer uses to perform a specific function.

Q2: What is Process?

Ans: A process can be thought of as a program in execution. A process needs certain resources such as CPU time, memory, files, and I/O devices to accomplish its task. These resources are allocated to the process either when it is created or while it is executing.

Q3: What are the basic differences between Program and a process?

Ans:

Program	Process
1. A program is a set of instructions.	1. When a program is executed, it is known as a process.
2. Program is a passive entity, such as a file containing a list of instructions stored on a disk often called an executable file.	2. Process is an active entity, with a program counter specifying the next instruction to execute and a set of associated resources.

3. The program is stored on a disk in some files and does not require any other resources.	3. Process holds resources such as CPU, memory address, disk, I/O, etc.
4. Lifespan is longer.	4. Lifespan is limited.

Q4. What are the states of the process?

Ans:

States of the process:

a)New

b)Ready

c)Running

d)Waiting

e)Terminated

a)New: A program that is going to be picked up by the OS into the main memory is called a new process.

b)Ready: The process is now prepared to execute when given the opportunity.

c)Running: The process is currently being executed.

d)Waiting: From the Running state, a process can make the transition to the block or wait for state depending upon the scheduling algorithm or the intrinsic behavior of the process.

e)Terminated: When a process finishes its execution, it comes in the termination state.

Q5: What is PCB?

Ans: PCB refers to Process Control Block.

The process control block represents a process in the operating system. A PCB is also known as a task control block. It's a repository of information associated with a specific process.

Q6: What are the components of the Process Control Block?

Ans: PCB includes:

i)Process state: The state may be new, ready, running, waiting, halted and so on.

ii)Program counter: The counter indicates the address of the next instruction to be executed for this process.

iii)CPU registers: The registers vary in number and type, depending on the computer architecture. They include accumulators, index registers, stack pointers, and general-purpose registers, plus any condition-code information.

iv)CPU-scheduling information: This information includes a process priority, pointers to scheduling queues, and any other scheduling parameters.

v)Memory-management information: This information may include such information as the value of the base and limit registers, the page tables, or the segment tables, depending on the memory system used by the operating system.

vi)Accounting information: This information includes the amount of CPU and real-time used, time limits, account numbers, job or process numbers, and so on.

vii)I/O status information: This information includes the list of I/O devices allocated to the process, a list of open files, and so on.

Q7: What are the differences between Multiprogramming and Multitasking?

Ans:

Multiprogramming	Multitasking
1.In a Multiprogramming system, one or more programs are loaded in the main Memory which is ready to execute simultaneously.	1.Multitasking refers to execute multiple programs, tasks, threads running at the same time

2.The multiprogramming objective is to improve the utilization of the CPU.	2.The multitasking objective is to improve the timing of the response.
3.Multiprogramming takes more time to execute any program to process	3.Multitasking takes less time to execute any task or program process.
4.Multiprogramming is implemented by using the concept of context switching	4.Multitasking is implemented by using the concept of time-sharing.
5.Multiprogramming is more expensive.	5.Multitasking is less expensive.

Q8: What is a Scheduler? What are the types of Scheduler? Ans:

Schedulers in OS are special system software. They help in scheduling the processes in various ways. They are mainly responsible for selecting the jobs to be submitted into the system and deciding which process to run.

Types of Scheduler:

i)Long-term scheduler

ii)Short-term scheduler

iii)Medium-term scheduler

Q9: Compare Long-term, Short-term and Medium-term schedulers.

Ans:

Long-term	**Short-term Medium-term**
It is a job scheduler.	It is a CPU scheduler. It is swapping.
Speed is less than a short term scheduler.	Speed is very fast. Speed is in between both
It controls the degree of multiprogramming.	Less control over the degree of Reduce the degree of multiprogramming.

	multiprogramming.
Absent or minimal in a time-sharing system.	Minimal in a Time-sharing system time-sharing system. uses a medium-term scheduler.

Q10: What is a Context switch?

Ans: Switching the CPU to another process requires performing a state save of the current process and a state restore of a different process.This task is known as a context switch.

Q11:What are Interrupts?

Ans: Interrupts are signals sent to the CPU by external devices, normally I/O devices. They tell the CPU to stop its current activities and execute the appropriate part of the operating system.

Q12:What is Dispatcher?

Ans: A dispatcher is a module, it connects the CPU to the process selected by the short-term scheduler. The main function of the dispatcher is switching, it means switching the CPU from one process to another process. The time taken by the dispatcher to stop one process and start another running is called the Dispatch Latency in OS.

Q13: What is CPU Scheduling? What are the types of CPU Scheduling?

Ans: CPU scheduling is the basis of a multiprogramming operating system. By switching the CPU among processes, the operating system can make the computer more productive.

Types of CPU Scheduling:

i)Non-Preemptive

ii)Pre-emptive

Q14: What are the differences between Non-Preemptive and Preemptive scheduling?

Ans:

Non-Preemptive	Preemptive
1.Once the processor starts its execution, it must finish it before executing the other. It can't be paused in the middle.	1.A processor can be preempted to execute the different processes in the middle of any current process execution.
2.CPU utilization is less efficient compared to preemptive Scheduling.	2.CPU utilization is more efficient compared to Non-Preemptive Scheduling.
3.Waiting and response time of the non-preemptive Scheduling method is higher.	3.Waiting and response time of preemptive Scheduling is less.
4. Non-preemptive Scheduling is rigid.	4.Preemptive Scheduling is flexible.

Q15: What are the criteria for CPU scheduling?

Ans:

The criteria of CPU scheduling:

- **CPU Utilization:** We want to keep the CPU as busy as possible.Conceptually,CPU utilization can range from 0 to 100 percent.In a real system,it should range from 40 percent(for a lightly loaded system)to 90 percent(for a

heavily used system).

- **Throughput:** If the CPU is busy executing processes,then work is being done.One measure of work is the number of processes that are completed per time unit,called throughput.For long processes,this rate may be one process per hour;for short transactions,it may be ten processes per second.
- **Turnaround time:** From the point of view of a particular process,the important criterion is how long it takes to execute that process.Turnaround time is the time interval from the time of submission of a process to the time of the completion of the process. It can also be considered as the sum of the time periods spent waiting to get into memory or ready queue, execution on CPU and executing input/output.
- **Waiting time:**Waiting time is the total time spent by the process in the ready state waiting for the CPU.
- **Response time:**Response time is the time spent when the process is in the ready state and gets the CPU for the first time.

Q16: What are the CPU scheduling algorithms?

Ans:

There are mainly six types of process scheduling algorithms:

- **First Come First Serve (FCFS):**Simplest scheduling algorithm that schedules according to arrival times of processes.
- **Shortest-Job-First (SJF) :**Scheduling:Processes which have the shortest burst time are scheduled first.
- **Shortest Remaining Time:**It is a preemptive mode of SJF algorithm in which jobs are scheduled according to the shortest remaining time. ● **Priority Scheduling:** In this scheduling, processes are scheduled according to their priorities, i.e the highest priority process is scheduled first. If priorities of two processes match, then scheduling is according to the arrival time.
- **Round Robin Scheduling:** Each process is assigned a fixed time, in a cyclic way.

- **Multilevel Queue Scheduling:** According to the priority of the process, processes are placed in the different queues. Generally high priority processes are placed in the top level queue. Only after completion of processes from the top level queue, lower level queued processes are scheduled.
- **Highest Response Ratio Next (HRRN):** In this scheduling, processes with the highest response ratio are scheduled. This algorithm avoids starvation.
- **Multilevel Feedback Queue (MLFQ) Scheduling:** It allows the process to move in between queues. The idea is to separate processes according to the characteristics of their CPU bursts. If a process uses too much CPU time, it is moved to a lower-priority queue.

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Q17: What is Spinlock?

Ans: It is a locking mechanism. It enables a thread to wait for the lock to become ready, i.e., the thread can wait in a loop or spin until the lock is ready. It is only held for a short time, and it is useful in a multiprocessor system.

A spinlock also avoids the overhead caused by OS process rescheduling or context switching. Furthermore, the spinlock is an effective method to block the threads temporarily. As a result, spinlocks are used in most of the operating system kernels.

Q18:What is Race Condition?

Ans: Race condition is a situation where-

- The final output produced depends on the execution order of instructions of different processes.
- Several processes compete with each other.

Q19: What is a thread? What are the types of threads? Ans: A thread is a single sequential flow of execution of tasks of a process so it is also known as a thread of execution or thread of control.

Types of Threads

In the operating system, there are two types of threads.

1. Kernel-level thread.
2. User-level thread

Q20: What is the concept of multithreading?

Ans: Multithreading is the ability of a program or an operating system process to manage its use by more than one user at a time and to even manage multiple requests by the same user without having to have multiple copies of the programming running in the computer.

Q21: What are the advantages and disadvantages of round robin scheduling ?

Ans:

Advantages:

- Every process gets an equal share of the CPU.
- RR is cyclic in nature, so there is no starvation.

Disadvantages:

- Setting the quantum too short, increases the overhead and lowers the CPU efficiency, but setting it too long may cause poor response to short processes.
- Average waiting time under the RR policy is often long.

Module 3: Process Synchronization and Deadlocks

Q1. What is Concurrency?

Ans: Concurrency is the execution of a set of multiple instruction sequences at the same time. This occurs when there are several process threads running in parallel. These threads communicate with the other threads/processes through a concept of shared memory or through message passing.

Q2: What are the principles of concurrency?

Ans:

Principles of concurrency:

- Concurrency is the tendency for things to happen at the same time in a system. It also refers to techniques that make the program more usable.
- Concurrency can be implemented and is used a lot on single processing units, nonetheless, it may benefit from multiple processing units with respect to speed.
- If an operating system is called a multitasking operating system, this is a synonym for supporting concurrency.

Q3: What is Inter-Process Communication(IPC)?

Ans: Inter-process communication helps exchange data between multiple threads in one (or more) process or program. It doesn't matter whether the process is running on single or multiple computers (connected by a network). It allows coordination of activities among various program processes running concurrently in an OS.

Q4:What are the methods of Interprocess Communication?

Ans:

Following are some important methods for interprocess

communication:

- **Pipes:** This half-duplex method allows communication between two related processes. A half-duplex method allows the first process to communicate with the second process. In order to achieve a full-duplex, we need to add another pipe.
- **Message Passing:** It helps a process communicate and synchronize with each other without resorting to shared variables. IPC provides two operations on message passing, namely, sending a message of either fixed or variable size and receiving a message.
- **Message Queues:** A linked list that stores messages in the kernel and is identified by a message queue identifier. It provides communication between one or many processes with full-duplex capacity.
- **Direct Communication:** This requires processes to name each other explicitly. A single link is then established between a pair of communicating processes.
- **Indirect Communication:** This is established when processes share a common mailbox. Each pair of processes can share multiple communication links. Similarly, one link can communicate with several processes and it can either be bi-directional or unidirectional.
- **Shared Memory:** This is the shared memory between two or more processes, established using shared memory between all the processes. It requires protection from each process that can be achieved through synchronized access among processes.
- **FIFO:** A full-duplex method where the first process can communicate with the second process, and vise-versa. This is communication between two unrelated processes.

Q5:What is process synchronization?

Ans: Process Synchronization means managing the process in such a manner so that no two processes have access to share similar data and resources.

Q6:What do you mean by mutual exclusion?

Ans: A mutual exclusion (mutex) is a program object that prevents simultaneous

access to a shared resource. This concept is used in concurrent programming with a critical section, a piece of code in which processes or threads access a shared resource.

Q7:What are the requirements of mutual exclusion?

Ans:

Requirements of Mutual exclusion:

- No Deadlock
- No Starvation
- Fairness
- Fault Tolerance

Q8: What is Semaphore?

Ans: Integer variables that help solve the critical section problem are known as semaphores. Wait and signal are the two atomic operations that help achieve process synchronization in a multiprocessing environment.

Q9:What is the producer and consumer problem?

Ans: The producer-consumer problem is a synchronization problem. There is a fixed size buffer and the producer produces items and enters them into the buffer. The consumer removes the items from the buffer and consumes them. The producer-consumer problem can be resolved using semaphores.

Q10:What is the Dining Philosopher Problem?

Ans: The Dining Philosopher Problem states that K philosophers are seated around a circular table with one chopstick between each pair of philosophers. There is one chopstick between each philosopher. A philosopher may eat if he can pick up the two chopsticks adjacent to him. One chopstick may be picked up by any one of its adjacent followers but not both.

Q11: What is Deadlock?

Ans: A deadlock is a situation where a set of processes are blocked because each process is holding a resource and waiting for another resource acquired by some other process.

Q12: What are the characteristics of Deadlock?

Ans: Deadlock has the following characteristics.

- Mutual Exclusion
- Hold and Wait
- No preemption
- Circular wait

Q13: How can we prevent deadlock?

Ans: We can prevent Deadlock by eliminating any of the above four conditions.

- Eliminate Mutual Exclusion
- Eliminate Hold and wait
- Eliminate No Preemption
- Eliminate Circular Wait

Q14: What is Banker's algorithm?

Ans: Bankers's Algorithm is a resource allocation and deadlock avoidance algorithm which test all the request made by processes for resources, it checks for the safe state, if after granting a request system remains in the safe state it allows the request and if there is no safe state it doesn't allow the request made by the process.

Q15: By which algorithm deadlock avoidance can be done?

Ans: Banker's algorithm.

Module 4: Memory Management

Q1: What is Memory management?

Ans: Memory management is the functionality of an operating system that handles or manages primary memory and moves processes back and forth between main memory and disk during execution.

Q2::What is Memory-management-unit(MMU)?

Ans:A memory management unit (MMU), sometimes called paged memory management unit (PMMU), is a computer hardware unit having all memory references passed through itself, primarily performing the translation of virtual memory addresses to physical addresses.

Q3:What is Contiguous memory allocation?

Ans: In the Contiguous Memory Allocation, each process is contained in a single contiguous section of memory. In this memory allocation, all the available memory space remains together in one place which implies that the freely available memory partitions are not spread over here and there across the whole memory space.

Q4: What are the contiguous memory allocation techniques?

Ans:

The contiguous memory allocation techniques are as follows:

- Fixed-Sized Partition
- Variable-Size Partition

Q5: What are the strategies for memory allocation?

Ans:

The strategies for memory allocation are as follows:

- **First Fit:**The first fit approach is to allocate the first free partition or hole large enough which can accommodate the process. It finishes after finding the first suitable free partition.
- **Best Fit:**The best fit deals with allocating the smallest free partition which meets the requirement of the requesting process.
- **Worst fit:**In the worst fit approach is to locate the largest available free portion so that the portion left will be big enough to be useful. It is the reverse of best fit.

Q6:What is Memory Partitioning?

Ans: Memory partitioning is the system by which the memory of a computer system is divided into sections for use by the resident programs. These memory divisions are known as partitions. There are different ways in which memory can be partitioned: fixed, variable, and dynamic partitioning.

Q7:What is translation lookaside buffer (TLB)?

Ans: A Translation lookaside buffer can be defined as a memory cache that can be used to reduce the time taken to access the page table again and again. It is a memory cache that is closer to the CPU and the time taken by the CPU to access TLB is lesser than that taken to access main memory.

Q8: What is Virtual Memory?

Ans: Virtual memory is a feature of an operating system that enables a computer to be able to compensate shortages of physical memory by transferring pages of data from random access memory to disk storage.

Q9: What is Demand Paging?

Ans: Demand paging follows that pages should only be brought into memory if the executing process demands them. This is often referred to as lazy evaluation as only those pages demanded by the process are swapped from secondary storage to main memory.

Q10: What is Paging?

Ans: Paging is a memory management technique in which process address space is broken into blocks of the same size called pages (size is the power of 2, between 512 bytes and 8192 bytes). The size of the process is measured in the number of pages.

Q11:What is the page fault?

Ans: A page fault is an interruption that occurs when a software program attempts to access a memory block not currently stored in the system's RAM. This exception tells the operating system to find the block in virtual memory so it can be sent from a device's storage (SSD or HD) to RAM.

Q12: What are the page replacement algorithms?

Ans:

There are certain page replacement algorithms:

- **First In First Out (FIFO):** This is the simplest page replacement algorithm. In this algorithm, the operating system keeps track of all pages in the memory in a queue, the oldest page is in the front of the queue.
- **Optimal Page replacement:** In this algorithm, pages are replaced which

are not used for the longest duration of time in the future.

- **Least Recently Used (LRU):** In this algorithm, the page will be replaced with the one which is least recently used.

Q13: What is Thrashing?

Ans: Thrashing is when the page fault and swapping happens very frequently at a higher rate, and then the operating system has to spend more time swapping these pages. This state in the operating system is known as thrashing. Because of thrashing, the CPU utilization is going to be reduced or negligible.

Q14:What is Segmentation?

Ans: Segmentation is used for memory management where the user's view is plotted onto the physical memory. In segmentation, the user program is divided into a number of segments where each segment is of variable size.

Q15: What are the advantages and disadvantages of paging?

Ans:

Advantages:

- Easy to use memory management algorithm.
- No need for external Fragmentation.
- Swapping is easy between equal-sized pages and page frames.

Disadvantages:

- May cause Internal fragmentation.
- Page tables to consume additional memory.
- Multi-level paging may lead to memory reference overhead.

Module 5: File Management

Q1:Define a file.

Ans: A file is a collection of correlated information which is recorded on secondary or non-volatile storage like magnetic disks, optical disks, and tapes. It is a method of data collection that is used as a medium for giving input and receiving output from that program.

Q2:What are the operations that can be performed on a file?

Ans:

There are many file operations that can be performed by the computer system:

- File Create operation
- File Delete operation
- File Open operation
- File Close operation
- File Read operation
- File Write operation
- File Append operation
- File Seek operation
- File Get attribute operation
- File Set attribute operation
- File Rename operation

Q3:What is a File Control Block?

Ans: A File Control Block (FCB) is a file system structure in which the state of an open file is maintained. A FCB is managed by the operating system, but it resides in the memory of the program that uses the file, not in operating system memory. This allows a process to have as many files open at one time as it wants to, provided it can spare enough memory for an FCB per file.

Q4:Define File System.

Ans: A File System is a data structure that stores data and information on storage devices (hard drives, floppy disc, etc.), making them easily retrievable. Different OS's use different file systems, but all have similar features.

Q5:What is the file organization?

Ans: File organization refers to the manner in which the records of a file are arranged on secondary storage.

Q6:What are the methods of file organization?

Ans:

The most popular file organization methods in use follows:

- **Sequential :** Records are placed in physical order. The "next" record is the one that physically follows the previous record. This organization is natural for files stored on magnetic tape, an inherently sequential medium.
- **Direct :** Records are directly (randomly) accessed by their physical addresses on a direct access storage device (DASD).
- **Indexed sequential :** Records are arranged in logical sequence according to a key contained in each record. Indexed sequential records may be accessed sequentially in key order or they may be accessed directly.
- **Partitioned** :This is essentially a file of sequential subfiles. Each sequential subfile is called a member. The starting address of each member is stored in the file's directory.

Q7:What is the file directory in os?What are the types of file directories?

Ans: Group of files combined is known as a directory. A directory contains all information about a file, its attributes. The directory can be viewed as a symbol table that translates file names into their directory entries.

Types of file directory:

- Single level directory
- Two level directory
- Tree structured directory

Module 6: I/O Management

Q1: What are the I/O devices?

Ans: Some common I/O devices are mouse, keyboard, touchpad, USB devices, Bit-mapped screen, LED, On/off switch, network connections, audio I/O, printers etc.

Q2: What are the categories of I/O devices?

Ans:

Following are the three categories of I/O devices:

- **Human-readable:** These are suitable for communicating with the user. For example, mouse, printer, keyboard, etc.
- **Machine-readable:** These are suitable for communicating with electronic equipment. For example disk and tape drives, sensors, etc.
- **Communication:** Suitable for communicating with remote devices. For example digital line drivers, modems, etc.

Q3: What is I/O management?

Ans: It handles input to and output from attached hardware devices, such as the keyboard, mouse, monitor, hard disks, and printers. Ensuring that device drivers are present and up to date is another responsibility of the input/output management layer.

Q4:What is Disk Scheduling?

Ans:Disk scheduling is done by operating systems to schedule I/O requests arriving for the disk. Disk scheduling is also known as I/O scheduling.

Q5:Why disk schedulings are important?

Ans:

Disk scheduling is important because:

- Multiple I/O requests may arrive by different processes and only one I/O request can be served at a time by the disk controller. Thus other I/O requests need to wait in the waiting queue and need to be scheduled.
- Two or more requests may be far from each other so can result in greater disk

arm movement.

- Hard drives are one of the slowest parts of the computer system and thus need to be accessed in an efficient manner.

Q6:What are the Disk Scheduling Algorithms?

Ans:

Disk Scheduling Algorithms:

- **First Come First Serve (FCFS):**In this algorithm, the requests are served in the order they come. Those who come first are served first. This is the simplest algorithm.
- **SSTF (Shortest Seek Time First):**SSTF is another type of scheduling algorithm. In this type of disk scheduling, the job which has less seek time will be executed first. So, in SSTF (shortest seek time first) scheduling, we have to calculate the seek time first. After calculating the seek time, each request will be served on the basis of seek time.
- **SCAN Disk Scheduling Algorithm:**The SCAN disk scheduling algorithm is another type of disk scheduling algorithm. In this algorithm, we move the disk arm into a specific direction (direction can be moved towards a large value or the smallest value).
- **C-SCAN Disk Scheduling Algorithm:**C-SCAN stands for Circular-SCAN. C-SCAN is an enhanced version of SCAN disk scheduling. In the C-SCAN disk scheduling algorithm, the disk head starts to move at one end of the disk and moves towards the other end to service the requests that come in its path and reach another end.
- **Look Disk Scheduling:**Look disk scheduling is another type of disk scheduling algorithm. Look scheduling is an enhanced version of SCAN disk scheduling. Look disk scheduling is the same as SCAN disk scheduling, but in this scheduling, instead of going till the last track, we go till the last request and then change the direction.