# Operating System

Q What is operating system

A operating system is a software that act as an interface b/w computer hardware and user application. its manges the resources and provides services for the efficient and secure execution. the primary function of an operating system include process management memory management, file system management devices management and user interface. its allow us to communicate with the computer without knowing the computer language, without OS computer is not useful.

## Types of OS

1) Batch OS (payroll system, bank statement, data entry)

Batch OS is the first operating system for second-generation computer, Batch operating system is does not directly interact with the computer, in Batch operator take up similar jobs and group them together into a Batch and then batches are excuted one by one based on FCFS principle.

→ 2) ~~multiprogramming~~ multitasking (eg Unix)

the multitasking OS is also know as time-sharing operating system as each task is given some time so that all the ~~process~~ task work efficiently. each task ~~time~~ get an equal time for execution.

→ 3) distributed OS (eg Locus)

in distributed OS, the various computer are connected through a single communication channel. there are independent computer have their own memory unit and CPU. failed of one system will not affect the other system because all the computer are independent of each other.

→ 4) Network OS (eg microsoft windows server)

Network operating system are the system that run on a server and manage all the networking function. they allow us to share various of file, Application, printers, etc.

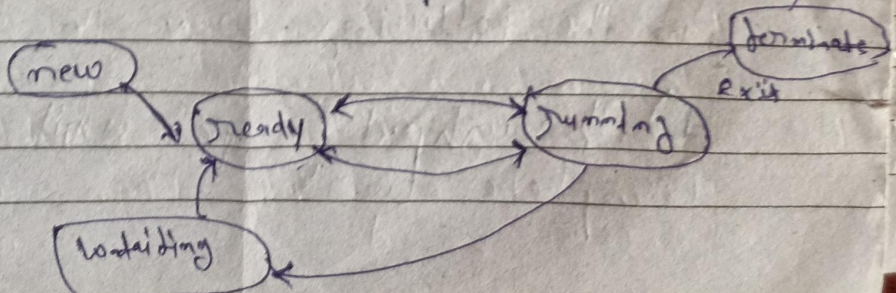
RTOS

→ 5) Real-time OS (eg. medical imaging, Robots)

these operating system are useful where many events occurs in a short time or certain deadlines. these are commonly used in embedded system, IoT devices.

* program :- A program is a set of instructions written in a programming languages to perform a specific task, its typically stored in a file on disk. program can be compiled or interpreted they serve as a blueprint for the excution of task on a computer system.

* process :- process is an instance of a program in excution. when a program is loaded into memory and excuted it. its become process. a process is an independent entity with its own memory space, resources and excution context. it has its own program counter. the process are run in separate memory space.



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* thread :- A thread is a unit of execution within a process. its represent the sequence of instruction that can be scheduled and executed independently. multiple threads within a process can run simultaneously. its allow for parallel execution of tasks.

* CPU scheduling Algorithms follow

cpu scheduling algorithms are used by the OS to determine the order in which processes are executed on the cpu.

→ 1.) first-come first serve : In this algorithms, the process that arrives first will execute first. its follow a non-preemptive approach. means that once a process start running it continues until it completes. it may lead poor utilization of the cpu if the long term process is come first.

* Scheduling Algo is schedule it in the following way to execute.

1.) throughput :- per unit time to complete work.

2.) Waiting time :- which process wait in waiting queue is called waiting time

3.) Burst time / Response time :- time to excute process.

4.) Turnirad time :- which time take by both waiting and Burst time.

→ 2.) Shortest Job first (SJF) :- which process have the shortest Burst time are scheduled first. SJF algm to minimize the average waiting time.

→ 3.) Shortest Raining time first (SRTF) : it is a preemptive mode of SJF algorithm in which jobs are scheduled according to the shortest remaining time

→ 4) Round Robin (RR) : each process is assigned a fixed time, in a cyclic way, it may not efficient for long-running processes.

→ 5.) priority scheduling :- processes are scheduled according to their priorities i.e., highest priority process is scheduled first, if priorities of two processes match, then scheduling according to Arrival time

→ 6.) multilevel queue scheduling :- the multilevel queue scheduling divides the ready queue into multiple priority queue. the processes are initially placed in highest priority queue.

* the critical section problem

the critical section Represent the portion of a code in program where shared variables, file are accessed and updated.

Solution for critical section

1.) Mutual exclusion
2.) progress
3.) Bounded Waiting

* [redacted]

it refers to techniques and mechanisms used to coordinate the execution of processes or threads so that they can work together harmoniously. it helps prevent issues like race condition, deadlock that can arise when multiple process access shared resources simultaneously.

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* process synchronisation tool :-

•) Semaphores :- Semaphores are synchronization objects that can be used to control access to the shared resources.

• they can implemented as.

1.) Binary semaphores
2.) Counting semaphores.

→ Binary Semaphores :- its take only 0 and 1 as a value and used to implement mutual exclusion.

→ Counting semaphores :- are allow a specific no. of process to access a shared resources.

•) lock / mutex :- lock or mutex is provide the mutual execlusions. they allow only one process to take the lock at a time.

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# * Deadlock

Deadlock is a situation where a set of processes are blocked because each process is holding a resources and waiting for another resources which is assigned to some other process.

* 4 nessasary condition satisfied for deadlock

1) Mutual Exclusion :- which is non-sharable resources. only one process can use at a time.

2) Hold and wait :- process is holding resources and waiting for the another resources.

~~3) No preemption : the process once scheduled will be execute till the completion.~~

3) Circular wait :- A set of processes are waiting for each other in circular form.

4.) No preemption :- A resources cannot be taken from a process unless the process releases the resources.

- methods for handling deadlock :- there are three way to handling deadlock.

1.) Deadlock prevention or avaidance :- the idea is to not let the system into a deadlock state.

2.) Deadlock detection and recovery :- let deadlock occurs, then do preemption to handle it once occurred.

3.) ignore the problem all tog ether :- let deadlock is very rare, then let it happen and reboot the system.

* Banker algorithm :- is used to avoid deadlocks. it is one of the deadlock avoidance method.

* memory management

these techniques allow the memory to be shared among multiple process

- overlays :- contain only required data at given time.
- swapping - used time slice to swapped out from the memory.

→ techniques

- single partition Allocation : the memory schemes is divided into two parts. one part is kept to be used by os and other is used by user.
- multiple partition schemes

1) fixed partition :- the memory devided into fixed size partition.
2) variable partition :- the memory devided into variable size partition

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* Partition Allocation Schemes

1) First fit :- the arriving is allotted the first hole of memory in which its fit completely

2) Best fit : the arriving process is allocate the hole of memory in which it fit the best by leaving the min memory empty

3) Worst fit :- the arriving process is allocate the hole of memory in which it leaves the maximum gap.

* Paging :- Paging is a storage mechanism used to retrieve processes from the secondary ~~memory~~ storage into main memory in the form of pages.

The main idea behind the paging is to divide each process in the form of pages.

One page of process are store in the form of frames.

* Segmentation

its ~~devide~~ divide processes into smaller subparts known as modules. there is no continuous memory allocation

* page fault :- A page fault is a type of interrupt data. its happen by hardware when program accesses a memory page that mapped into the virtual addresses space.

* Page Replacement Algorithms

1) First in First out (FIFO) :- this is the simplest page replacement Algorithm, operating system keep track of all pages in the memory in a queue, the oldest page is in the front of queue, when page need to replace, the front page is selected from queue to remove.

2) optimal page replacement :- in this Algorithm, page are replaced which are not used for the longest duration of time in the future.

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3.) Least Recently used (LRU) :- In this Algorithm, the page will be replaced ~~with the~~ which is least recently used.

## * Process Synchronization

Process Synchronization is a task of ensuring that multiple processes can safely share resources without interfering with each other. its ensure that data integrity and resources efficiency are maintained and its help to prevent issues like race condition, deadlock, that can arise when multiple process access shared resources simultaneously.

* Disk Scheduling :- disk scheduling is done by operating system to schedule I/O request arriving for disk. this is also know as I/O scheduling.
  1.) Seek time
  2.) Rotational latency
  3.) Tranfer time
  4.) Disk access time
  5.) Disk Response time

## * Disk Scheduling Algorithms

1.) FCFS :- FCFS is the simplest of all the Disk scheduling Algorithms. in FCFS the request are addressed in the order they arrive in the disk queue.

2.) SSTF :- SSTF stand for shortest seek time first, request having the shortest seek time are executed first. in a simple words, the closest request from the disk are is executed first.

3.) SCAN :- in SCAN Algorithms the disk arm moves into a particular direction and services the requests coming in its path. and after reaching the end of the disk, its reverse its direction and again services the request arriving in its path.

4.) C-SCAN :- in the SCAN Algorithms, the disk arm again scans the path that has been scanned, after reversing its direction so, its may be possible that too many request are waiting at the other end.

5.) Look :- look is a variant of SCAN that only goes as far as the last request in its current direction.

* Real-time System :- A Real-time operating system is a special-purpose operating system that used in computers to perform a specific task in a certain deadline. these system is used in real-time applications that must work within specific deadlines. Ex:- medical image sys, IOT devices, embedded system.

* A monolithic kernel :- is a kernel which includes all operating system code in a single executable image.
→ monolithic kernel is an operating system architecture where entire operating system is working in kernel space.

* kernel :- kernel is central component of an operating system that manages operations of computer and hardware. its bassically manages operations of memory and cpu time.

* Micro kernel :- microkernel is the kernel which runs minimal performance affecting services for operating system. in the micro-kernel operating system all other operations are performed by the processor.

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* Macro kernel :- macro kernel is a combination of micro and monolithic kernels.

* Re-entrancy :- it is a very useful memory saving techniques that is used for multi-programmed time sharing system.

* Demand paging :- A ~~computer~~ process of loading the page into memory on demand (whenever a page fault occurs) is know as demand paging

* Demand paging :- demand paging in OS is a techniques in which pages are loaded from disk into main memory only when they are needed. this techniques allow in OS to save memory space and improve system performance.

* Virtual memory :- A computer can address more memory than the amount physically installed on the system. this extra memory is actually called virtual memory. this memory is especially used when an executing program cannot fit in the physical memory.
→ virtual memory is commonly implemented by demand paging.

- RAID :- stands for Redundant Array of independent Disks. it is used to store the same data redundantly to improve the overall performance. there are 7 RAID levels.

- logical address space :- its specifies the address that is generated by the CPU.

* physical address space : its specifies the address that is seen by the memory unit.

* Fragmentation :- is a phenomenon of memory wastage. its reduces the capacity and performance because space is used inefficiently

1.) Internal fragmentation :- its occurs when we deal with the system that have fixed sized allocation units.

2.) External fragmentation :- its occurs when we deal with system that have variable size allocation units.

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* Spooling :- spooling is a process in which data is temporarily held to be used and executed by a devices. spooling is often used when data needs to be transferred from a program to printers.

* Starvation :- is Resource management problem. its occurs when a process waits for an ~~in definite~~ indefinite time to get the resource it require, because resources are allocated to the other process.

* Aging : is a technique used to avoid starvation in the resource scheduling system

* Multithreading :- multithreading is model of program execution that allows for multiple threads to be created within a process

* Thrashing :- is a phenomenon in virtual memory schemes when the processor spends most of its time in swapping pages, ~~then~~ rather than executing instructions.