Toppersnotes
Unleash the topper in you

ToppersNotes

GATE

COMPUTER SCIENCE & INFORMATION TECHNOLOGY

VOLUME-V

OPERATING SYSTEM & SOFTWARE

Sierra Innovations Pvt. Ltd.

Toppersnotes
Unleash the topper in you

Contents

Toppersnotes
Unleash the topper in you

Operating System

Syllabus :-

1. Introduction and Background.
2. Process Management
   - Process Concept
   - CPU Scheduling.
   - Synchronization.
   - Concurrent programming
   - Deadlock
   - Threads.
3. Memory Management
   - RAM chip implementation
   - Loading, linking and Address Binding
   - Techniques
     - paging
     - Multilevel paging.
     - Inverted paging.
     - Segmentation.
     - Segmented paging.
   - Virtual Memory.
4. File and Device Management.

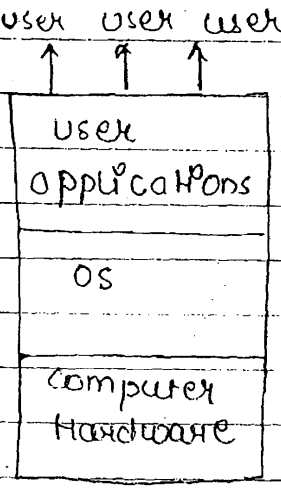
Toppersnotes
Unleash the topper in you

Syllabus :-

1. Introduction and Background.
2. Process Management
    - Process Concept :
    - CPU Scheduling.
    - Synchronization.
    - Concurrent programming
    - Deadlock
    - Threads
3. Memory Management
    - RAM chips implementation
    - Loading, Linking and Address Binding.
    - Techniques
        - paging
        - Multilevel paging.
        - Inverted paging.
        - Segmentation.
        - Segmented paging.
    - Virtual Memory.
4. File and Device Management.

What is an Operating System?

Operating system is a interface between user and computer hardware.




```
main()
{
  int x;
  printf("Hello")
}
```

→ internally calls write() system call inorder to communicate with the monitor

System Call:- System call is a request made by the user program to the operating system inorder to get any kind of service.

Operating System is also called as Resource Allocator because it is responsible of allocating resources of a computer.

Resources

1. Hardware Type
   eg. Devices & Memory.

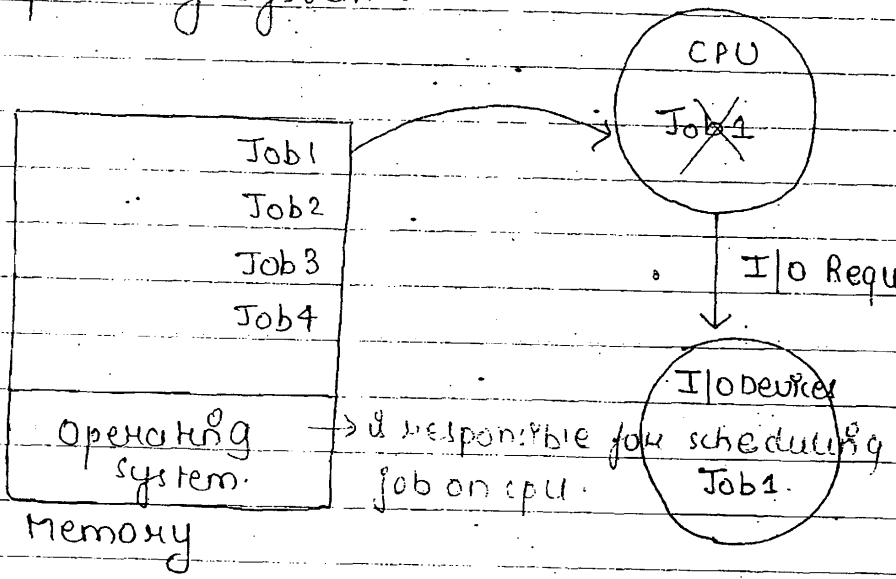
2. Software Type
eg. Files

Goals of the operating system:

1. The primary goal of the operating system is convenience
   ↳ easy to use
2. Secondary goal is efficiency.
   ↳ the operating the system computer is very much stable in case of utility

Types of the operating System.

1. Batch operating system :-



- If the job is completed completely then only another job will be schedule onto the CPU.
- Increase the CPU idleness
- Decreased the throughput of the system.

eg IBM OS/2.

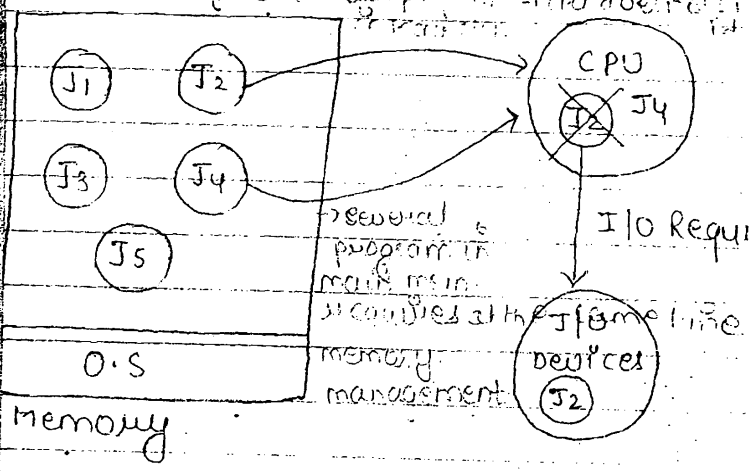
Throughput :-

No of jobs completed for unit time is called as Throughput of the system.

2. Multiprogramming Operating System:-

The use of multiprogramming was enhanced by the arrival of virtual machines. It enables the individual prog to make use of memory and other resources as if other concurrently programs were to use all practical purposes, non existent and invisible to them.

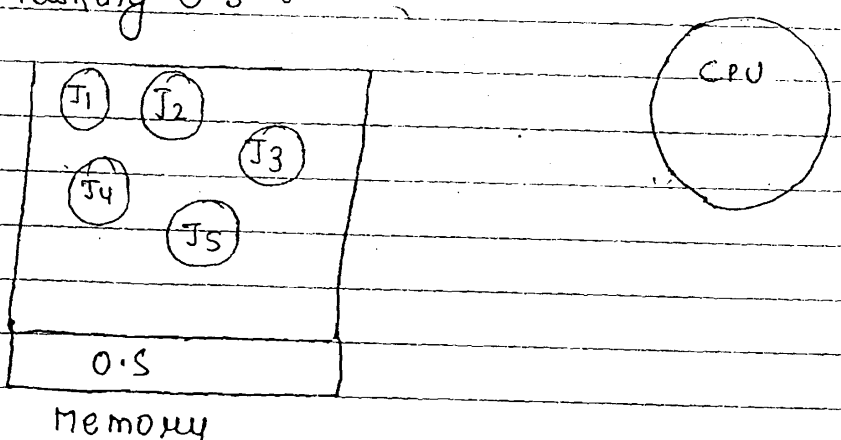
It doesn't give guarantee that prog will run in a timely manner. Indeed, very first prog may run for hours but it greatly reduces wait times when multiple jobs are being processed.



- If the job is leaving the CPU to perform I/O operation then another job which is ready for execution will schedule onto the CPU.
- Increased CPU utilization
- Throughput of the system is increased.

eg Windows, Unix and Linux

3. MultiTasking O·S :-

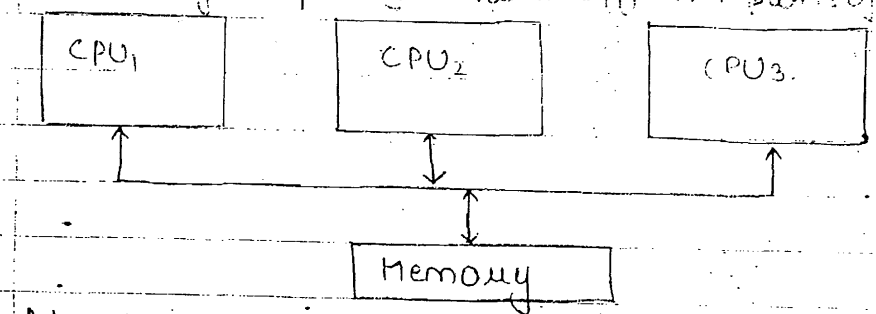


- Multitasking is an extension of multiprogramming O.S.
- The Jobs will be executed in a time sharing mode.
- At any point of time, only one job execute inside the CPU

eg→ Windows, Unix, Linux.

4. Multiprocessor O.S :- (Parallel System).

A method of computing in which different parts of the task are distributed among more than one CPU, allowing the computer to complete the execution more quickly and to handle larger and more complex programs.



Advantage :-

1. Increased throughput of the System.
2. Reliability. (If one CPU fails, the system will still run with the help of remaining CPU's).
   Also called as Fault Tolerant System.
3. Economical. (In compare, if we have three different system with single-single CPU, the multiprocessor system sharing same peripheral devices, cost will be very less).

5. Real Time O.S :-

The system which are strict deadly time bound are called as Real time systems. ↳ there should not be any delay while executing the instruction of a computer program.

They are of two types.

1. Hard Real time (No delay accepted)
   eg. Missile system, Satellite system.
2. Software Real time (Minor delay can be accepted).
   eg. Banking sector.

eg→ classroom

Process Management

↳ active entity

Process Concept :-

Def :- The program under execution is called as a process

- It should reside on the main memory.
- It is occupied the CPU to execute the instructions of the process.
- Process will have a various attributes.

- Process Id
- Process state
- Priority
- Program Counter
- General purpose Register
- List of open file
- List of open devices
- Protection information

→ All the attributes of the process called as context of the process

Process Id :-

Process id is the unique identification no which is assigned by the operating system at the time of process creation.

Process State :-

Process state contains the current state information of a process where it is residing.

Priority :-

Priority is a parameter which is assigned by the O.S at the time of the process creation

Program Counter :-
It contains the address of the next instruction to be executed.

- All the attributes of the process called as context of the process
- Context of the process will be stored in PCB (process control Block.

Pid	P.S
Priority	P.C
G.P.R	L.O.F
L.O.D	protection information

PCB.

- Every process will have its own PCB.
- PCB of the processes will be stored in the main memory.
- PCB's of the processes will be implemented by using the Double link list

Process will be having various states.

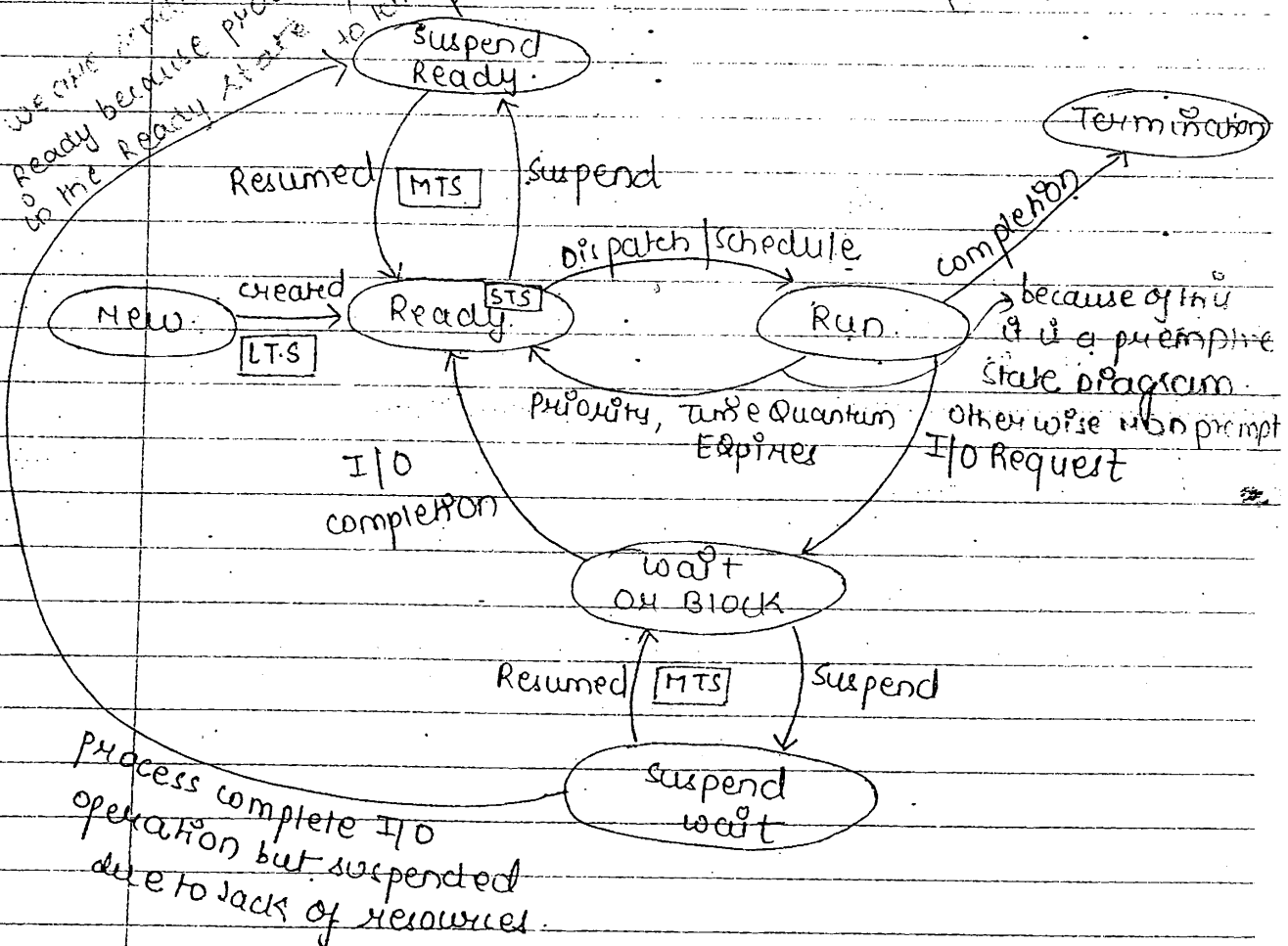
1. New state
2. Ready.
3. Run.
4. wait or Block.
5. Termination or completion.
6. Suspend Ready.
7. Suspend Block or suspend wait.

The various operations will be performed one the process.

1. Creation → fork
2. Scheduling
3. Dispatching
4. Execution
5. Termination or killing: kill system call
6. Suspend
7. Resume

Process State Diagram

Time quantum used in the Round Robin once it completed, preempted back to Ready state



1. Initially process will be in the New state.
It means the process is under creation or process is being created.
2. Once the process is created, it will be moved onto the Ready state and in the ready state there will be multiple no of processes.
3. One of the process will be selected from the ready state and that will be dispatched / schedule on the Running state
4. When the process is in the running state, it is occupied the CPU and executing the instr of a process and performing the CPU time.
5. In running state there will be only one process at any point of time.
6. If the running process requires any I/O operation then it will be moved onto the wait or Block state.
7. In the wait also, there will be multiple no of processes, it means multiple processes will perform I/O operation simultaneously
8. Once the I/O is completed the process moves into the ready state.
Once the process in the Running state is completed it will be moved to the Termination state.

Multiprogramming.

Non-pre-emptive

~~Non~~ pre-emptive. called multitasking

OR

~~multitasking~~

OR

Time sharing.

9. When the process is in the Ready, Running and the wait state, it is residing in the main memory.
10. If the Resources are not sufficient to maintain the processes in the Ready state then some of the process will be suspended and they will be moved onto the suspend Ready state.
When the process in the suspend Ready state., it is residing in the ~~no~~ secondary memory. (Backing store
→ In the same manner, when the resources are not sufficient in the wait then some of the processes will be suspended and moved into the Suspend wait state.

Degree of Multiprogramming
The no of process present in the main memory at any point of time is called Degree of multiprogramming

Processes are characterised into the two types
1. CPU Bound process
2. I/O Bound process

CPU Bound process
- The process which require more amount of CPU time are called as CPU Bound processes.
- They will busy in performing CPU time.
- These processes will spend more time in the running state.

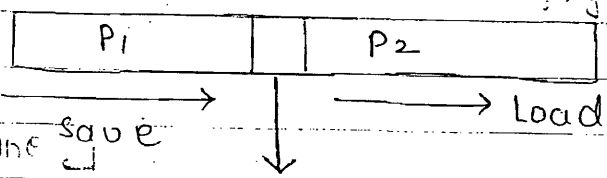
I/O Bound Process.
- The processes which requires more amount of I/O time are called as I/O bound processes.
- These processes will spend more time in the wait or Blocked state.

- Each and every time when the process is moving from one state to other state, the context of the process will change

Context switching :-

- Saving the context of one process and loading the context of another process is called as Context switching.

↳ highly dependent on hardware support



Already saving the context of PC so that when it returns to the same process it can execute the next address.

Note :- In some special if there is only one process, still that is called as a context switching.

eg :- Round Robin scheduling with the one process.

- If the context of the process is more then context switching is also increase which is undesirable.
- Context switching time is considered is overhead for the system.

In

In the operating system there are 3 different schedulers.

1. Longterm Scheduler / Job scheduler.
2. Short term Scheduler / CPU scheduler.
3. Mid term. Scheduler. / Medium Term Scheduler.

LTS is responsible of creating and bringing new processes into the system

STS is responsible of selecting one of the process in the ready state for scheduling onto the CPU (Running state).

MTS is responsible of suspending and resuming the processes.

LMTS can both increase and decrease degree of multiprogramming.

The job done by the MTS is called as swapping. because it swapping the process from main memory to secondary mem. or secondary mem to main memory.

Dispatcher :-

It is responsible of performing context switching. Also responsible of loading the selected job onto the CPU

Longterm scheduler should select good combination of both CPU bound and I/O bound processes inorder to get good throughput of the system.

Longterm scheduler controls the degree of multiprogramming. When the large no of processes are created by the LTS then degree of multiprogramming will increase.

Q. Consider a system which has n CPU processors then what is the minimum and maximum no of processes that may present in the ready, running, wait states.

	Min	Max	
Ready	0	Any no of processes.	Any Depends on Maximum degree of Multiprogramming in the system.
Running	0	n	
Wait	0	Any no of processes.	

The process will have various different times.

1) Arrival Time :- The time when the process is arrived in the ready state is called as Arrival time of the process

2) Completion Time :- The time when the process is completed its total execution is called as completion time of the process

3.) Burst Time :- The time required by the process for its execution is called as Burst time of the process.

4.) Turn Around Time :-
The time difference b/w completion time and arrival time is called as turn around time of a process.

$$T.A.T = C.T - A.T$$

5.) Waiting Time :-
The time difference b/w turn around time and burst time is called as waiting time of a process.

$$W.T = T.A.T - B.T$$

→ useful time
→ Total time interval.

6.) Response Time :-
The time difference b/w the first response and arrival time is called as Response time of a process.

Dual Mode operation.

User Mode
Non privileged Mode
Kernel Mode.
Privileged Mode

Mode Bit

0 → Kernel Mode

1 → User Mode.

- In the hardware level, the Instr are executed by using dual mode operation.

1.) User Mode
2.) Kernel Mode OR System Mode OR Supervisory Mode.

- The dual mode operation is used inorder to provide protection and security to the user program and also to the operating system from the 'errant users'
- It is purely the decision of the O.S in which particular mode the instr has to be executed
- Generally, the priviliged instr are executed in the kernal mode, and the Non-Priviliged are executed in the user mode.
- The mode bit is used to identify in which particular mode the current instr is executing.
- In the boot time the system always, starts with the Kernel mode.
- The O.S always runs in Kernel mode
- The mode-switching takes very less time compared to the process switching.

Privileged Instructions

Examples

I/O operations — Reading file from harddisk.
Context switching
Disabling the interrupts.
clearing the memory. — Deallocating mem. to the process
Set the time of the clock — changing the system clock time.
Changing Mem. Map. — changing process from one mem. location to another.

Non Priviliged Instructions:

Examples

Reading the time of the clock.
Reading the status of the processor
Sending the final print o/p to the printer