- Operating system:- Operating system is a collection of set of Program which manages all the resources of the computer system.
It is intermediater between user and hardware.

- Characterestics:-

1. Scheduling
2. memory management
3. security
4. Intract with diffrent software
5. Device management
6. File management

- TYPE

1. Single user o/s: MS Disk Operating System
MS-DOS (CUI)
2. Multiuser o/s: Window 95, 97, XP, Vista, UNIX, LINUX etc (GUI)
3. Multiprogramming o/s
4. multiprocess
5. Time sharing
6. Real time

- Single user o/s: In single user operating system only one user can access the resources and perform its tasks.

P.C.B (Process Control Block)
T.C.B (Task control Blocks)

- A P.C.B is a data structure used by computer operating system to store all the information about a process. It is used to industry to maintain quality and improve performance.

Information store P.C.B

1	ProcessID
2	Process state
3	scheduling Info
4	Program Counter
5	Accounting Inform
6	Memory managent info
7	Register Information
8	I/O Device Information

(2) The kernal - level thread is good for those application that block the frequency.

- Disadvantages:-

(1.) The kernal thread manages and schedules all threads.

(2) The Implementation of kernal Threads is difficult than the user Thread.

(3) The kernal thread is slower then user - level threads.

- Components of Threads

(1) Program counter

(2) Register set

(3) Stack space

* Benefits of Threads:-

- Enhanced throughput of the system
- Effective utilization of multiprocessor system:-

DEADLOCK

Question: What is deadlock?

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

* Nessary condition for deadlock:-

1. Mutual exclusion
2. Hold and wait
3. No preemptive
4. circular wait

- Deadlocks characteriation

(1) Mutual exclusion:- If two process cannot use some resource of some time.

2) Hold and wait:- A process waits for some resource while holding and another resource at the some time.

3) No Preemption:- In process which once scheduled will be excuted till the completion.

- Faster context switch:-
- Responsiveness
- Communication
- Resource sharing

- What is thread?

Thread is a path of excution with a process.
A process can contain multiple thread.
If the process has multiple of control it can do more then more task at a time.
A traditional/heavy weight process is equal to a task with one thread.

- Need of thread:-

(1) Threads can share common data they do not need to use Inter-process communication.

(2) context switch is faster when working with threads.

(3) It takes less time to terminate a thread then a process.

Deadlock prevention:- when the any one no of the four condition mutual exclusion, no preemption, hold & wait, circular wait not occurs or we stop any of the one condition so it is known as deadlock prevention.

In direct method of deadlock prevention

If we can break the mutual Exclusion, hold and wait non-preemption or any one of them so we indirectly prevent deadlock by break that all condition

direct method of deadlock prevention

If we break the circular wait so we prevent system directly from deadlock.

(1) Mutual Exclution:- We can break mutual exclusion by using sharable mode of resource.
we use the protocol of using sharable mode of resources which which are in read only format.

Non-Sharable (Read-write file)

Sharable (Read only file)

CPU Scheduling

- The CPU scheduling is the process by which a process is executed by using the resource of the CPU. the process also can wait due to the absence of the resource. the process make the complete of CPU.

modes of CPU Scheduling algorithm

1. Pre-emption
2. Non Pre-emption

type of CPU Scheduling algorithm.

1. FCFS (First come first Serve)
2. SJF (Shortest Job First)
3. Priority
4. Round robin

1. FCFS:- FCFS is first type CPU Scheduling algorithm. FCFS CPU Scheduling algorithm the CPU allot the resources to the process in certain order. we can also say that FCFS CPU Scheduling algorithm follows first in first out ready queue.

FCFS serve can be called as FCFS in short form.

Advantages:—
very easy to perform by the CPU.
follow FIFO Queue Approach.

Disadvantages:—
FCFS serve is not very efficient.

FCFS suffers because of convoy effect.

SJF:- this is another type of CPU scheduling algorithm. here is this CPU scheduling algorithm we are going to learn how CPU is going to allot resource to the certain process.
the SJF is heavily dependent on the Burst times. every algorithm is basically dependent on the arrival times.

ADvantages:—
SJF used because it has the least average waiting time than the other CPU Scheduling algorithm.

that peace in user area.

(* dynmic approach *)

In this which data we want to access loded into primary memory from secondary memory and than instructions load one by on in RAM which are needed.

there we need to conversion of address logical to physical. so there is RA (RE - allocation Rogister) which contain allocation address of data than the allocation address add in base address of Process or instruction and than it is the physical address of that data or Program

Memory allocation techni

↓ Contiguous memory Allocation

↓ Non-Contig memory Alloca

Memory Allocation:- A Process requir memory space in order to run. As a result, a process must be given a specifi amount of memor that correspond to its needs. memory allocation is a term

(Memory Management)

Memory is the important part of the computer that is used to store the data. its management is critical to computer system because the amount of main memory available. the amount of main memory available in a computer system is very limited.

Type

Primary memory
P-M-M

Secondary m
S-M-M

Secondary M.M
Secondary memory (Auxiliary/ mass storage)

Cloud

Space very large size

Space in virtual where we can securely save our data.

Memory management

sharing

protect

Mansa

for this process Procedure.

there are two type of techniques
1) Contiguos memory Allocation
2) Non-Contiguos memory Allocation.

Contiguos memory Allocation
In this technique we allocate contiguous blocks for each process. whenever a process request to reach main memory.

there are two type of contiguous memory Allocation technique.

- Fixed-size partitioning / position each process in this method of contiguous memory allocation is given a fixed size continuous block in the main memory.

- Variable-size partition
In this type of memory allocation each block's size is determind by the the needs of the process that used it.

{Paging Hardware}

Page table - Page table is a data structure used by paging which contain two information

1. Page no.
2. Frame no.

Page are devided into two part page no. and it's corresponding offset.

Frame are also devided into two parts frame no. and offset of Page.

Segmentation

Segmentation is a non-contiguous memory allocation technique where process are devided into multiple segment and allocate to memory in frames with the help of a data structure known as segment table.

In segmentation, segment is divide into two part segment no. and segment offset.

s	d

* Segment table contain two informa
1. Limit (size of segment)
2. Base address (logical address)

segmentation Hardware

In segmentation logical address divides into segment size, its corresponding offset.

first it check it into the segment table and if size > offset so it it genrates absolute address by adding Base address + offset and it is false (size ! > offset) so the segment trapped into o/s

Comparison between Paging and Segmentation

- Paging :- Non Contiguous memory allocation.

2) Paging divides program into fixed size page.

3) OS is responsible.

4) Paging is faster than ~~paging~~ Segmentation.

5) Paging is closer to OS System.

6) It suffers from internal fragmentation

7) There is no external fragmentati

8) Logical address is divided into Page number and Page offset.

9) Page table is uld to maintain the page information.

Logical V$ Physical address

(1) Logical address :- It generated by CPU while a program is running.

(2) the logical address is virtual address as it does not exist physically, therefore, it is also known as virtual address.

(3) This address is used as a reference to access the physical memory location by CPU.

• 1) physical address :- Identifies a physical location of required data in a memory.

(2) The user never directly deals with the physical address but can access by its corresponding logical address.

Process Synchronization

Process synchronization is the technique to overcome the problem of concurrent access to shared data which can result in data inconsistency.

Definition:- The procedure involved in preserving the appropriate order of execution of cooperative process is known as Process synchronization.
There are various synchronization mechanisms that are used to synchronize the processes.

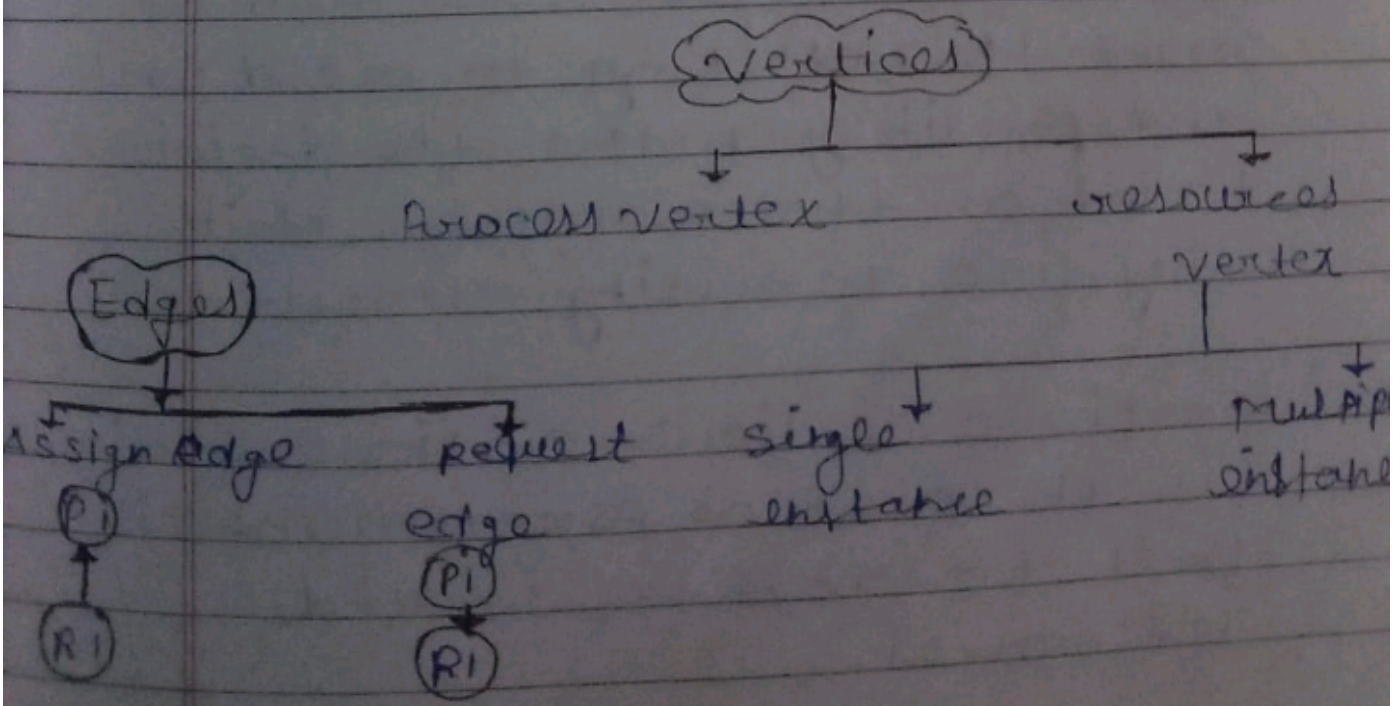
Race Condition:- A Race Condition typically occurs when two or more threads try to read write and possibly make the decision based on the memory that they are accessing concurrently.

Critical Section:- Critical section is the part of program which tries to access shared resources.

Resource Allocation Graphs

The resource allocation graph is the pictorial representation of the state of a system.
As its name suggests, the resource allocation graphs is the compete information about all the processes which are holding some resources or waiting for some resources.
In resource allocation graphs, the process is represented by a circle while the resource is represented by a rectangle.

Type of vertices and edges in detail



- First in First out page Replacement Algorithm.

This is the first basic algorithm of Page Replacement Algorithms. this algorithm is basically depends on the number of frames used. then each frame takes up the certain page and tries to access it.

- optimal Page Replacement Algorithm
This is the second basic algorithm of page Replacement algorithm. this algorithm is basically dependent on the number of frames used. then each frame takes up the certain page and tries to access it.

Least Recently Used (LRU)
This is the last basic algorithm of page Replacement algorithms this algorithm is basically dependent on the number of frames used.
then each frame takes up the certain page and tries to access it.

Swapping

- Swapping is a memory management scheme in which any process can be temporarily swapped from main memory to secondary memory so that the main memory can be made available for other process.
It is used to improve main memory utilization.

Page Replacement Algorithm

- There are three type of page Replacement Algorithm. They are.
- Optimal page replacement algorithm
- First In First Out page replacement Algorithm.
- least recently used (LRU) Page Replacement algorithm.

Segmentation

(1) Non-contiguous memory allocation.

(2) Segmentation divides program into variable size segments.

(3) Compiler is responsible.

(4) segmentation is slower than paging.

(5) segmentation is closer to user.

(6) It suffers from external fragmentation.

(7) There is no external fragmentation

(8) Logical address is divided into Segment number and Segment offset

(9) Segment table maintains the segment information.

Operating System Services

1) operating system provided service to both program as well as user.

2) OS provide an environment to program to execute.

3) OS provide service to user to execute program in environment manner.

OS common services
- Program execution
- I/O operations
- File system manipulation
- Communication
- Error detection
- Resource allocation.
- Protection.

(3) Priority Frame Allocation Algorithm.
According to the quantity of frame allocations and the processes, priority frame allocation distributes frames. Let's say a process has a high priority and needs more frames. In such cases additional frames will be given to the process.

A Physical Address is required by the CPU. For the frame creation and the physical addressing provides the actual address to the frame created.

- The following frame algorithm

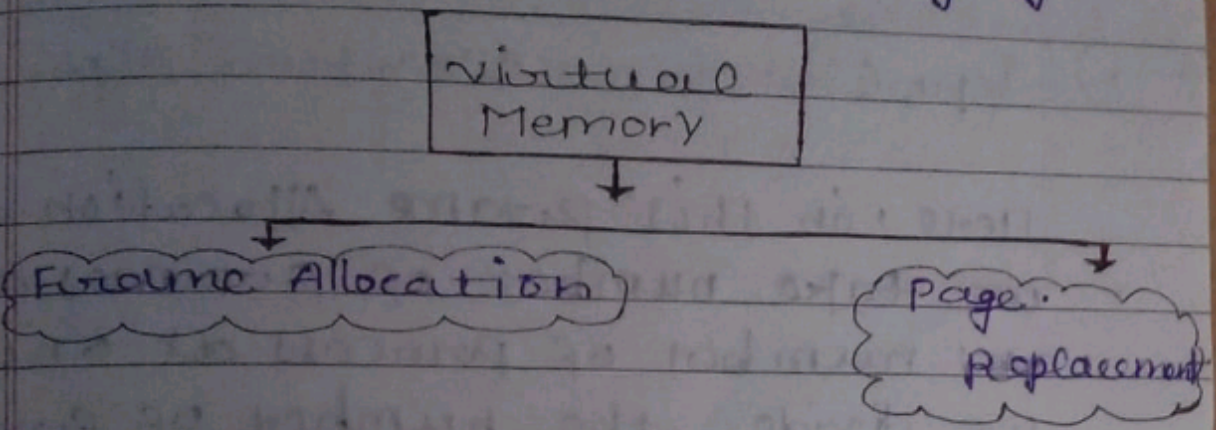
1) Equal frame Allocation Algorithm

Here, in this frame Allocation algorithm we take number of frames and number of process at once. we divide the number of frames by number of processes. we get number of frames we must provide for each Process.

2) Proportionate frame Allocation Algorithm.

Here, is frame Allocation Algorithm we take number of frames based on the process size. For big process more number of frames is allocated. For small processes less number of frames is allocated by the OS.

when the frames are filled then the the actual problem starts. the fixed number of frames is filled up with the help of first frames present.
this concept is fulfilled with the help of Demand paging.



The important job of virtual memory in OS are two.

- Frame Allocation
- Page Replacement.

- Frame Allocation in virtual memory.

Demand paging is used to implement virtual memory, an essential component of OS system.
A page replacement machanism and a frame allocation algorithm must be created for demand paging.

Critical Section Problem

Critical Section problem is the part of program which tries to access shared resources.
the critical section cannot be executed by more then one process at the some time difficulties in allowing and disallowing the process from entering the critical section.
The critical section problem is used to design a set of protocols which can ensure that race condition among the processes will never arise.

Give the Condition that a solution to the critical section problem must satisfy.

Any solution to the critical section problem must satisy three requirement.

* Primary.
1. Mutual exclusion
2. Progress
3. Bounded waiting
2. Architectural Neutrality.

Secondary

System call

- System call is a method for a computer program to request a service from the kernel of the operating system on which it is running. A system call is a request from computer s/w to an operating system kernel.

How System call work:

The application work in an area of memory known as user space. A system call connects to the operating system's kernal which executes in kernal space.

- ## Type of System Call

1) Process Control
2) File management
3) Device management

* Why do you need system call in OS
- It is must require when a file want to create or delete a file.

Network Connection
- If you require the system call to sending and receiving data packet.

Virtual memory & Demand Paging.

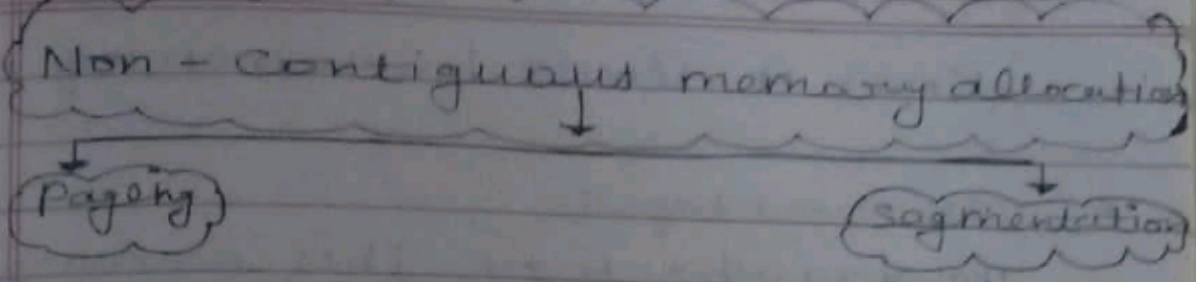
Demand Paging is a technique to implement virtual memory in primary memory.

In this memory allocation technique only need / demanded or usable pages of a process allocated into the frames by a module known as pager.

swapper is a module used in paging which swap all the pages of a process into the frames.

Implementation of demand Paging.

Page fault :- A situation arise when CPU what to execute that page which is not in primary memory because the operating system invalidates its bit status in page table.



* Non-Contiguous memory allocation:
Non-contiguous memory allocation divides the process into blocks (or page or segments), which are subsequently allotted to different memory location in accordance with the quantity of free memory. this method use to make a process's physical address space non-contiguous are Paging and segmentation.

non-contiguous memory allocation also reduces memory waste caused by internal and external fragmentation because it utilises the memory gaps left by internal and external fragmentation.

Non-contiguous memory allocation proceeds more slowly than Contiguous memory allocation. segmentation and paging are included.

memory management

uniprogramming approach (Mono-programming

multiprogramming approach

- Uniprogramming Approach:-
It is used for single process are single program at a time so in this it easy to secure the system but now-a-days uni-programming approach is not feasible and not used.

- Multiprogramming Approach:-
In this approach multiple process or program execute at some time so because of multiple program it is very difficult or compex to manage.

(* static approach *)

In these are two section memory used area & O/S area which are separate by FR fence Register. And every process has it's own base address so if BA<FR so there is a trap and if BA>FR so that process allocated at

- Disadvantages:-

1) Starvation is one of the negative traits of CPU scheduling algorithm exhibits.

(3) Priority :- This is another type of CPU Scheduling Algorithm.
The priority CPU Scheduling Algorithm. different from the remaining CPU scheduling Algorithm.

There are two type Priority values:-

1) Highest number is considered as highest Priority value.
2) Lowest Number is consider as lowest priority value.

ADVantages:-

1) It is easier to handle priority CPU scheduling.

2) It is less complex.

DisAdvantages:-

1) The starvation problum is one of the Pre emptive priority CPU Scheduling Algorithm's most prevalent flaws.

Banker's Algo:

Step-1 Let work and finish are two vectors of length m and n respectively let work = Available, and finish i = false for all i.

Step:-2 find a process i such that:-
(i) finish i = false
Need i ≤ work
if such i exists go to step 4

Step:-3 work = work + Allocation i
Repeat step 2

Step4:- if finish i = true for all i system is SAFE & SAFE sequence exists.

- Deadlock Avoidance
- when we do any one
- kill that victim process
- Ignore deadlock
- So it is known as deadlock Avoidance

Difference between Deadlock Prevention and Deadlock Avoidance is.

	Deadlock prevention	Deadlock Avoidance
1.	It assures that at last one of the four deadlock conditions never occurce.	It prevents the ~~the~~ system from coming to an unsafe system
	All the resources in deadlock prevention are requested together.	Resource requests in deadlock avoidance are excuted according to safe path.
	It ~~do~~ is conservation in deadlock prevention.	It is not conservation in deadlock Avoidance.

Data structure Algorithm Bankers algorithm.

- Deadlock Algorithm

(i) Safty Algorithm (Bankers algorith)

Data structure in Bankers algo.

(1) Accocation:- Matrix of order mxn which defines no of allocated Resources to any process.

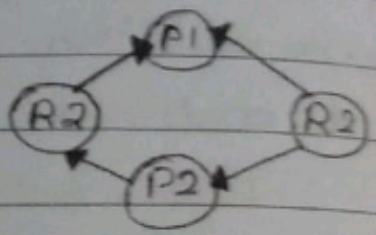
Allocation(i j) = Resource Rj has been allocated to process P i.

(2) Max :- Matrix of mxn which define no of maximum Resources to be allocate to any Procer ~~max~~ ~~ij~~

Max(i,j) = maximum instanses of Resources Rj can be allocated to process Pi

(3) Need :- matrix which define need of any resources to any process.
Need(i j) = k instances of resource Rj is needed by processPi.
Need(i,j) = max(i,j) - Allocation (i,j)]

② Hold and wait:- we break or avoid that condition by using the protocol which is "before generating a request for a resource a process must be release all the resources held by that.



Release

we use the model

1) Request
2) Allocation
3) use
4) Relase.

③ Non-preemption:- this condition will break by using emplicity Relase protocal.

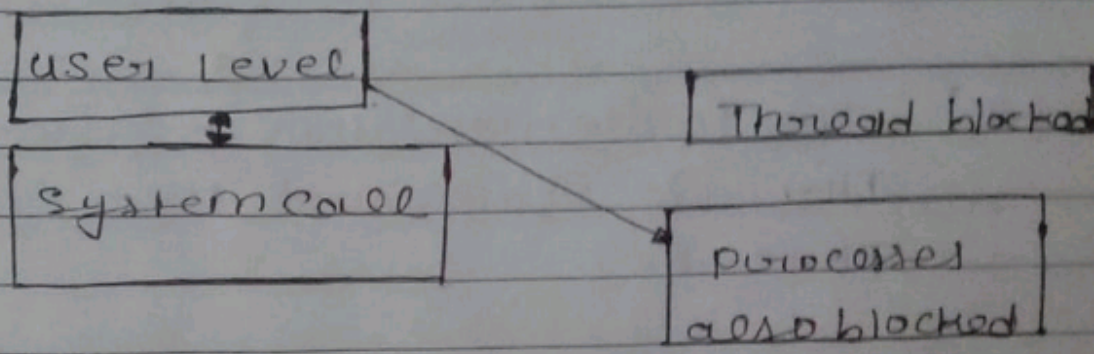
emplicit → not expressed in a direct way but understood by the people involved.

④ circular wait:- to violate wait, we can assign a priority number to each of the resource

(1) Disadvantages:-

(i) User-level threads lack coordination between the thread and kernel.

(2) If a thread causes a page fault the entie process is blocked.



- Kernal thread:- Kernel threads are empeemanted by operating system. Thread managent is by the Kernal.
- No Thread table in each Process.
- Kernal has a thread table that keeps track of all the threads of all the users in system.
- Information stored in Kernal instead of user space.

- ADVANTAGES:-

(1) The Kernal-level thread is fully aware of all threads.

(4) Circular wait :- All the process must be waiting for the resource in a cycle manner.

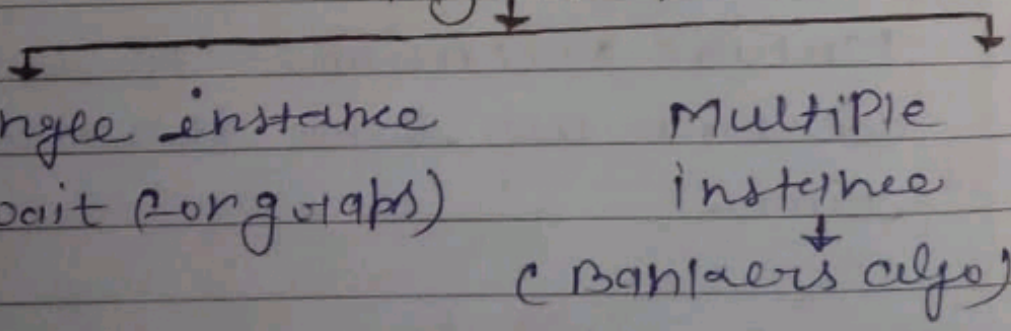
* Deadlock Prevention :-

- Avoidance detection and recovery

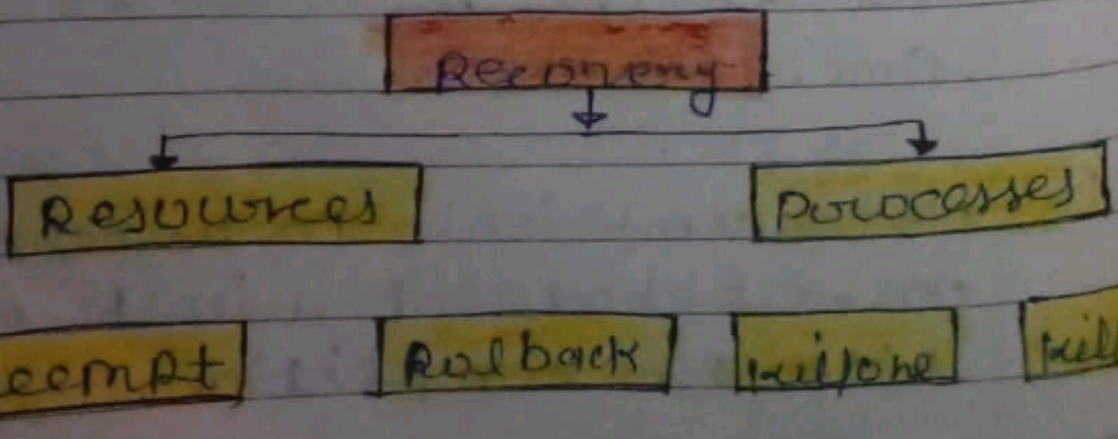
- Allow the system to enter into deadlocked state.

- Deadlock detection algorithm
- Recovery techniques

* two type of Deadlock detution Algorithm



Deadlock recovery



THREAD

Small weighted process

Multi-threading O/S

EX:- window: 7, 8, 11....

TYPE THREAD → User Threads

TYPE THREAD → "kernal/system Thread

(1. • User Thread

User thread are implemented by user.

kernal known nothing about user level thread.

User level threads are loaded entirely in user space.

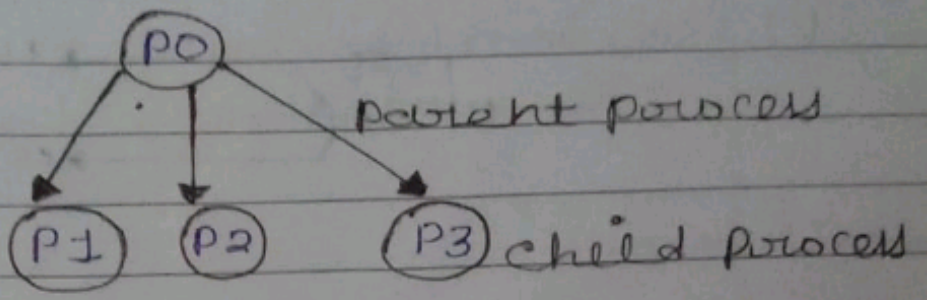
Each process need its own Private thread table which consists of Program Counter, Stack, Pointer, register, state etc.

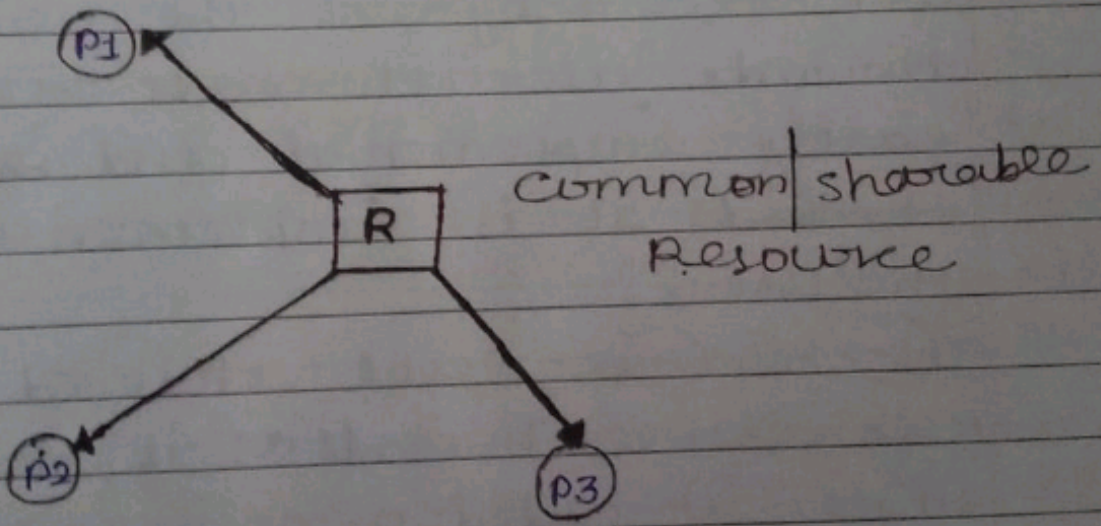
• ADVANTAGES

(1) The user threads can be easily implemented than the kernal thread.

0) It is fast and efficient.

- child process.
  the process which will execute by deviding process sub-processes and every process execute defferently.

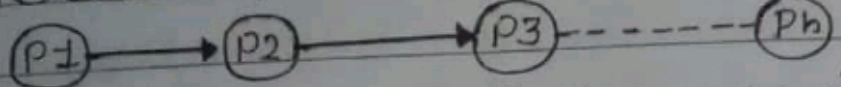




Different type of Process

1. Serial process
2. concurrent process
3. co-opperating process
4. child process.

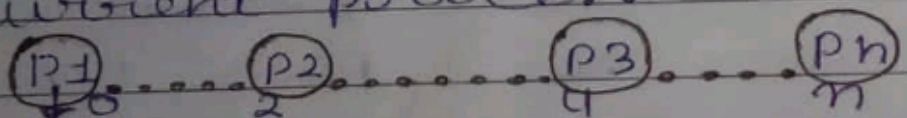
(1.) Serial process:-



the process which executed without affecting other process is known as serial process.

(2) Co-current process

The process which execute by sharing time slice or time quanta is known as concurrent process.



(e) q=2

(3) Co-operating process:-

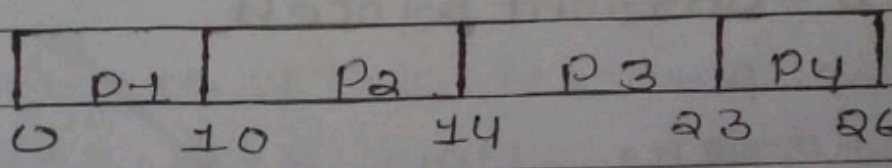
the process which execute parellery is known as co-opera process thise process execute by sharing resources.

Turn around time for P1 = 30ms
P2 = 06ms
P3 = 03ms

* FCFS Algo *

Process	CPU BT (ms)
P1	10
P2	4
P3	9
P4	3

Gantt Chart



waiting time for P1 = 0ms
P2 = 10ms
P3 = 14ms
P4 = 23ms

Average WT = $\frac{47}{4}$ = 11.75m

TAT for P1 = 10ms
P2 = 14ms
P3 = 23ms
P4 = 26ms

ATAT = $\frac{73}{4}$ = 18.25ms

(4) Turn around time:- It should be low
TAT = (FT - AT)
Some of all TAT of process
Noumber of process.

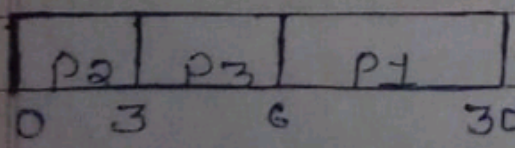
(5) ARRIVal time:- Rate at which process are completed porewit time.

6) Finish time:- FAIR Share US OF CPU

Time when the Process come out fo the system.

Process	CPU Burst time (ms)
P2	3
P3	3
P1	24

- Gantt chart for following condit



waiting time for P1 = 6ms
waiting time for P2 = 0ms
waiting time for P3 = 3ms
Average waiting time = $\frac{6+0+03}{3}$

$= \frac{09}{3} = 3ms$

- CPU use multipse Algorithm which are :-

1) FCFS (First come First Serve)

2) SJF (Shortest Job First)

3) RR (Round Robin)

4) Priority

CPU scheduling algorithm

Non-pre-emptive scheduling	pre-emptive scheduling
FCFS, SJF, RR, Priority	SJF, Priority

Different term Related to CPU scheduling Algorithm.

(1) Throughput:- Rate at which Process are completed pre unit time throughput should be high.

(2) CPU Burst time:- time Required by process complete its execution.

(3) Wating time:- SUM of Avarage time Process number of Proce

It should be less.

formula:- TAT - Burst time

- CPU scheduling :- CPU schduling is a schedule which CPU use to execute its process.

CPU scheduling is a process of determining which process will one CPU for execution while another process on hold.

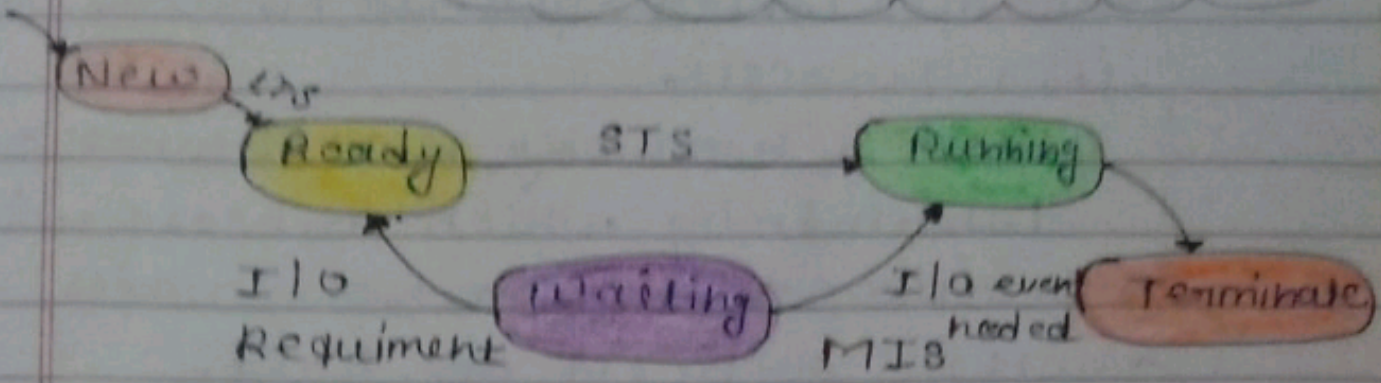
TYPE CPU scheduling

* Pre-emptive	non-Pre-emptive
• Round Robin	• first com first
• priority scheduling	
• shortest Remaning time first	shortest job first
	• logest job first
• longest remaining job first.	• highest response Ratio next

* Purpose of scheduling Algorithm

- Maximum CPU utilization
- fare allocation of CPU
- Maximum through
- Minimum waiting time.

PROCESS State Diagram(Task)



1. New:- Process has been genrated in this state.

2. Ready:- This state ensures that process is ready for allocating to CPU.

3. Running:- Actualy executing inside CPU

4. Waiting: wait to free the resource that needed to complete the process.

5. Terminate: end of currently execution process

Modules(S) → 1) scheduler: long time, short time, middle time

2) dispatcher

long term → Job Schduler
short term → (CPU) Scheular

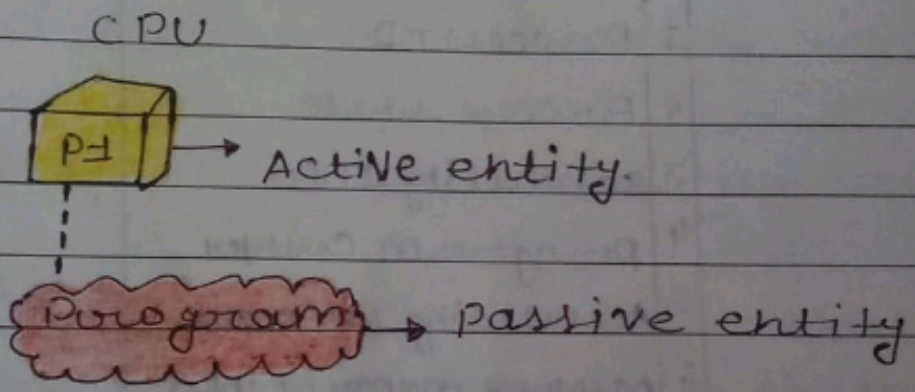
Process Management

"Program during execution"

"Process is activity entity" which generates program after complete execution.

A program does nothing unless its instruction are executed by a CPU.

A program in execution is called a process.



- Creation
- Updation
- Control
- Operation
- termination

	Process	Program
①	Active entity	① passive entity
②	responsible for generating Program	② generates by process

BATCH PROCESSING O/S

- A Batch processing mode Batch of some types of jobs and install the environment execute jobs and then it then install another environment and execute other jobs.

- ADvantages:-

(1) Multiple user can share the batch system.

(2) The idle for the batch system is very less.

- Disadvantages:-

(1) Batch System are hard to debug.

(2) It is sometimes costly.

Example of Batch processing System.
Billing system
Bank invoice system.

- ADVANTAGES OF O.S

1. O.S also allow us to sharing the resource with other user.

2. It help user to understand the function of a computer.

3. It is very ~~useful~~ easy to use.

4. It can be easily updated.

- Disadvantages

1. Only some task no at a time.

Difference singee user and multiuser OS

	Singee user	Multiuser
1.	singee user can use	More then one user
2.	at a time	can use at a time.
3.	simpee	compex
4.	small in size	Large in size
5.	No sharing of data	Sharing of data
6.	cpu sits idle most of the time	Best untilization of cpu time because of many
7.	standalone	Many system are connected with one system

- Multiuser:- In the multiuser operating system, multiple user can access the resources simultaneously.

- Multiprogramming:- A multiprogramming operating system may run many programs on a single processor computer.

Multiprocessor:- In operating system, to improve the performance of more than one CPU can be used within on computer system is called multiprocessor operating system.

Time sharing:- Time sharing operating system work with time sharing concept.
A time sharing operating system allows many users to be served simultaneously. So sophisticated CPU scheduling schemes and I/O managment are required.

Real time:- Real time operating system is very useful where we required a quick responce for ex:- Missile system.