Chapter-1

17/4/21

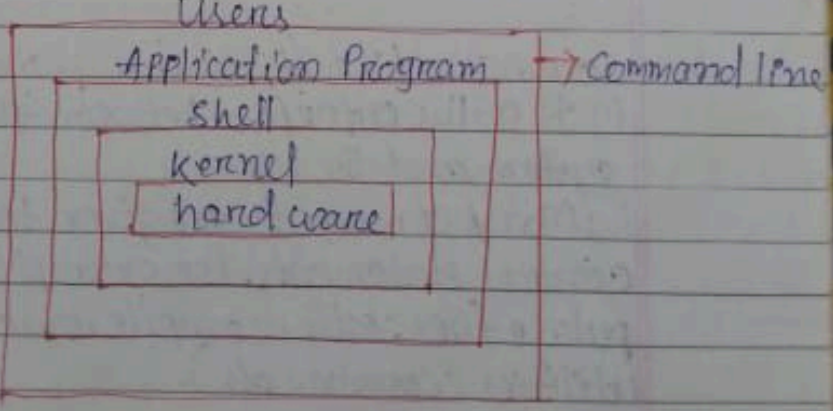
INTRODUCTION

Introduction to Operating system (O.S)

→ An operating system is a software program
→ That controls the overall operation of the computer system.
→ It controls the computer hardwares, manages system resources and supervises the interaction between the system and its user.
→ It acts as an interface between the computer hardware and user.
→ Without an operating system machine can not work.

Purpose of Operating System :-

The purpose of an operating system is to provide an environment in which a user can execute program in a convenient, efficient manners.



(i) The user of a computer doesn't interacts with the hardware of the machine. User interact with operating system, supplies

ii) Shell is the mediater which interprets the commands that we give and then conveys carry on them to the kernel which ultimately executes them.

Function of operating system:-

→ An Operating System (OS) is an interface between a computer user and computer hardware.

→ An operating system is a software which performs all the basic tasks like file management, memory management, process management, handling input and output, and controlling peripheral devices such as disk drives and printers.

Evolution of Operating system:-

Evolution of operating system: User driven, operator driven, simple batch system, off-line batch system, directly coupled off-line system, multi-programmed spooling system, online timesharing system, multiprocessor systems, multi computer/ distributed systems, Real time operating systems.

(1) Batch processing operating system.
(2) Multiprogramming operating system
(3) Multitasking operating system or Time sharing operating system.
(4) Real time operation system.

i) Batch processing operating system :-
In batch processing operating system collects jobs in a batch and submitted to the computer where they are executed one after another. When the jobs is completed, its output is printed then another batch of jobs are collected and processed But the processing of job takes place sequentially in the same order of submission In batch processing operating system, one job which is executed remains in the memory. When the execution of the job is finished the operating system clears the memory and loads data relating to the next job and runs it. As only one program stays in the memory at a time when the program enters into input/output bound phase (for performing i/p or o/p activities). The CPU remains idle as it doesn't have to do anything.

DRAW BACKS :
- User can not interact with a job during its execution i.e he can not modify a programastic executes to study its behaviour.
- Poor utilisation of CPU.

ii) Multiprogramming Operating system:-
In batch processing environment, CPU cannot go to the other job until the current job is finished. If this job has some input/output request, their it must wait typically for the completion of some I/O request. This draw back is overcome by multiprogramming operating system. In this operating system more no. of programms are kept in the memory at one time. When one job has to wait, the operating system takes the CPU away from that job and gives it to another job. This pattern continue every times one job has to wait, another job may takeover the use of the CPU. The benifit of multiprogramming are increased CPU utilization and higher to the total through put.

iii) Multitasking Operating System or Time sharing Operating System:
It is a logical extension of multiprogramming OS, where multiple job are executed by CPU by switching between them. The basic idea behind time sharing system is to allow all user programs to have a brief share of the CPU time in turn. This short period of time during which a user gets the attension of the CPU is known as a time slice. When the time slice of one job is completed, the time sharing supervisor moves on to the next ready job.

CHAPTER-2

PROCESS MANAGEMENT

Process concepts:-

A process is a program under execution. It can be defined as a program currently making use of the processor at any one time.

i) **Process state:** It is defined as the current activity of that process. It may be any one of the following:

(i) **New:** The state of the process when it is created.

(ii) **Ready:** It is ready for execution.

(iii) **Run:** Process under execution.

(iv) **Wait:** A process waiting for an event to occur.

(v) **Terminate:** finished execution.

Process Control Block: (PCB)

Each process is represented in the OS by a process control block also called as task control block. The PCB is a data structure containing certain important information about the process including.

ii) **Process identification no:-(ID-identification):** Os allocate a unique number to each process

iii) **Pointer:** Pointers to locate the process memory and to allocate resources.

iv) **Program counter:** It contains the address of the next instruction to be executed.

v) **CPU registers:** keeps the information of various registers like accumulators, (Stack pointer) general purpose registers.

vi) Memory registers :- It includes information on the memory system used i.e paging or segmentation.

~~vii) Accounting information :- This information~~

vii) Accounting information :- This information includes the amount of CPU time used, time limits and account no.s of job or process no. and so no.

viii) Input/output status information :-
This information includes the list of i/p - o/p device allocated to the process and a list of open files and so on.

~~Interacting processes~~

Inter Process messages :-

→ A process can be two types
*Independent process is not affected by the execution of other process.
*Co operating process can be affected by other executing processes.

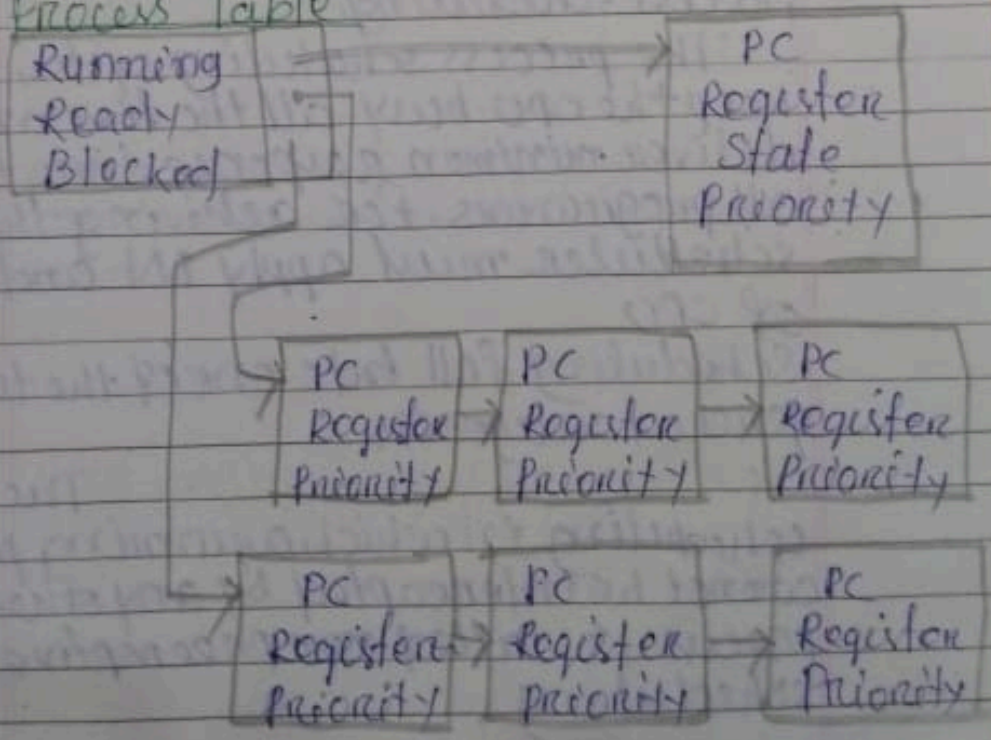
→ Inter process communication (IPC) is a mechanism which allows process to communicate with each other and synchronize their actions.

→ The communication between these process can be seen as a method of co-operation between them.

Implementation Issues of processes :-

Process model is implemented by the process table and process control block which keep there all information of process.

* At the time of creation of a new process the OS allocates a memory for it loads a process code in the allocated memory. and setup data space for it.
* The state of process is stored OS Next in its PCB and when this process move to ready state its state is also changes in pcb.
* When a running process needs to wait for an I/O device, its state is changed to 'Blocked'. The various queues used for this which is implemented as linked list.



There are many following queues
→ Read Queue: This queue is used for storing the processes with state ready
→ Blocked Queue: It is used for storing the processes but need to wait for an input output device or resource.

Each PCB has a pointer that point to net PCB. There is a header for each type of queue. The header stores the inf about the 1st and last PCB in their queue

Process scheduling:-
The act of determining which process is in the ready state, and should be moved to the running state is known as process scheduling.

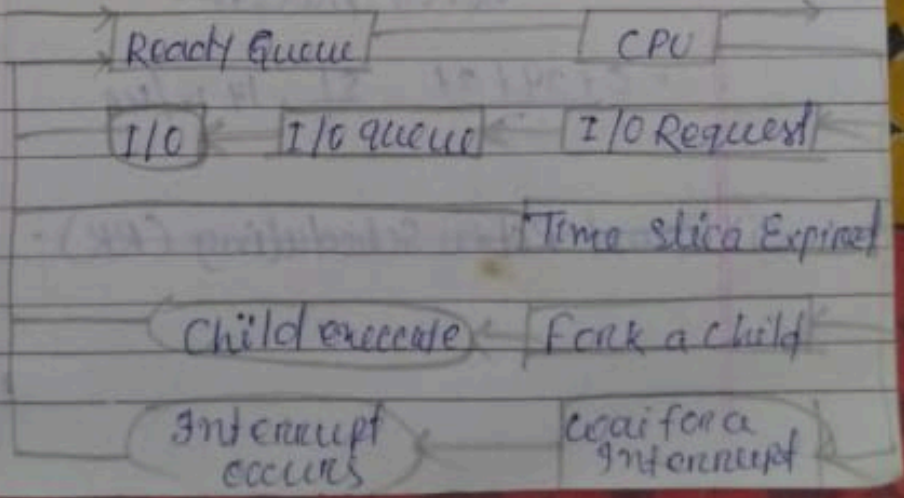
The process scheduling system is to keep the CPU busy all the time and to deliver minimon response time for all programmes. For achieving this, the scheduler must apply IN and OUT of CPU.
Scheduling fall into one of the two general categories.
→ Non preemptive scheduling: The scheduling in which a running process cannot be interrupted by any other process is called non preemptive scheduling.

→ Preemptive scheduling: The scheduling in which a running process can be interrupted if a high priority process enters the queue and is allocated to the CPU is called preemptive scheduling

What is Scheduling Queues?

→ All processes upon entering Data the system are stored in the Job queues.
→ Processes in the ready state are placed in the Ready queue.
→ Processes coneting for a device to become available are placed in Device queues. There are unique device queue available for each I/O device.

A new process in initially put in the Reddy Queue. It waits in the ready queue until it is selected for execution (for dispatched). Once the process is assigned to the CPU and is executing one of the following secuents can occurs



1) Process Scheduling Algorithms :-

(i) first come first served Scheduling:

→ It is semplist scheduling algorithms it assign CPU to the process which arrive 1st.

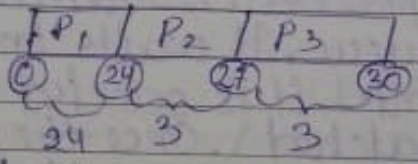
→ Easy to understand and can easily be semple method using queue data structure.

→ first served algorithms work on the principle of first in first out queue.

Example

(i) Process execution time (in mili second)

P_1	24
P_2	3
P_3	3



Waiting time of (WT) $P_1=0$, $P_2=24$, $P_3=7$

= Average waiting time (Avg WT)

= Sum of all waiting time of a process / no. of processes

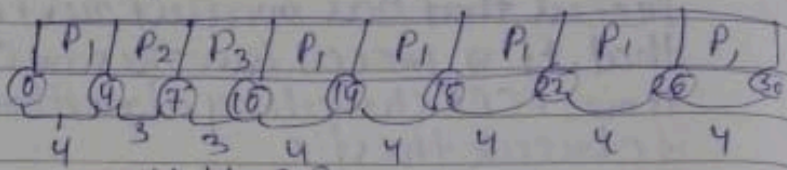
$= \frac{0+24+27}{3} = \frac{51}{3} = 17$ m/sec.

ii) ~~Round Robin Scheduling (RR)~~ :-

Example Process | Burst time

P_1	24
P_2	3
P_3	3

Time quantum = 4



(i) $P_1 = 24 - 4 = 20$

$P_1 = 20 - 4 = 16$

$P_1 = 16 - 4 = 12$

$P_1 = 12 - 4 = 8$

$P_1 = 8 - 4 = 4$

WT for $P_1 = 0 + (10 - 4)$

$= 6$

$P_2 = 4$, $P_3 = 7$

$AWT = \frac{6 + 4 + 7}{3} = 5.6$ msec

(ii) Priority scheduling :-

Each process is associated with priority and CPU is allocated to process with highest priority. Equal priority processes are scheduled in FCFS model

Ex-

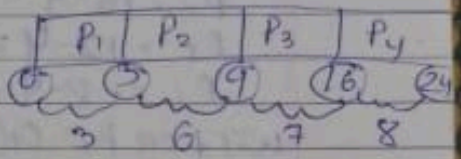
Process	burst time	Priority
P_1	24	2
P_2	3	1
P_3	3	3

ii) Shortest Job first: (SJF).

The shortest job first algorithms is associated with the length of each jobs or processes in the CPU burst time. When the CPU is available it is assigned to the process that has smallest next CPU burst that. If 2 process have the same CPU burst time, FCFS scheduling algorithm is used to break the tie.

Ex:

Process	burst time (in msec.)
P_1	6
P_2	8
P_3	7
P_4	3



waiting time of $P_4 = 0$, $P_1 = 3$, $P_3 = 9$, $P_2 = 6$

Average waiting time $= \frac{0+3+9+6}{4} = 4$ M/sec

iii) Round Robin scheduling (RR):

→ It is the preemptive process scheduling algorith.

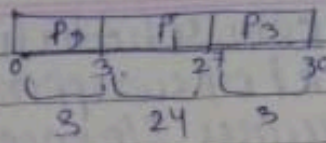
→ Each process is provided a fix time to execute it is called a quantum.

→ Once a process is executed for a given period it is preempted and other process executes for a given time period.

→ Context switching is used to save state of preemptive process.

Criteria "Time Quantum"

Mode 'Preemptive'



WT = $P_2 = 0, P_1 = 3, P_3 = 27$

AWT = $\frac{0+3+27}{3} = 10$ m/sec

v) Multilevel Queue scheduling:

→ A multilevel queue scheduling algorithm partitions the ready queue into several separate queues.

→ The system process executed first similarly the other process started executing by FCFS algorithm.

Types of scheduling:

(i) Long term scheduling:

It selects processes from the queue and loads them into the memory when the process changes the state from new to ready then there is use of long term scheduling

ii) Short term scheduling:

It is also called as CPU scheduling or dispatchers STS selects a process among the process that are readily to execute & allocate CPU to one of them that means STS/CPU scheduler make the decision on which process to execute next

iv) Real time Operating System :-

A real time operating system is an operating system intended to serve real time applications that process data as it comes in, typically without buffer delays. Processing time requirements are measured in tenths of seconds or shorter increment of time.

Structure of Operating System :-

An operating system is composed of a kernel, possibly some servers, and possibly some user-level libraries. The kernel provides operating system services through a set of procedures, which may be invoked by user processes through system calls.

iv) Circular wait:- There must be a circular chain two or more processes, each of which is waiting for a resource held by the next no. of the chain.

Q) Explain (Discuss) in detail about deadlock avoidance deadlock Avoidance?

The method of avoiding deadlock is to require addⁿ inf about how resources are to be requested. To avoid deadlock condⁿ we will have to implement some algorithm which takes care of all the resource which has bee allocated to different process the resources which are available.

The deadlock avoidance algorithm dynamically resource allocation safe to ensure circular wait condⁿ prevⁿ resources and the exclusion condⁿ.

5) Scheduling :-
Scheduling is a process which allow one process to use the CPU while the execution of another process is on hold due to unavailability of any resources.

~~Type~~

6) function of Operating System :-
→ Hardware Management.
(O.S. must be provide programs to manage the hardware)

→ OS is also manage Memory.

→ Booting the computer.

→ Provide a user interface.

→ OS is a ~~fo~~ software its ~~provides~~ perform all the basic tasks like that.

command has been executed and the device is temporarily released, and at the job level, when the job is finish and the device is permanently released.

Types of devices:
The Os peripheral devices can be categorized into 3; Dedicated, Shared and Virtual. The difference among them are the functions of the characteristic of the devices as well as how they are managed by the device manager.

(i) Dedicated Devices:
A dedicated devices is allocated is to a job for the job's entire duration. Some devices lend themselves to this form of allocation. Dedicated assignment is inefficient if the job does not fully and continually utilized the device.

(ii) Shared Devices:
Some devices such as disks and most other direct access storage devices may be share concurrently by several processes. Several process can read from a single disk at essentially the same time. e.g if two processes

(iii) Virtual Devices:-

A technique where one physical device this simulated on another physical device is combination of dedicated devices that have been transformed into shared devices.

Device allocation considerations I/O traffic control:

Keeps track of the status of all devices control units, and communication channels.

I/O traffic controller has 3 main tasks:

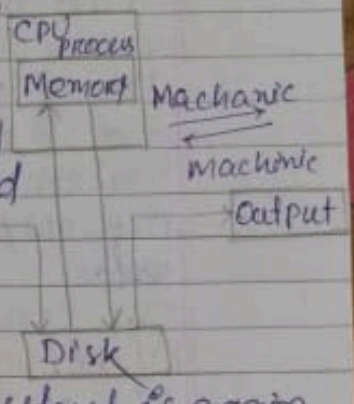
→ The primary task is to check if there's at least one path available.
→ If there exists more than one path, it must decide which one to select.
→ If the paths are occupied, its task is to analyzed which paths will be available at the earliest.

I/O Schedule:

function similar to process schedule it allocates the devices, control units and communication channels. However under heavy load of I/O requests. Scheduler must decide what request should be served first and for that coe multiple queues to be managed by OS.

SPOOLING:
Simultaneous peripheral operations on-line.

→ A kind of buffering mechanism.
→ Spooling is a process in which input is taken from user and that input is stored in the disk first and after that it is stored in the memory and then the CPU takes the input from the memory and process the Output. and then the output is again in the disk and afterwards disk introduces the output.



Why we use Spooling:
Because in this process input is taken by CPU from memory so the process ready first.

CHAPTER-6
FILE MANAGEMENT

File Organization :-

File organization refers to the logical relationships among the various records that constitute the file, particularly with respect to the means of identification and access to any specific record. 'file structure' refers to the format of the label and data blocks and of any logical record control information to organization of a given file may be sequential relative or indexed.

Directory :- It is a location for storing files on your computer. Directories are found in a hierarchical file system, such as Linux, MS-DOS, OS/2 and unix.

file structure :- A source file is a sequences of procedures and func. An object files a sequence of bytes organized into blocks that are understable by the machine. when o.s defines different file structures it also contain the code to support these file structure.

An o.s file system structure is the most basic level of org. Almost all of the ways an o.s interacts with its user app and secur model are dependent.

File Access Methods :-

The information stored in the file need to be accessed and read into the computer memory. There are different methods available to do it some of them are :-

1) Sequential Access :-

This is the most common method :

- Here the information present in the file is accessed in a sequential fashion one record after the other.
- It is a very common approch which is used by editor and compilers usually
- The reads write operations from the major part of the opers alone on a file.
- A ~~who~~ write operation appends to the end of the file and advances to the end of the newly written material.

(2) Direct Access :

- It provides a speedy access to the file. It provides immediate access to large amount of information.
- Here a file is made up of logical record that allows program to read and write
- It allows the programs to read & write the records in a rapid manner in particular (or predefined) order.
- One can view the files a numbered seen of blocks or records.
- This method is usually used in databases

3) Indexed Access :-

- Here an index contains the pointers to various blocks of the file.
- So, to find a record inside a file, we firstly search the index and later use the pointer obtain to access the file directly and find the record we have been searching for.

File systems :-

In computing a file system or file system is used to control how data is stored & retrieved. Without a file system, infor^{n} placed in a storage medium would be one large body of data with no way to tell where one piece of information stops and the next begins. By separating the data into pieces and giving each piece a name, the information is easily isolated & identified.

There are many diff^{n} kinds of file systems. Each one has diff^{n} kind of file & logic, properties of speed, flexibility, security, size of more. Some file system have been designed to be used for specific applications.

file systems can be used on numerous diff^{n} types of storage devices that use diff^{n} kind of media. The most common storage device use today is hard disk drive.

ensure that only process that have gained proper authorization from the OS can operate on the files memory segments CPU & other resources a systems.

Protection referens to a mechanism for controling the accen of programs processes. or users to the resources defind by a computer system. The mechanism must provide a means for specifying the control to be imposed.

Secondary storage MNG:

The main purpose of a computer system to evalute programs. These programs must be in main memory during execution. But main memory is too small to accommodate all data and programs & also data it holds are loss coher power is lost so the computer system must provides a secondary storage to back up main memory. The OS is responsible or the following activities is conn^{n} with disk management.

- Storage Allocation
- free space management
- Disk scheduling.

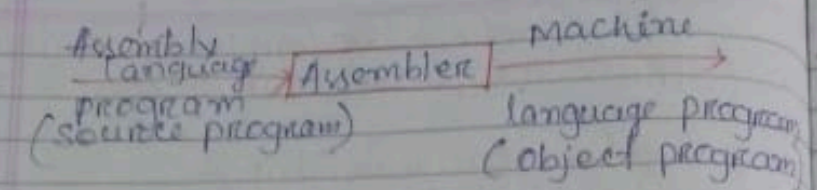
File system Mng :

→ A files is a collection of related info^{n} defind by its creator.

→ a.txt < Personal details, Account details. user.

→ General file is as sequence of bits bytes, lines. or records.
[name ... user].

→ Exp of file types
type file - sequence of characters organized into lines



Assembler are classification into one pass assembler and two pass assembler.

One pass assembler:
In this assembler program reads the assembly language only once. These assembler programs must be equipped with some means to assign addresses to the levels used to the assembly language program.

Two pass assembler:
In this the assembler goes through the program twice. In the 1st pass, it reads the assembly language programs and collects all the levels used. it assigns addresses to the levels by counting their position from the starting address. On the second pass, the assembler produces the machine code for each instruction and assign addresses to each.

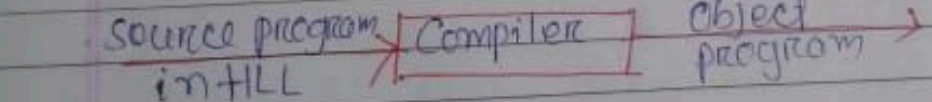
What do you mean by assembler? and what is the function of an assembler?
A computer doesn't understand any program written in a language other

than its machine language. Hence the programs written in other language must be translated into the machine language of the computer before they are execute such translation is perform with the help of software. A program which translate an assembly language program into a machine language program is called assembler.

What is a compiler? Explain the various phases of compilation process?

Ans Compiler :-

The compiler scan the whole high level program ~~is error~~ and translate it into machine language program of it is error free, otherwise it displays list of error present.



Phases of compiler →

Source program

~~Syntax~~ Analysis

Syntax analysis

Intermediate code generater

code optimization

Coder

CHAPTER-7

SYSTEM PROGRAMMING

Differentiate system programming and Application programming?

System programming →

System programming is an activity of designing and implementing system software program to hardware efficiently. Operating system, compiler, assemblers, loaders are example of system software.

Application programming:-

Application programming is an activity of designing and implementing application software program. User written software read may software are examples of application software. Application software may be general purpose application program like word processor, spread sheets are application specific program such as payroll, student information system.

What is an assembler? Explain one pass assembler and two pass assembler?

Assembler is used to translate the assembly language program (source program) into machine language (object programs).

file system Reliability :-

Reliability Regular file operations often involve changing several disk blocks. for exp: in creating a file in unix, we must write to the inode with the file information, a data file entry in to its directory and possibly create the 1st data block of the disk. The file system could enter some inconsistent state. confusing the O.S to the point that the file system can't used at all.

Allocation of Disk space :-

O.s maintains a list of free disk-space keep track of all disk blocks which is not being used by any file. when ever all file has to be created, the list of free disk space is searched for and then allocated to the new file. The amount of space allocate to this file is then removed from the free space list, when file is deleted its disk space is added to the free space list.

file Protection :-

The procession an OS must be protected from one another's activities To provide such protection, we can use various mechanism to

File Sharing of files:-
Providing access to digital media such as computer programs, multimedia (audio, images, & video) documents or electronic books, file sharing may be achieved in a number of ways common method of storage, transmission and dispersion include manual sharing utilizing removeable media, Centralized servers on computer networks, world wide web based hypelinked documents and these of distributed peer to peer networks.

Types: (1) Peer to Peer file sharing
(2) file sync and sharing devices

(1) Peer to peer file sharing:- It is base done the peer to peer (P2P) application architecture. Technology had taken over our lives and it's available at our fingertips Now a day file sharing is a common clouds are in the sky.

(2) file sync & sharing devices:-
cloud based file syncing and sharing services implement automated file transferby updating files from dedicated sharing directory on each users networked device files placed in this folder also are typically accessible in this trough a website and mobile app.

The major difference between process scheduler & and I/O scheduler is that I/O requests are not preempted: Once the channel program has started it's allowed to continue to completion. Although it is feasible because - programs are relatively short (50 to 100 ms). Some modern OS allows I/O scheduler to serve and higher priority then they are served before other I/O requests with lower priority. I/O scheduler works is coordination which the I/O traffic controller to keep track of which path is being served for the current I/O request.

I/O Device Handler:

Manages the I/O interrupts (if any) and scheduling algorithms. Few I/O handling algorithms are:

1. FCFS [first come first server].
2. SSTF [shortest seek time first].
3. SCAN
4. Look
   - → N-Step scan
   - → C-SCAN
   - → C-LOOK

Every scheduling algorithm aims to minimize arm movement, mean response time, variance in response time.

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CHAPTER-4

DEVICE MANAGEMENT:

Device management in operating system known as the management of the I/o devices such as a keyboard, magnetic tape, disk, printer, microphone, USB ports, scanner, etc. as well as the supporting units like control channels.

Technique of device management in the operating system:

An operating system or the OS manage communication with her device through their respective drivers. The operating system component provides a uniform interface to access devices of varied physical attributes. for device management in operating system.

- keep tracks of all devices and the program which is responsible to perform this is called I/o controller.
- Monitoring the status of each device such as storage drivers, printers and other peripheral devices.
- Enforcing present policies and taking a decision which process gets the device when and for how long.
- Optimize the performance of individual device.
- Allocates and dellocates the devices in an efficient way. De-allocating them at two levels: at the process level when I/o

1) Process synchronization
→ Process synchronization means sharing system resources by processes in a such a way that.
→ Maintaining dat consistency demands

2) Define deadlock and it's necessary condition ?
A)- A deadlock is a situation like where a group of process are permanently block and waiting for realese.

necessary condition are :-
a) Mutual Exclusion
b) Hold and wait
c) No Preemptive.
d) Circular wait.

3) Semaphore :
→ semaphore is an like a object.
→ That consists of a counter, a waiting list of process and 2 method.

4) Process : It is defind as a program currently making use of the processor at any time.
Inter process message : It's process com
between two (a) Independent (b) Co-operatin
process. process

CHAPTER-5

DEAD LOCK

Dead lock:-

A deadlock is a situation where a group of process are permanently blocks as a result of each process having acquired a subset of resources needed for its completion and waiting for release for it remaining resources held by others in the same group. Deadlock refers to a specific condit" where 2 or more processes are each waiting for other to release a resources or more the in a circular chain.

[Resource - CPU time, file, I/o device, Printer, tape drive]

Q-1 What are the necessary condition due to which deadlock appears?

A deadlock situation can arise if the following 4 given cond".

(i) Mutual Exclusion: A resource that can not be used by more than one process at a time.

(ii) Hold and wait: A process must be holding at least one resources and waiting to acquire addl" resources that are currently being held by other processes

iii) No Preemptive: Resources can be preempted that is a resource can be released without forcibly by the process holding it after that process has completed it task.

iii) Medium term scheduling:
It is a part of swapping same running process requires I/O operation" In the cond" process suspends from main memory and placed on the secondary memory & placed on the ~~second~~ then preempt after a while get out and in memory & can't picked (where they left earlier swapping in and swap out is done by MTS.