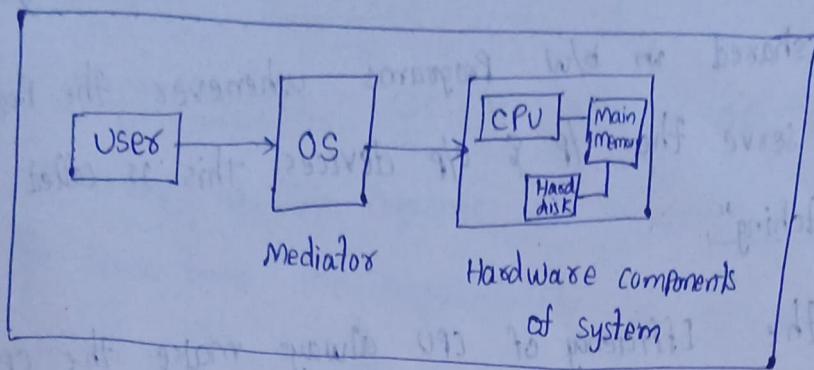


Operating Systems:-

→ It is a software program which is acting as mediator in between User & Hardware Components of computer.



* Bootstrap Program:-

→ It is a program which contains the set of Applications Programs & softwares which are required to ready the system for processing.

→ Whenever the User presses the CPU button then automatically this program is loaded from Harddisk to Main Memory & forwarded to CPU for execution.

→ The Operating System (OS) is responsible for loading the program for execution.

* Features of OS:-

① Convenience:- The OS makes the computer much more convenient to the user by providing the resources of system functionality to the user.

② Efficiency:- The responsibility of OS which is used to access the resources of System whenever the Multiple Programs are required to execute parallelly in the same time span.

→ the CPU is shared in b/w Programs whenever the Program requires to serve the i/p & o/p devices. This is called "context switching".

→ To increase the Efficiency of CPU always make the CPU Busy & not be Idle.

→ I/P & O/P devices are stored when compared to Hardware resource of System.

③ Ability to Evolve:- The OS allows the new softwares to be installed into the system to increase the functionality of System.

④ Throughput:- The OS is responsible for executing maximum no. of Programs to be served by CPU.

→ with the minimum waiting time & maximum throughput which makes CPU Busy & Increases the performance of System (OS) CPU.

Examples of OS:-

- ① Windows → Developed by Microsoft
- ② Linux → Unix based
- ③ DOS → Command Prompt based
- ④ iOS → Developed by Apple

Single user system

- Mobile OS
- ④ iOS → Developed by Apple
 - ⑤ Android → Linux Platform
 - ⑥ Unix → Multi User System.

* Responsibilities of OS:-

① Resource Manager:- OS is acting as Resource Manager whenever Multiple Programs are required to execute at the same time. The responsibility of OS which is used to manage (or) share the resources of System to perform execution by considering the factors minimum weight in time and maximum throughput.

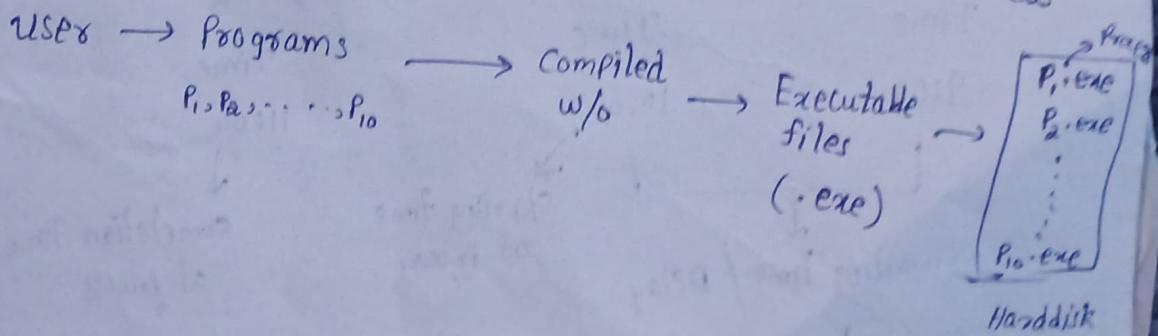
②

* Process / CPU Management:-

* Process refers to the program in execution.

Consider a user written some programs $P_1, P_2, P_3, \dots, P_{10}$ which are compiled without having errors which produce executable file. These files are nothing but process. These processes are stored permanently in harddisk.

* Processes → No. of Programs in execution / No. of Process



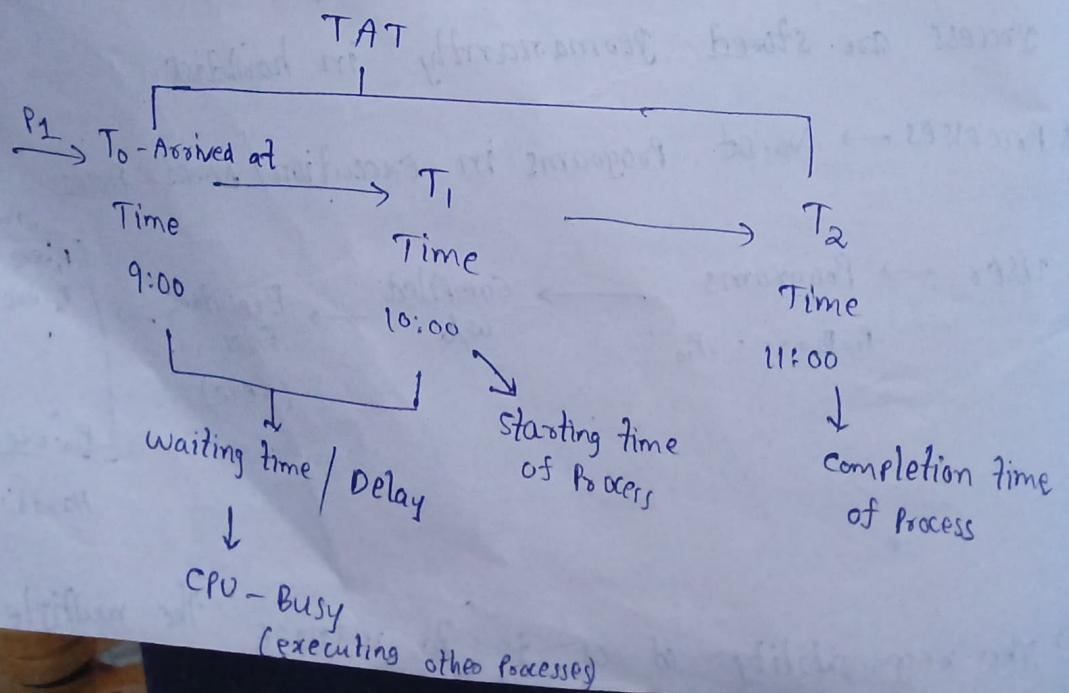
→ The responsibility of OS is to manage the multiple

processes execution by sharing the CPU.

- The OS uses CPU scheduling Algorithm in order to organise the processes and the OS is taken decision to pick one process at a time for execution.
- Consider process P_1 is selected for execution which is arrived at T_0 time (9:00) and started its execution at T_1 time (i.e., 10:00), in b/w the process is been in waiting state as CPU is busy with other process execution and its T_1 completed its execution at T_2 time [11:00]

TAT [Turn Around Time] = It is the interval b/w Arrival time & Completion time

- Always the OS ensures the minimum waiting time, minimum TAT time for processes execution.



③ Memory Management:-

- The OS is responsible for sharing the memory to multiple processes in order to perform the execution.
- * Primary Memory:-
 - The main memory is a single block of storage, it does not mean that there is a single memory chip.
 - The OS is responsible for allocating and reallocating the memory for processes & it also maintains the total available space.
- * Secondary memory:-
 - This devices does not have direct access with CPU.
 - Ex:- HD, CD-ROM, Magnetic Tapes, Floppy disk.
 - Every devices having different characteristics.
 - If the process is not available in Main Memory for execution the OS instructs the Device Driver to retrieve the process from Hard disk to main Memory for execution.
 - These devices are slow in speed compared to Primary Memory.

④ Device Management:- There are different types of devices. They are → Input Devices
→ Output Devices

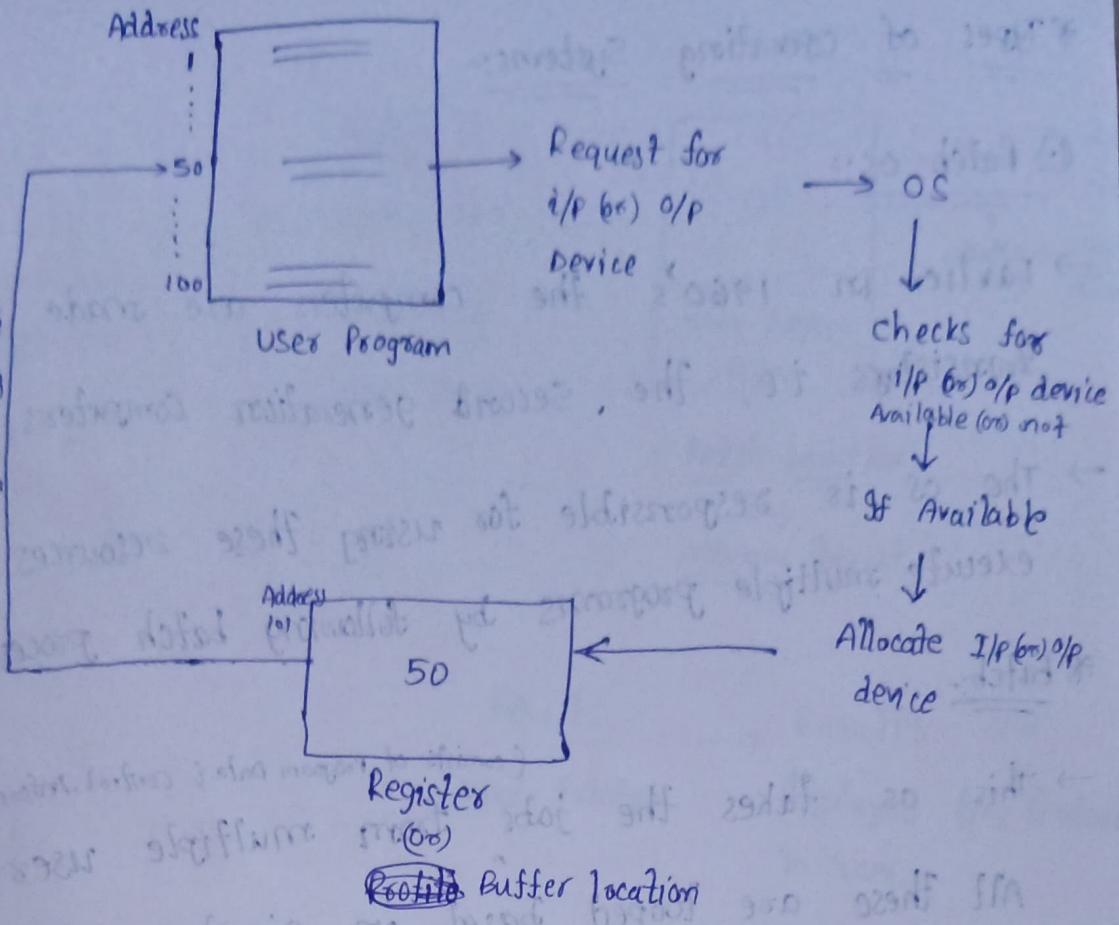
* Input Devices:- These devices are used for taking the input from user such as keyboard, mouse etc.

* Output Devices:- These devices are used to produce the results to the user such as monitor, printer, speaker, projector etc.

→ During the execution of Program (or) process if ever it requires input (or) output device then the request is forwarded to OS then OS will verify whether the devices are available (or) not and make allocation of device to the program.

→ During this time, the OS which is used to store the address of the program where it is stopped for requesting i/p (or) o/p devices from the OS in order to understand from which address the program execution required to continue after serving the i/p (or) o/p device.

We use registers in which the Address at which the program stopped. So, by using Registers we can continue the program from their onwards.



⑤ Security Management :-

→ OS provides protection to the System as well as for Data accessing it is required to maintain the passwords for user login accounts and it also maintains access control Matrix which is a collection of users and their permissions to access the data (or) file, applications etc.

Report
if
different surfaces

DOC ← Report ← → DOC ←

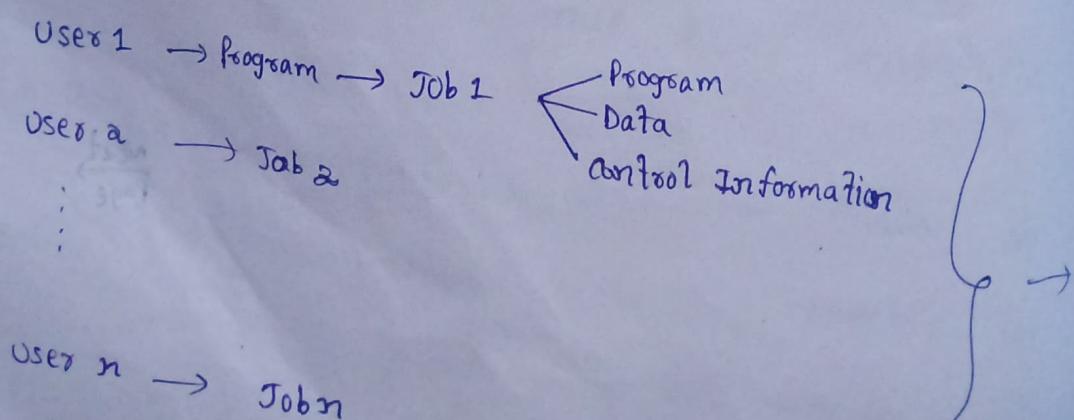
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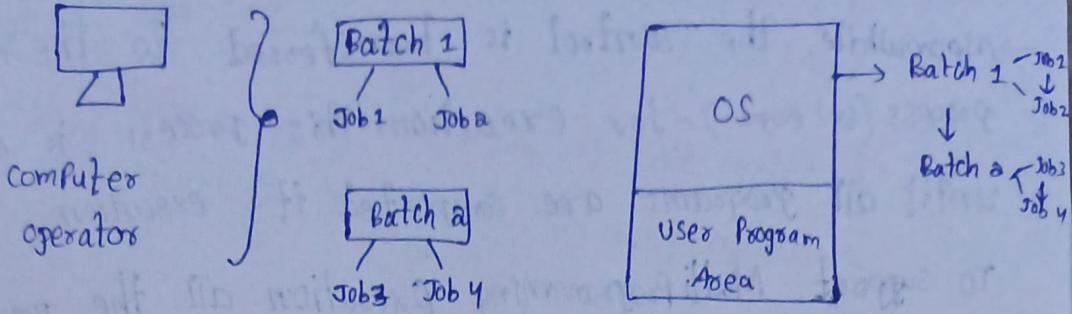
* Types of operating Systems:-

① Batch OS:-

- Earlier in 1960's the computers are made up of transistors i.e., the second generation computers.
- The OS is responsible for using these resources to execute multiple programs by following batch processing.
- * Batch:-
- This OS takes the jobs from multiple users. (consists of Program Data & control information) All these are loaded based on similar needs to form a Batch.
- All these batches are submitted to OS from user program memory area. Then, OS executes the programs batch by batch. Sequentially the control is automatically transferred to other batch if ever the previous batch is completed.

This is called "Batch OS".





Batch monitor
(or)

Memory Layout

Results
are pointed → Results are
displayed (or) Produced
to users.

* I/P Devices → Magnetic Tapes

O/P Devices → Line Printer

* Batch OS Responsibilities

Scheduling
Memory Management
Processing Control Information.

② Multi programming OS:-

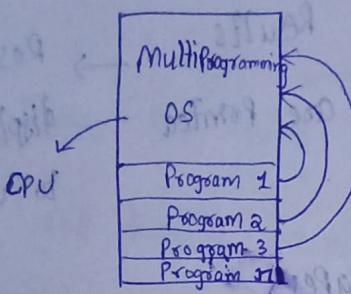
→ The OS is responsible for handling multiple programs at a time in order to increase the CPU utilization. For this the OS requires to follow "scheduling Algorithms" in order to choose one process at a time for execution.

If the process required any IO device then the OS switches the process control from CPU

to IO device.

→ Meanwhile, the control is transferred to the other process (or program) for execution. This process is continued until all programs are completed. It's execution.

To support Multi Programming Execution all the programs must be loaded into Main memory. Then, OS is responsible for handling all these programs for execution.



Main Memory Layout

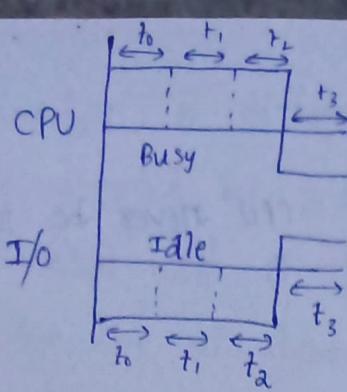
→ During the execution of program it follows CPU IO cycles i.e., in form of "CPU Bound Program Phase".

→ There are two types

- CPU Bound Program Phase
- IO Bound Program Phase

* CPU Bound Program Phase: This is the cycle of maximum CPU computation & minimum usage of IO devices.

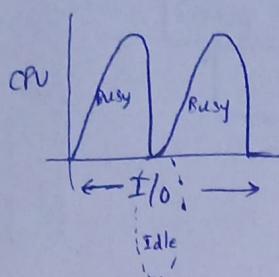
→ Similarly vice versa for IO Bound Program phase



CPU \Rightarrow Idle cycles = 3
Busy cycles = 3

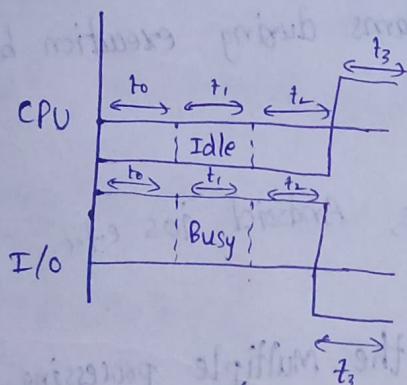
I/O \Rightarrow Idle cycles = 3

~~Busy cycles = 1~~



* I/O Bound Program Phase:-

→ This is the cycle of maximum usage of I/O devices and minimum CPU computation.



CPU \Rightarrow Idle cycles = 3
Busy cycles = 1

I/O \Rightarrow Idle cycles = 1
Busy cycles = 3

CPU \Rightarrow Idle cycles = 3
Busy cycles = 1

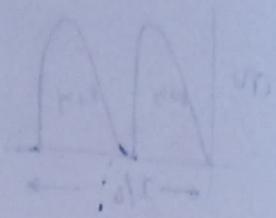
I/O \Rightarrow Idle cycles = 1
Busy cycles = 3

→ Always it is required to have CPU Bound program cycle for supporting Multi Programming OS and thereby increasing CPU utilization.

* Advantages of Multi Programming OS:-

- It increases CPU utilization because CPU never be in ideal state.
- Memory utilization is efficient
- Throughput CPU is high.

The maximum no of programs that are to be executed in the unit time



* Disadvantages of Multi Programming OS:-

- OS additionally uses Scheduling Algorithms to choose one process at a time.
- It also needs memory management.
- The user cannot modify the programs during execution because these are non-interactive OS.

Ex:- Linux, windows, Android, ios etc.

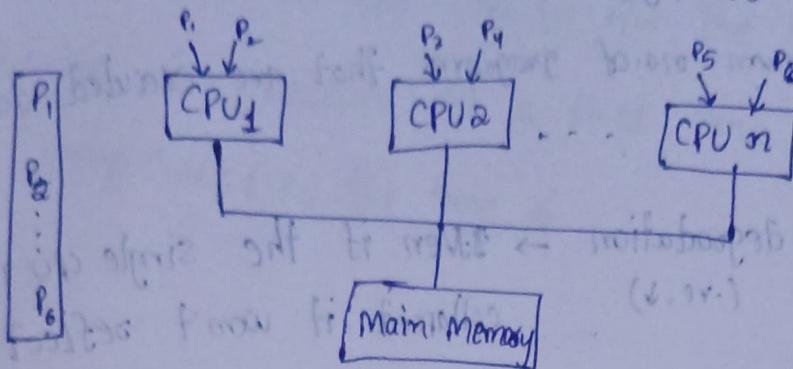
③ Multiprocessing OS:- It refers to the multiple processing units

(*) CPU's that are existed in the system by sharing with only single main memory block.

=) Quad core Processor :- 4 different CPU's are present

=) Octa core Processor :- 8 different CPU's are present

→ consider 6 different programs that are required to be executed by 3 different CPU's. Each and every CPU is allocated with 2 different programs for execution. This is the way of sharing the work load of Programs execution.



→ There are 2 types of Multiprocessing os. They are:-

① Symmetric Multiprocessing os

② Asymmetric Multiprocessing os

① Symmetric Multiprocessing os :- It refers to that all the CPU's are treated equally. No one is Prior or other.

② Asymmetric MOS :- One CPU is acting as Master among other CPU's

→ It follows Master-Slave Policy.

→ The Master CPU is responsible for allocation of workload to the remaining CPU & also monitors the processing of workloads.

- * Advantages of Multiprocessing as:
- ① It increases reliability
→ If one CPU fails, other CPU's will share the workload.
 - ② It increases throughput
 - ③ The maximum no. of programs that are executed for unit time.
 - ④ Graceful degradation → Even if the single CPU is collapsed, it won't reflect the performance of system when it is always in increasing.

- * Disadvantages of Multiprocessing as:
- ① It is more complex in structure
 - ② It requires largest Main Memory Space.
 - ③ It creates overhead (or) Coupling which reduces throughput.
→ When Multiple CPU's required the I/O devices (or) Printer (or) Monitor at the same period of time then it creates conflicts in b/w them which is required to enter into waiting stage which leads to reduce the throughput.

* Real time operating System (RTOS):-

- These are the special purpose systems which are used in real-time applications.
- These Systems are worked with embedded systems.

* Working:-

- The system is attached with external event that is processed by OS by using sensors.
- It is treated as a interrupt after initiation of event, the control is sent back to the CPU.
- There are a different types of RTOS. They are:-

① Hard RTOS

② soft RTOS

① Hard RTOS:-

- These Systems having time constraint (or) time is fixed to perform every operation.
- These are strict in time.

Ex:- Traffic control

systems, flight control systems.

- If the system is exceeded the time-limit then it is treated as failure.

② soft RTOS:-

- These systems having time constraints which can be modified by the user i.e., These systems are flexible.

→ If the time is exceeded to perform operations then the system is not treated as failure.

Ex:- Washing Machine, Telephone box switching etc.

* Advantages:

→ System has limited time to perform its task.

→ It has to process the task as per requirement.

→ It also benefits in terms of power saving.

* Disadvantages:

→ At first it takes off from the system.

→ These devices are expensive.

→ The Algorithms & Programs used in the system's are complex.

→ Programs the system can process at a time is very less.

Examples for RTOS:

RT Linux, Lynx, pcos

⑥ Distributed Operating Systems:-

→ When multiple computers are connected using a communication channel, all the system resources are shared using a communication channel to perform multiple programs execution.

These systems are "loosely coupled systems". These CPU's communicate with high speed buses.

→ It can create a network using either LAN (local area

network) (or) WAN

→ The distributed os shares the computer resources to the processors which are required for execution.

Ex:- Solaris, Micros, Locus

* Resource sharing:-

* Advantages:-

- ① Resources sharing
- ② Concurrency:- Multiple programs are executed in different computers simultaneously.
- ③ It can increase ~~the~~ no. of computers connected in the network.

④ Fault Tolerance:- If any resource is failed then it will not affect the entire system performance.

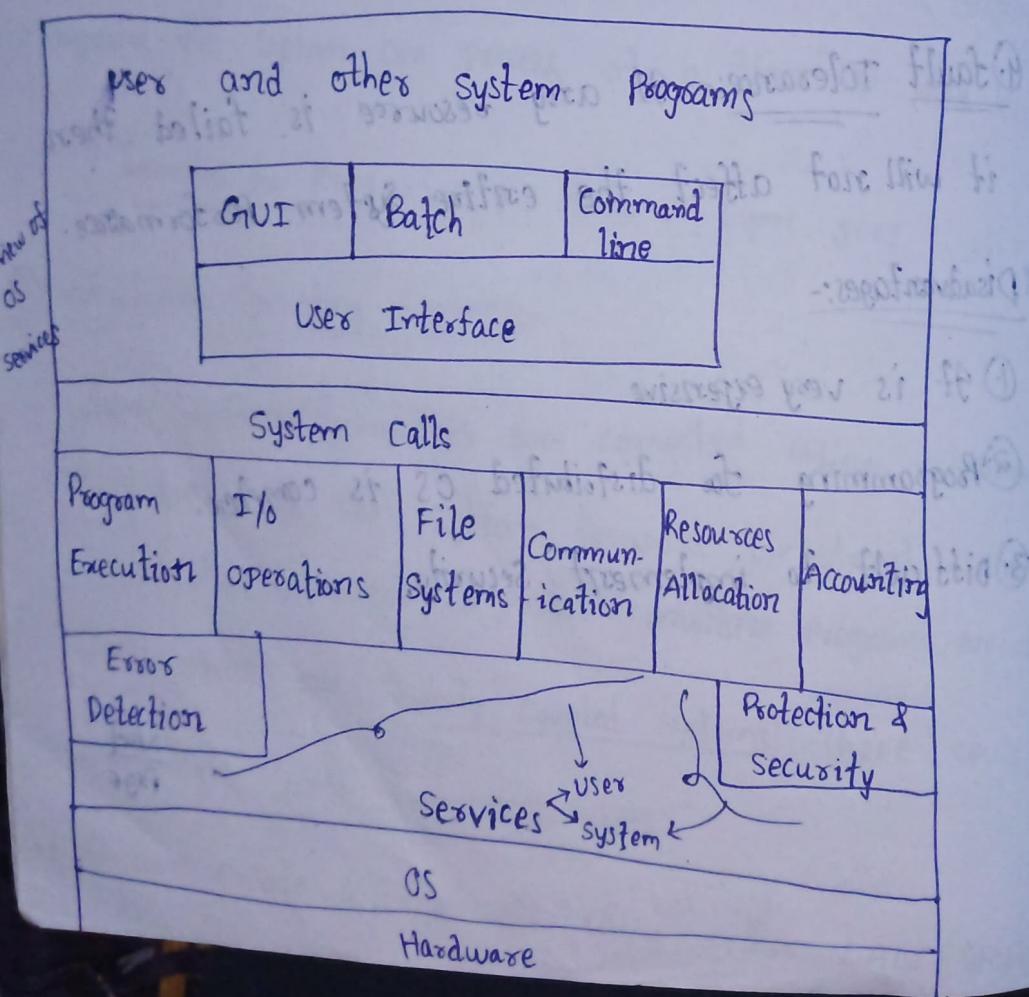
* Disadvantages:-

- ① It is very expensive
- ② Programming for distributed OS is complex.
- ③ Difficult to implement security.

- OS is decided in external device (OS) Secondary storage device ^{temporarily} then by pressing the CPU button, (on power on) the system automatically BOOTSTRAP Program called first instruction of program is BIOS (Basic I/O System)
- This is responsible for Loading OS from Secondary device, to Main Memory.

* OS Services / Function of OS:-

→ OS provides services to the user & System in order to create an convenient usage of a system & it's resources.



* User services:-

(i) User Interface:- All the operating systems have user interface.

→ This is required in order to

system resources ^{output from} ~~to~~ to users by using this mediator
(ii) Interface.

① Command line Interfaces:- ^{Different types}

→ It uses text-line interface in order to display the results to user. Ex:- MS-DOS, Windows

② Batch Interfaces:- It is a file which contains commands that are used to activate commands & directives to produce the output to user. It executes multiple commands at a time.

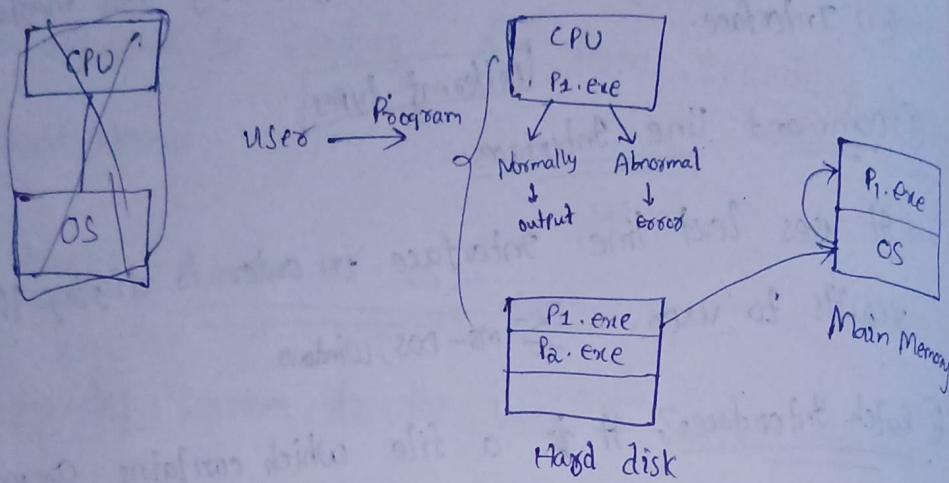
③ Graphical User Interface:- It is the window system with a pointing device which is connected with I/O devices in order to choose the menu (iii) selector text to display on the screen.

→ By using Images (iv) Icons the user can easily understand the description of the Icon to perform operations over it.

④ Program Execution:- The user written programs are forwarded for the execution into the system.

→ The OS handles this execution files in order to load

→ in Main Memory to make available to the CPU.
→ The program can be terminated either normally
i.e., without errors it displays output (Ox) abnormally
with the errors & without any ~~any~~ output.



③ *Input & output operations:-

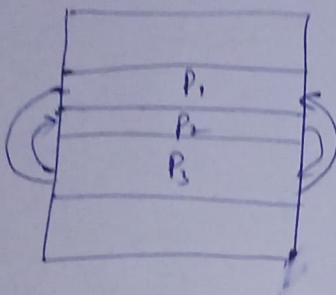
- During the execution of a program it requires IO devices like Keyboard, Pointer, recorder, audio file, etc.
- As the user cannot have the access to control IO devices, the OS which is used to manage & control IO devices.

④ File System Manipulation:- Every OS supports different variety of file system, those systems are required to perform operations like open, close, read, write, create, delete, search data in file, file permission.

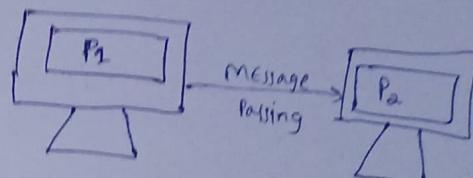
6) Communication:-

- Multiple process communication each other the communication takes place within the same computer (i.e.) b/w different computers using shared memory mechanism. The processes within the computer communicate with each other.
- Using Message Passing the processes can communicate b/w the different computers.

Shared Memory



Processes in different systems



* Introduction to System calls:-

→ System call is an software program which is acting as interface between User & Kernel.

② Kernel

Components of operating System:-

① Shell:- It is the software program which is used to interact with the users.

→ It is the outermost layer of os.

② Kernel:- It is the software program which is used to interact with hardware resources of system.

→ It is the innermost & core part of os.

→ When the system is power on, ~~the~~ Kernel is the first part which is loaded into main memory.

→ The functions of kernel are device management, Memory management & Task Management.



* Dual-Mode operation:-

→ There are two different modes of operations. They are,

(i) User Mode:→ refers to the operations that are performed user in the local system.

Ex:- word document.

(ii) Kernel Mode: It refers to the operations that are performed with the use of system resources.

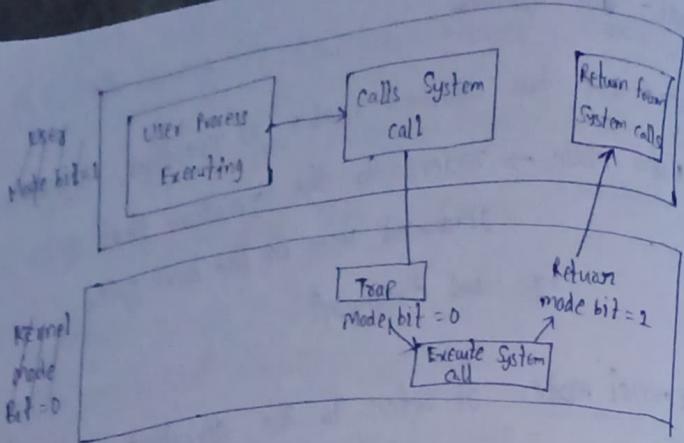
Ex:- Process Execution, Attaching External devices etc.

when
→ Multiple processes are executing parallelly the conflicts are raised with the system and user process, it leads to slow down the system, stuck the system this is because ~~corrupted~~ files may be in the external devices.
(iii) in the software, ~~less~~ less RAM size.

→ This is resolved by increasing RAM size & avoiding user-involvement during system process execution (os).
setting the mode bits i.e;

Mode-bit = 1 → User Mode

Mode-bit = 0 → Kernel Mode



*Types of System calls:

① Process Control

② File Management

③ Device Management

④ Information Maintenance

⑤ Communication.

Process Control

→ process is an program in execution. The process is created by using `fork()` system call.

→ To execute a process we use `Exec()` system call

→ To terminate a process we use `Exit()` system call

→ The process can be terminated either normally (o) Abnormally

→ In the case of abnormal termination it produces errors. This code is dumped into disk for debugging process & make it is corrected for execution.

→ In order to support Multiprogramming, the multiple processes are required to be loaded into main memory & to control over the process uses locks i.e., Acquire locks & Release locks are used for controlling other processes to access the data during execution.

② File Management: - To perform the operations over files it is required to use system calls like `Open()`, `Close()`, `Read()`, `Write()`, `Reposition()`.

→ The operations like create file & delete file, open & close file, read & write file, get & set file attribute.

Ex:- Copy files

Input filename

open

read

close

Output filename

open

write

close

source file

destination file

Prompt user for input filename

Enter filename

Prompt user for output filename

Enter filename

open file

open() ← open outputfile

read() ← read input file

write() ← write output file

close() ← close files

prompt user for successful
formation of file

③ Device Management: Definite system calls are used for accessing the resources, of system in order to complete execution of process.

→ the OS verifies whether the resources are available or not. If it is available then allocate to the process by using system call. If it is not available then ask the process to wait.

→ The operations like request & release device; read & write device; get & set device attributes; Logical Attached (or) Detached devices.

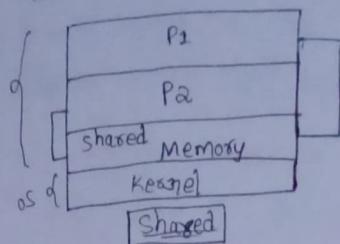
④ Information Maintenance: The system calls are used to maintain information like the system time & date, version of OS, free disk space.

→ Operations like get time (or) date, set time (or) date, get process, file (or) device Attributes, set process, file (or) device Attributes.

* Communication in Processors:

Whenever two (or) more Processors are required to communicate each other & the processors are resided in single system (or) multiple systems connected using communication channel.

(i) Shared Memory: A single block of memory is shared in b/w the Processors in order to communicate each other.



(ii) Message Passing: Process can share the messages by using process memory with the help of message passing techniques, the process can communicate each other.

→ The operations like create, delete, communication & collection (or) send, receive messages, transform status information, Attach (or) Detach remote devices.

