OS concepts and interview questions

What is a process and process table?

A process is an instance of a program in execution. For example a Web Browser is a process, a shell (or command prompt) is a process.
The operating system is responsible for managing all the processes that are running on a computer and allocated each process a certain amount of time to use the processor. In addition, the operating system also allocates various other resources that processes will need such as computer memory or disks. To keep track of the state of all the processes, the operating system maintains a table known as the process table. Inside this table, every process is listed along with the resources the process is using and the current state of the process.

What are different states of process?

Processes can be in one of three states: **running, ready, or waiting**.
The running state means that the process has all the resources it need for execution and it has been given permission by the operating system to use the processor. Only one process can be in the running state at any given time.
The remaining processes are either in a waiting state (i.e., waiting for some external event to occur such as user input or a disk access) or a ready state (i.e., waiting for permission to use the processor). In a real operating system, the waiting and ready states are implemented as queues which hold the processes in these states.

What is a Thread? What are the differences between process and thread?

- A thread is a single sequence stream within a process. Because threads have some of the properties of processes, they are sometimes called lightweight processes. Threads are a popular way to improve application through parallelism. For example, in a browser, multiple tabs can be different threads. MS word uses multiple threads, one thread to format the text, other thread to process inputs, etc.

A thread has its own program counter (PC), a register set, and a stack space. Threads are not independent of one other like processes as a result threads share with other threads their code section, data section and OS resources like open files and signals

What is deadlock?

Deadlock is a situation when two or more processes wait for each other to finish and none of them ever finish. Consider an example when two trains are coming toward each other on the same track and there is only one track, none of the trains can move once they are in front of

each other. Similar situation occurs in operating systems when there are two or more processes holding some resources and waiting for resources held by other(s).

What are the necessary conditions for deadlock?

Mutual Exclusion: There is a resource that cannot be shared.
Hold and Wait: A process is holding at least one resource and waiting for another resource which is with some other process.
No Preemption: The operating system is not allowed to take a resource back from a process until the process gives it back.
Circular Wait: A set of processes are waiting for each other in circular form.

What is critical section?

A Critical Section is a code segment that accesses shared variables and has to be executed as an atomic action. It means that in a group of cooperating processes, at a given point of time, only one process must be executing its critical section.

What is race condition?

A race condition is a situation that may occur inside a critical section. This happens when the result of multiple thread execution in critical section differs according to the order in which the threads execute.

Race conditions in critical sections can be avoided if the critical section is treated as an atomic instruction. Also, proper thread synchronization using locks or atomic variables can prevent race conditions.

The solution to the critical section problem must satisfy the following conditions:

- **Mutual Exclusion**
  Mutual exclusion implies that only one process can be inside the critical section at any time. If any other processes require the critical section, they must wait until it is free.
- **Progress**
  Progress means that if a process is not using the critical section, then it should not stop any other process from accessing it. In other words, any process can enter a critical section if it is free.
- **Bounded Waiting**
  Bounded waiting means that each process must have a limited waiting time. Itt should not wait endlessly to access the critical section.

What is segmentation?

In Operating Systems, Segmentation is a memory management technique in which, the memory is divided into the variable size parts. Each part is known as segment which can be allocated to a process. The details about each segment are stored in a table called as segment table.

What is fragmentation and its types?

Fragmentation refers to the condition of a disk in which files are divided into pieces scattered around the disk. **Fragmentation** occurs naturally when you use a disk frequently, creating, deleting, and modifying files. At some point, the **operating system** needs to store parts of a file in noncontiguous clusters.
Internal fragmentation occurs when fixed sized memory blocks are allocated to the process without concerning about the size of the process, and **External fragmentation** occurs when the processes are allocated memory dynamically.

What is the difference between preemptive and non-preemptive scheduling?

Preemptive Scheduling:
Preemptive scheduling is used when a process switches from running state to ready state or from waiting state to ready state. The resources (mainly CPU cycles) are allocated to the process for a limited amount of time and then are taken away, and the process is again placed back in the ready queue if that process still has CPU burst time remaining. That process stays in the ready queue till it gets the next chance to execute.
Non-Preemptive Scheduling:
Non-preemptive Scheduling is used when a process terminates, or a process switches from running to waiting state. In this scheduling, once the resources (CPU cycles) are allocated to a process, the process holds the CPU till it gets terminated or it reaches a waiting state. In case of non-preemptive scheduling it does not interrupt a process running CPU in the middle of the execution. Instead, it waits till the process completes its CPU burst time and then it can allocate the CPU to another process.

What is the difference between mutex and semaphore?

Strictly speaking, a **mutex** is locking mechanism used to synchronize access to a resource. Only one task (can be a thread or process based on OS abstraction) can acquire the mutex. It means there is ownership associated with mutex, and only the owner can release the lock (mutex).
Semaphore is signaling mechanism (“I am done, you can carry on” kind of signal). For example, if you are listening songs (assume it as one task) on your mobile and at the same time your

friend calls you, an interrupt is triggered upon which an interrupt service routine (ISR) signals the call processing task to wakeup.

What is overlay cocept?

overlaying means "the process of transferring a block of program code or other data into main memory, replacing what is already stored". **Overlaying** is a programming method that allows programs to be larger than the computer's main memory.

What is Virtual Memory? How is it implemented?

Virtual memory creates an illusion that each user has one or more contiguous address spaces, each beginning at address zero. The sizes of such virtual address spaces is generally very high. The idea of virtual memory is to use disk space to extend the RAM. Running processes don't need to care whether the memory is from RAM or disk. The illusion of such a large amount of memory is created by subdividing the virtual memory into smaller pieces, which can be loaded into physical memory whenever they are needed by a process.

Explain the main purpose of an operating system?

Operating systems exist for two main purposes. One is that it is designed to make sure a computer system performs well by managing its computational activities. Another is that it provides an environment for the development and execution of programs.

What is demand paging?

Demand paging is referred to when not all of a process's pages are in the RAM, then the OS brings the missing(and required) pages from the disk into the RAM.

What is kernel?

State the main difference between logical and physical address space.

Logical address refers to the address that is generated by the CPU. On the other hand, physical address refers to the address that is seen by the memory unit.

What are the different types of CPU registers in a typical operating system design?

– Accumulators

– Index Registers

– Stack Pointer

– General Purpose Registers

What is multitasking?

Multitasking is the process within an operating system that allows the user to run several applications at the same time. However, only one application is active at a time for user interaction, although some applications can run “behind the scene”.

What is caching?

Caching is the processing of utilizing a region of fast memory for a limited data and process. A cache memory is usually much efficient because of its high access speed.

What is spooling?

Spooling is normally associated with printing. When different applications want to send an output to the printer at the same time, spooling takes all of these print jobs into a disk file and queues them accordingly to the printer.

What is an Assembler?

An assembler acts as a translator for low-level language. Assembly codes written using mnemonic commands are translated by the Assembler into machine language.

What are interrupts?

Interrupts are part of a hardware mechanism that sends a notification to the CPU when it wants to gain access to a particular resource. An interrupt handler receives this interrupt signal and “tells” the processor to take action based on the interrupt request.

What is preemptive multitasking?

Preemptive multitasking allows an operating system to switch between software programs. This, in turn, allows multiple programs to run without necessarily taking complete control over the processor and resulting in system crashes.