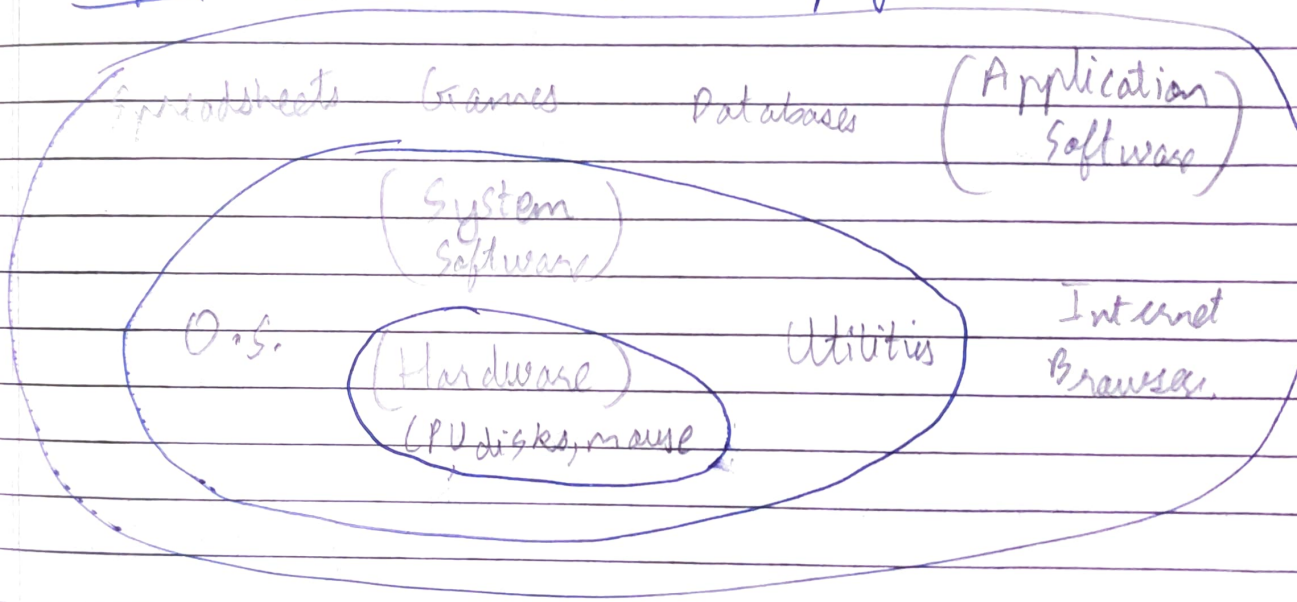
Module-1

1.1 Introduction to Operating System

Definition:-

- An operating system is a system software, which acts as a interface between a user of computer and the computer hardware.
- It is supervisory program that manages hardware, processes, files, memory, I/O etc in system.

Purpose:- Environment to execute programs. (Create)



Interaction of OS and Hardware

- It performs basic tasks such as recognizing input from keyboard, mouse, sending output to display screen, keeps tracks of files and directories on disks.
- It provides software platform where it provides interface between application software and computer hardware.
- Interaction with O.S through set of commands called as command processor or command line interpreter.

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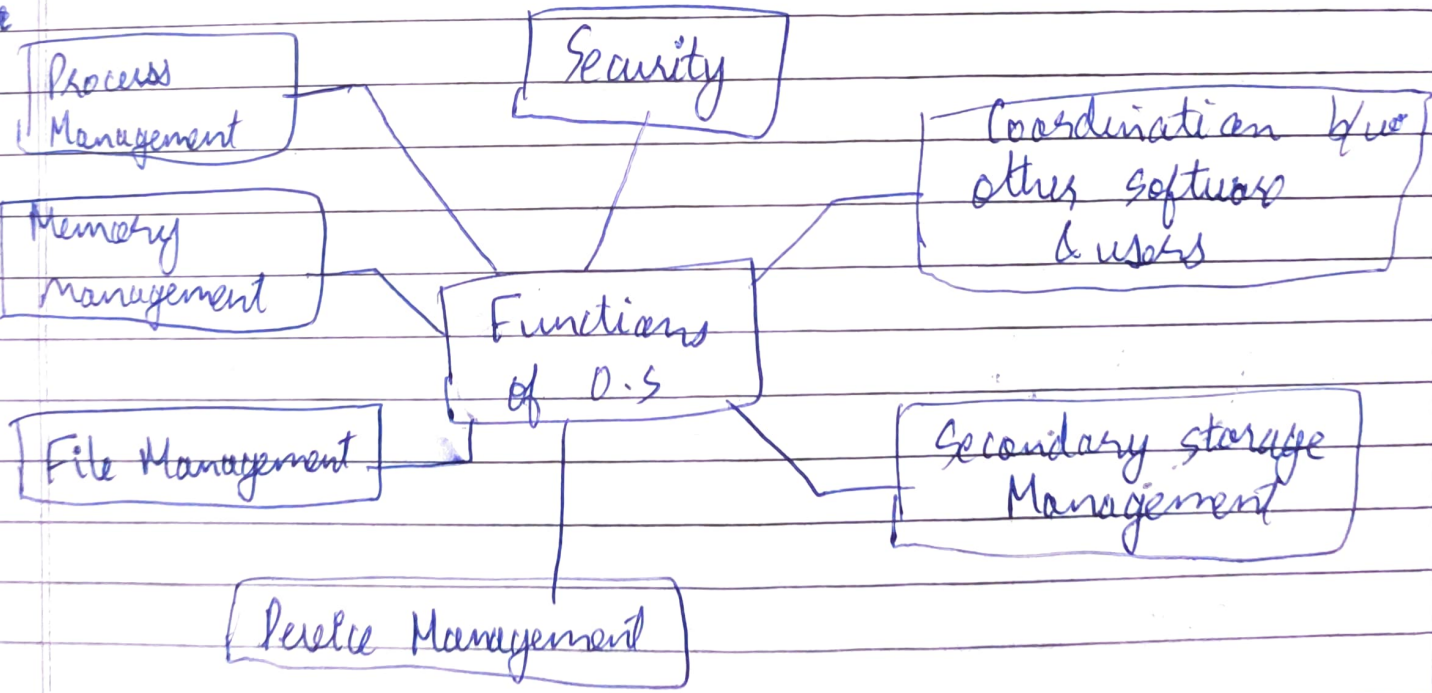
Functions of (O.S) Operating System

- It acts as a manager of all resources such as CPU time, memory space, file storage space, i/o devices etc and allocates them to specific programs and users as needed by their tasks.
- It can be also viewed as control program which control various I/O devices and the users program
- It executes the user programs to prevent errors & improper use of the computer resources



Multicore Processor

It is an integrated circuit of two or more processors have been attached for enhanced performance, less power consumption and more efficient simultaneous processing of multiple tasks.

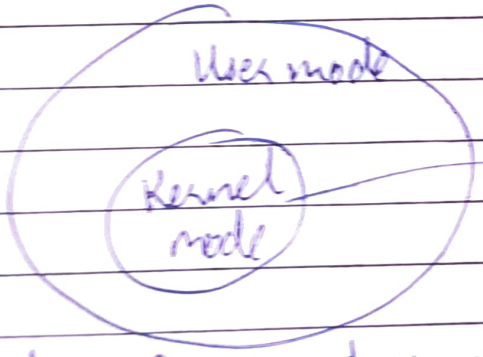
O.S Services

- It provides services to both users and to programs.
  - Providing environment to the programs for their execution.
  - Users can execute their programs in an efficient way.

Eg: Program execution, I/O operations, File System manipulation, Error detection, Resource Allocation.

System Calls

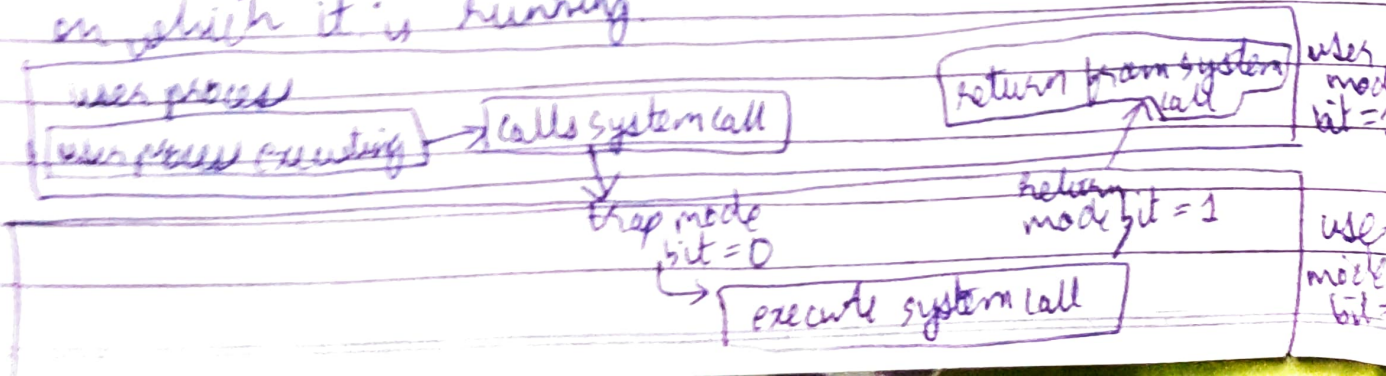
System calls provide an interface to the services made available by an operating system.



User mode - Program does not have direct access to memory, the hardware, and such resources.

Kernel mode - direct access

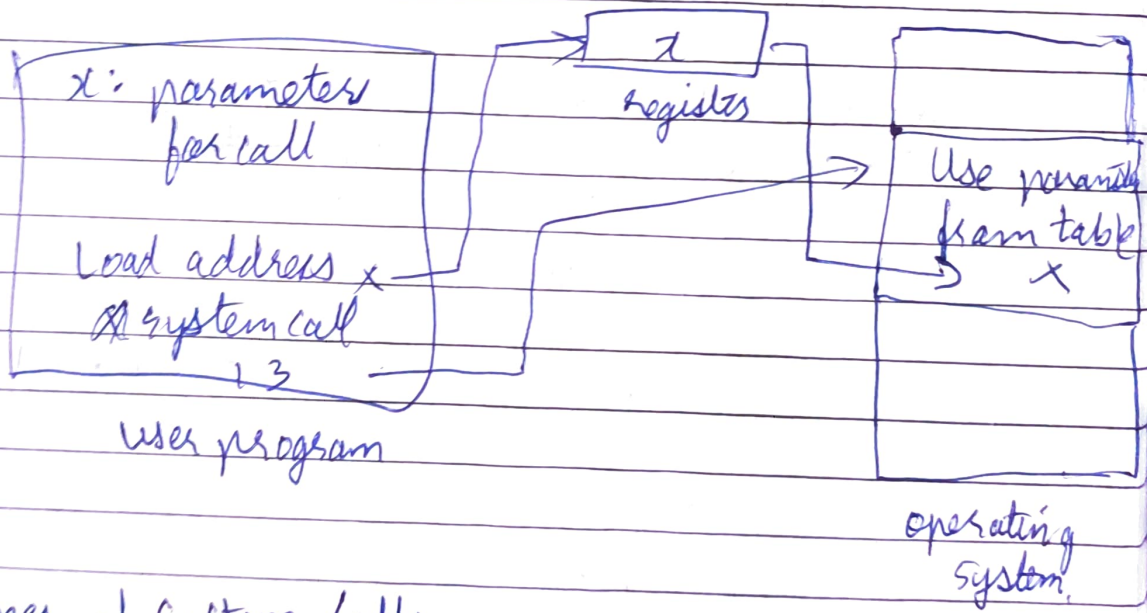
A system call is a method to request a service from kernel mode for resources by user mode of the operating system on which it is running.



Application developers often do not have direct access to system calls, but can access them through an (Application Programming Interface) (API).

System Call parameters

- Parameters can be passed in registers.
- When there are more parameters than registers, parameters can be stored in a block and the block address can be passed as a parameter to a register.



Types of System Calls

1) Process Control:

- A running program needs to be able to stop execution either normally or abnormally.
- When execution is stopped abnormally, often dump of memory is taken and can be examined with debugger.

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2) File Management:

Some common system calls are create, delete, read, write, and close. Also there is need to determine the file attributes 'get' and 'set' file attribute. Many times the OS provides an API to make these system calls.

3) Device Management:

- Process usually require several resources to execute, if these resources are available, they will be granted and control returned to user process.
- These resources are basically devices. Some are physical such as video card, and others abstracts, such as file.
- Uses programs requests the device, and when finish they release the device.

} code for system calls

4) Information Management:

- Some system calls exist purely for transferring information between the user program and the operating system. An example of this is time, or date.
- The OS also keeps information about all its processes and provides system calls to report this information. Eg: get system data, set system data.

5) Communication:

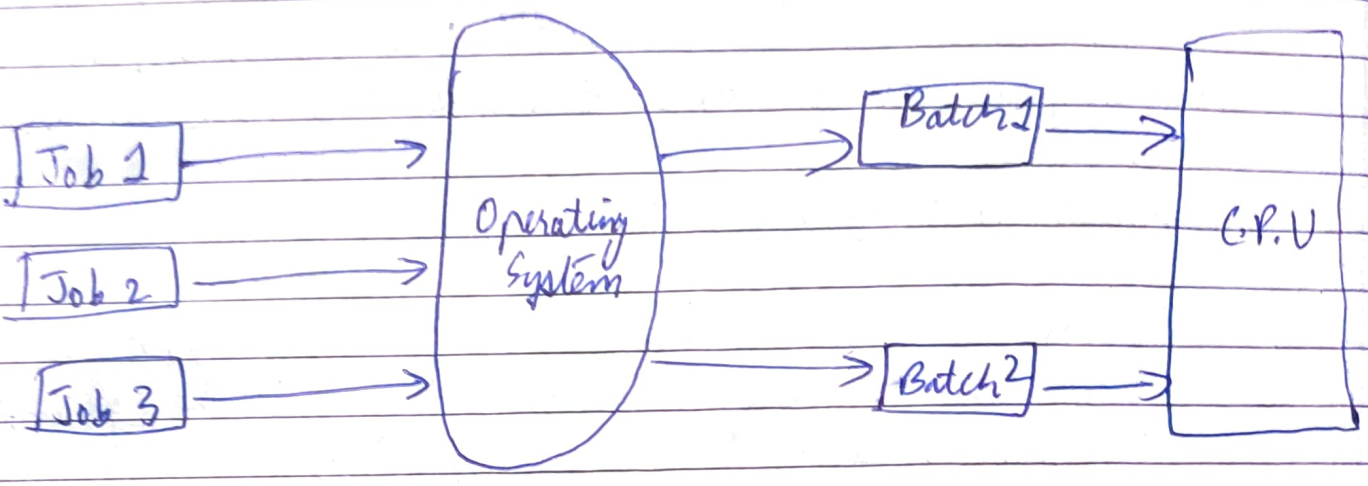
There are two models of interprocess communication:-

(i) Message-passing uses a common mailbox to pass messages b/w processes.

(ii) Shared memory use certain system calls to create and gain access to create and gain access to regions of memory owned by other processes.

1.2 Types of Operating System

1) Batch Operating System :-



- This type of O.S does not interact directly with computers ~~easily~~ directly. There is an operator which takes similar jobs with same requirement and groups them into batches.
- It is responsibility of operato to sort jobs with similar needs.

Advantages :

- Programs that do not require interaction & programs with long execution times may be served well by batch O.S.
- Scheduling in batch is very simple
- Easies to manage large work repeatedly in batch system.

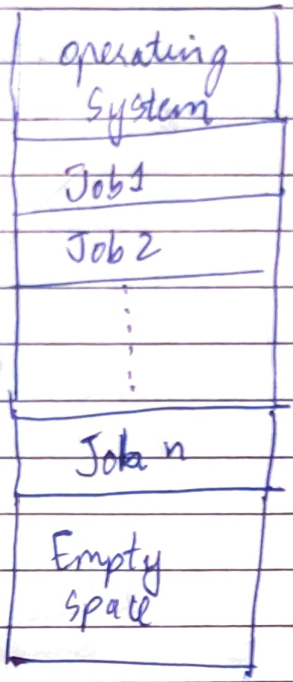
Eg: Payroll systems, Bank statements

Disadvantages :

- Batch systems are hard to debug.
- Other jobs have to wait for unknown time if any job fails

Job - it is work that needs to be done.
task - it is piece of work that needs to be done.

2) Multiprogramming Operating Systems



- ~~It can~~ Multiprogramming means sharing the processes when two or more programs reside in memory at same time is referenced as multiprogramming.
- It assumes single shared processors.
- It increases CPU utilizations because jobs are organized so that CPU always has one to execute.

Advantages:

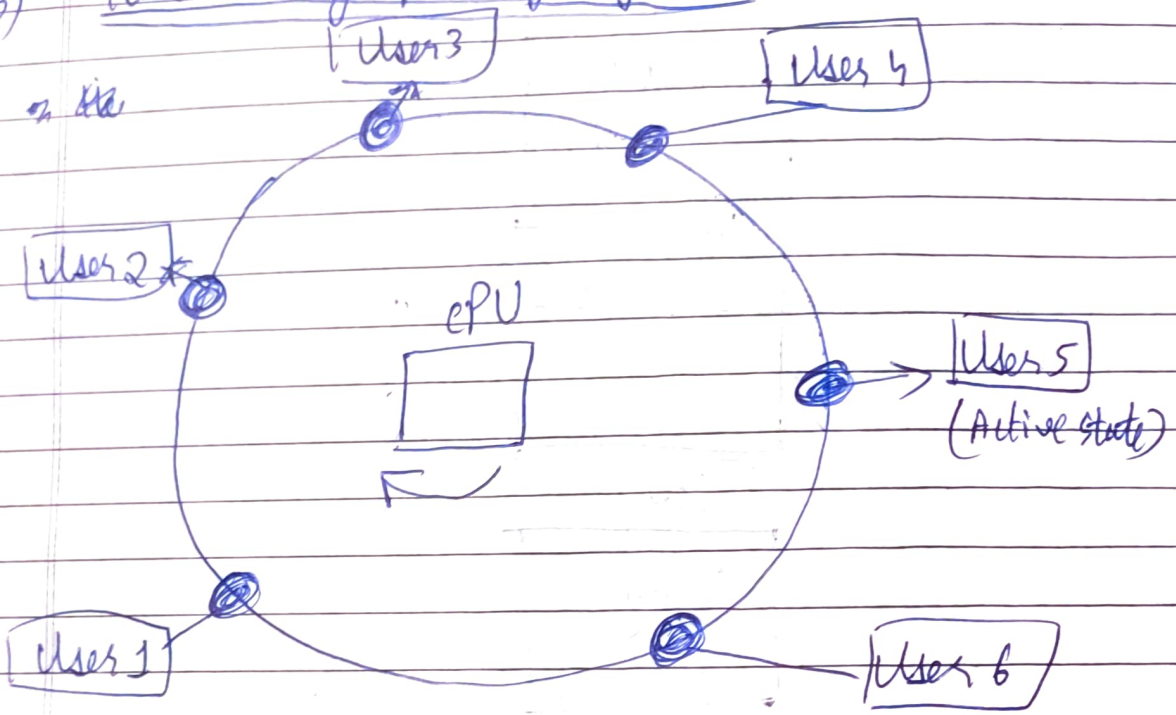
- High & efficient CPU utilization
- User feels that many programs are allotted CPU almost simultaneously.

Disadvantages:

- CPU scheduling is required.
- To accomodate many jobs in memory, memory management is required.

Eg: Airline ticket reservation system that supports hundreds of active terminal under control of single

3) Time Sharing Operating Systems



- Here each task is given some time to execute so that all tasks work smoothly.
- Each user gets the time of CPU as they use a single system.
- These systems are also known as Multitasking systems.
- The time that each tasks gets is called quantum and after that time interval it switches over to next task.

Advantages

i) Each task gets equal opportunity
ii) Improved productivity: It allows users to work concurrently, thereby reducing waiting time for their turn to use the computer. This increased productivity translates to more work getting done in less time.

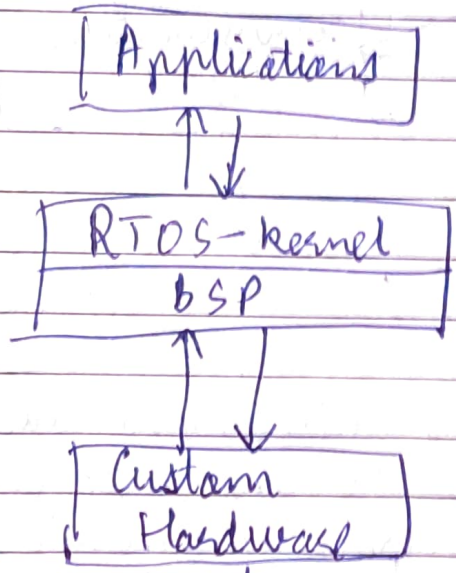
Disadvantages

i) Data Communication Problem.

ii) Security Risks: With multiple users sharing resources, the risk of security breaches increases. Time sharing requires careful management of users access, authentication, and authorization to ensure the security of data & software.

Eg: IBM VM/CMS, Windows terminal service.

4) Real-time Operating System



Two types
Hard RTS
&
Soft RTS

- The time interval required to process and respond to inputs is very small.
- They are used in space flights, missile systems, air port traffic control.
- It must be 100% responsive in time.
- Its primary objective is to provide quick-response times, and thus meeting scheduled deadlines.
- The processor is normally allocated to higher-priority process among those that are ready to execute.

Advantages:

i) Maximum Consumption: It has max utilization of devices and systems, thus more output from all resources.

ii) Error free: These types of system are error-free.

iii) Memory allocation: Memory allocation is best managed in these systems.

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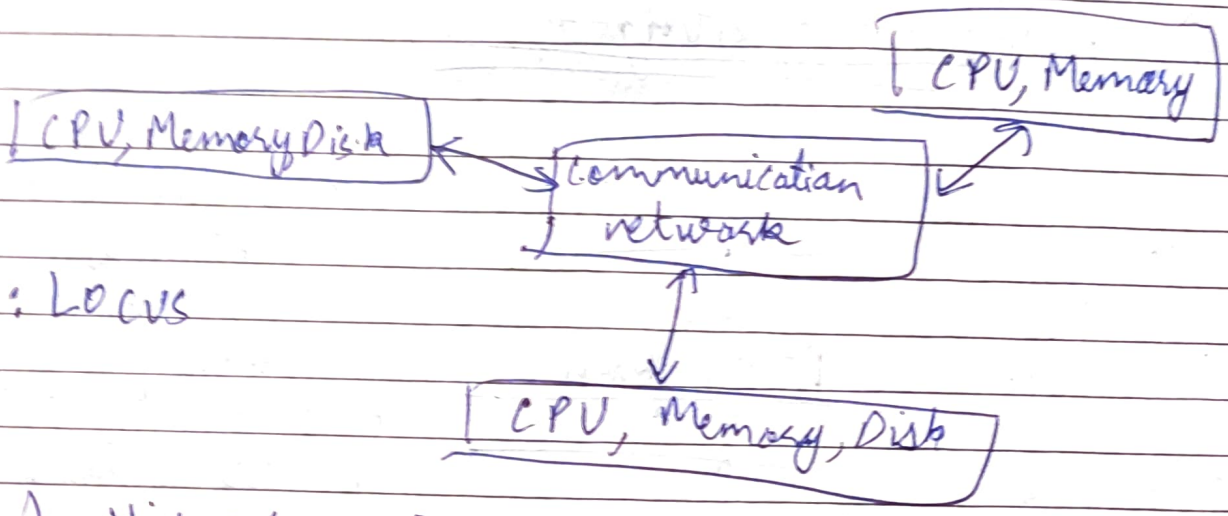
Disadvantages

i) Very Costly: The system resources in this O.S is very expensive.
ii) Limited tasks: Very few tasks run at same time and their concentration is very less on a few applications.

5) Distributed Operating Systems



Eg: LOCUS

- In this O.S, various autonomous interconnected computers ~~connected~~ communicate with each other using a shared communication network.
- Independent systems possess their own memory unit and CPU.
- These system's processors differ in size and functio

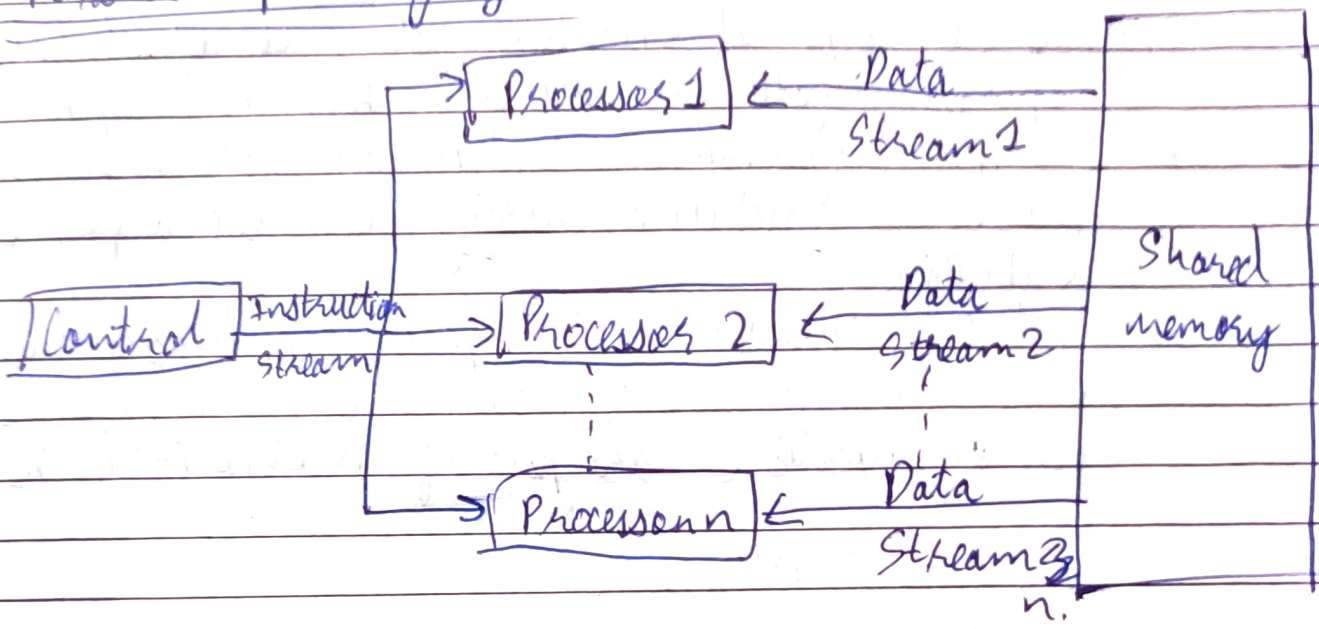
Advantages:

i) Load on host computers reduces.
ii) These systems are easily scalable as many systems can be added to network.
iii) Failure of one will not affect the other network communication.

Disadvantages :

i) Failure of main network will stop entire communicati

6) Parallel Operating System



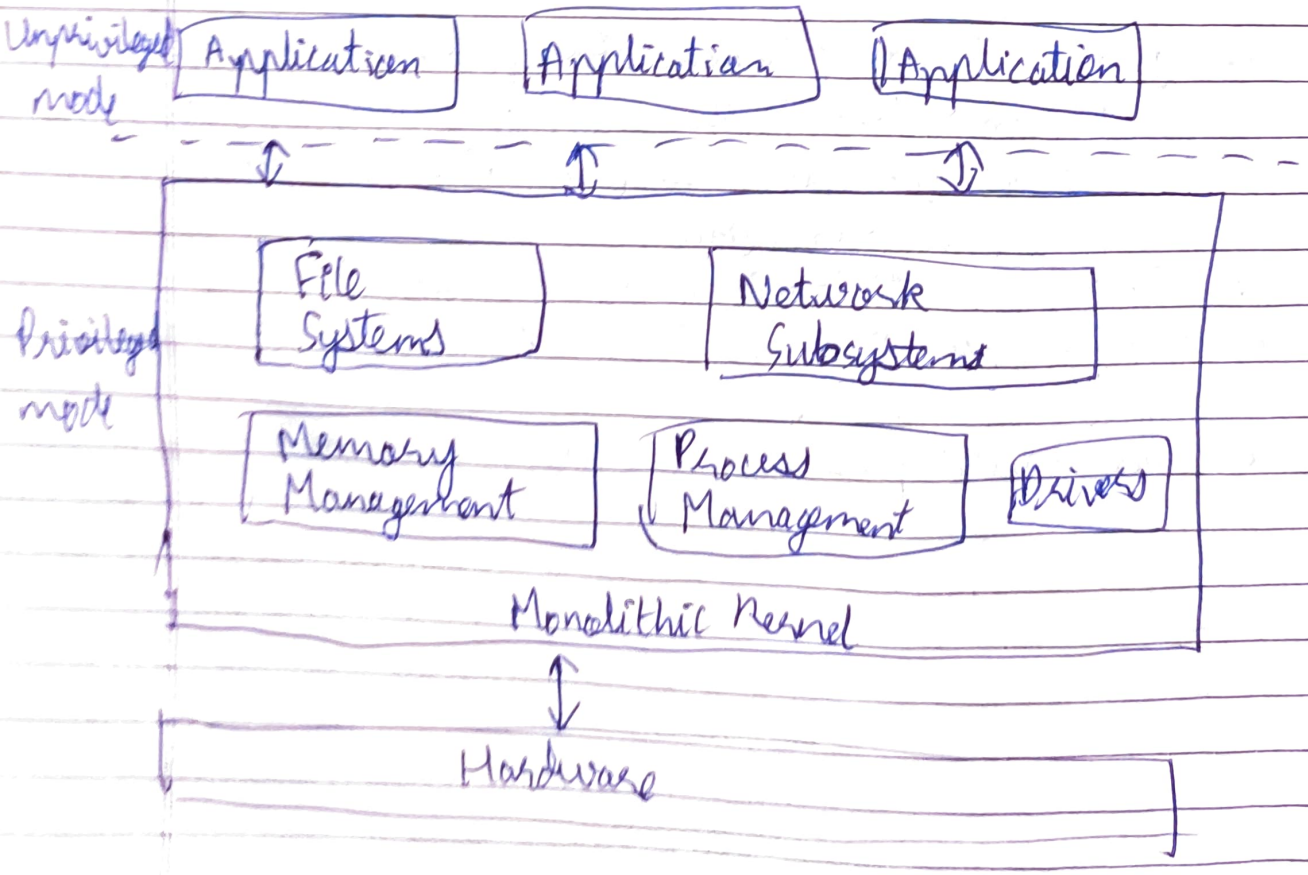
- It is a type of computer processing platform that breaks large tasks into smaller pieces that are done at the same time in different places and by different mechanisms.
- Efficient utilization of resources
- The parallel OS can handle load tasks in operating system.
- Has multi processing environment.

1.3 Structures of O.S

1) Monolithic Systems

- This is a type of operating system in which entire operating system works in a kernel space.
- Multiple programming techniques such as batch processing and time sharing increase a processor's usability.
- All OS processes such as process management, memory management, device management, i/o communication are part of monolithic kernel.

Structure



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Advantages

- Execution of this architecture is very fast.
- All memory management, file management & process scheduling is performed under one space.
- It utilizes same address space which speeds up and reduces time required for address allocation for new processes.

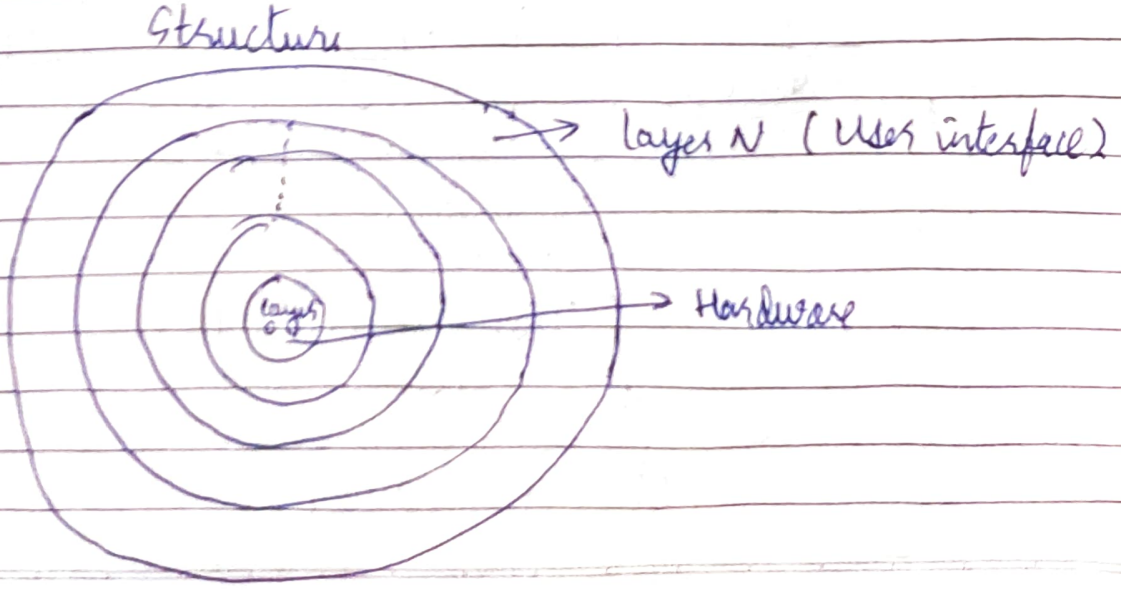
Disadvantages

- If any service fails then entire system fails.
- For adding any type of new service it must be modified by user.

Examples: 1) Original UNIX OS
2) LINUX

2) Layered Approached Operating system

- In this type of OS structure, OS is divided into ~~many~~ layers or levels.
- The hardware is on bottom layer (layer 0), while user interface is on top layer (layer N).
- These layers are arranged in a hierarchical way in which the top-level layers use the functionalities of their lower-level levels.



Advantages

- Each layer has its functionality, so work tasks are isolated, and abstraction is present up to some level.
- Debugging is simpler because lower layers are examined first followed by top layers.

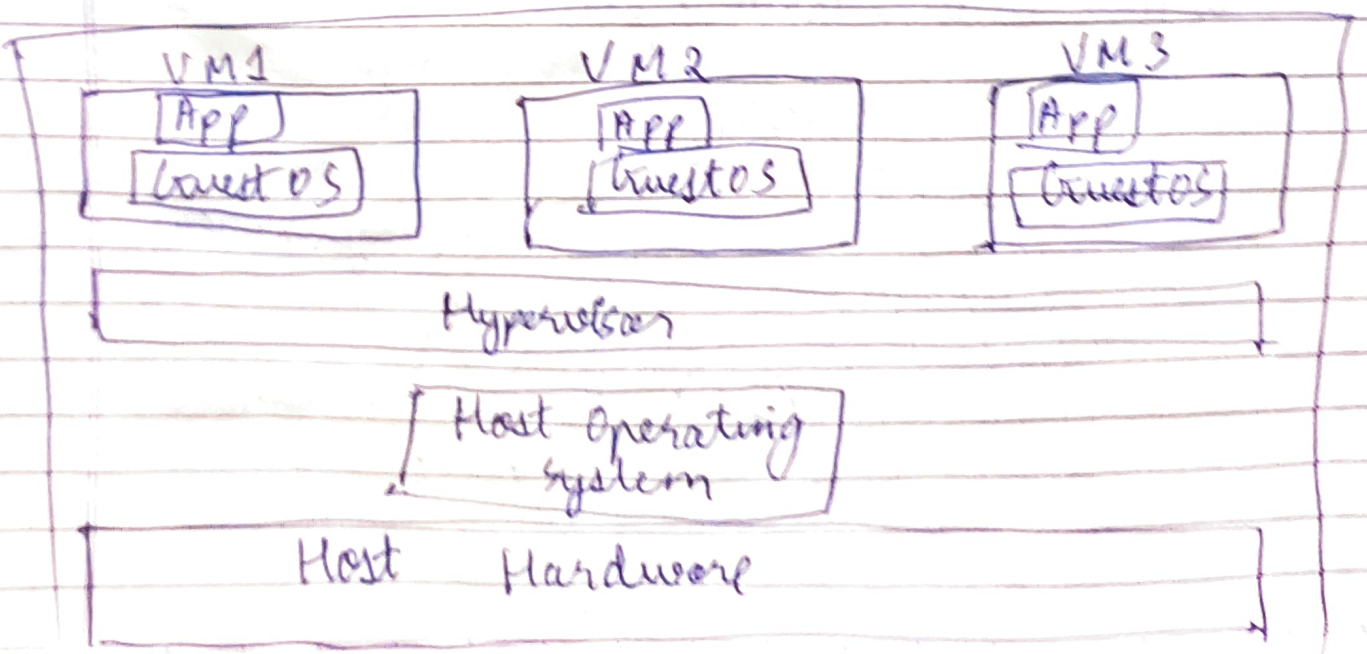
Disadvantages

- Performance is less in layered structures due to layering.
- Construction of layers require careful design as upper layers only make use of lower layers capabilities.

Example: 1) The OSI model for network protocols follows layered approach.

3) Virtualization - (Virtual machines)

- Virtualization allows multiple virtual machine to run on a single physical machine.
- Each (VMs) act as independent O.S with its own OS Kernel and software stack.
- A hypervisor or virtualization manages manages these VMs.



Advantages

- Due to total isolation b/w each virtual machine and every other virtual machine, there are no issues with security.
- Simple availability, accessibility & recovery convenience.

Disadvantages

- When it comes to hardware access, virtual machines are less effective than physical ones.
- Depending on work load, operating numerous (VMs) simultaneously on host computer, may have adverse effect on one of them.

Examples: 1) VMware
2) Virtualbox
3) Microsoft Azure offers VM in cloud.

4) Microkernels

- A micro kernels - based O.S. is designed by removing all non-essential components of kernel.
- These non-essential components of kernels are implemented as systems and users programs.
- Hence those implemented systems are called Microkernels.

Advantages

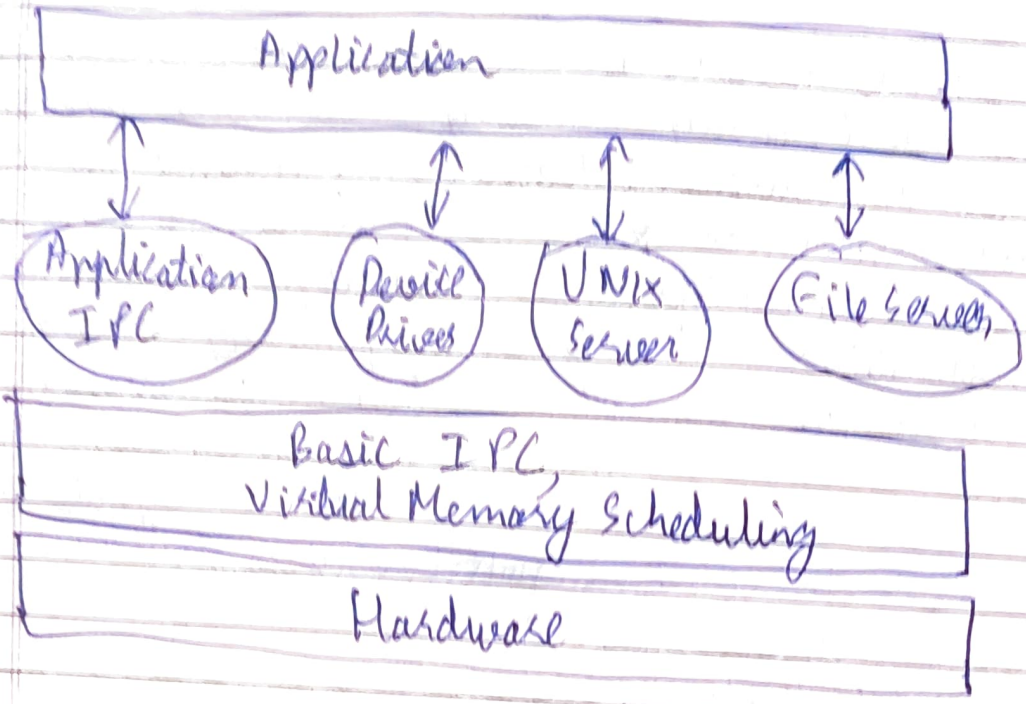
- It enables portability of O.S across platforms.
- Due to isolation of each Micro kernel, it is reliable & secure.
- The remaining O.S remains unaffected and keeps running properly even if a component fails

Disadvantages

- Construction of system is complicated
- Performance of system is decreased by increased inter-module communication.

Examples: Amoeba, EROS, MERT

Microkernel O.S.



1.4 Modern UNIX Systems

- It is an operating system that is base of all Operating systems like Ubuntu, Solaris etc.
- Its basic design philosophy of UNIX is to provide simple, powerful tools that can be combined to perform complex tasks.
- It features a command line interface that allows users to interact with system through series of commands, rather than through a graphical user interface.

Key features of UNIX

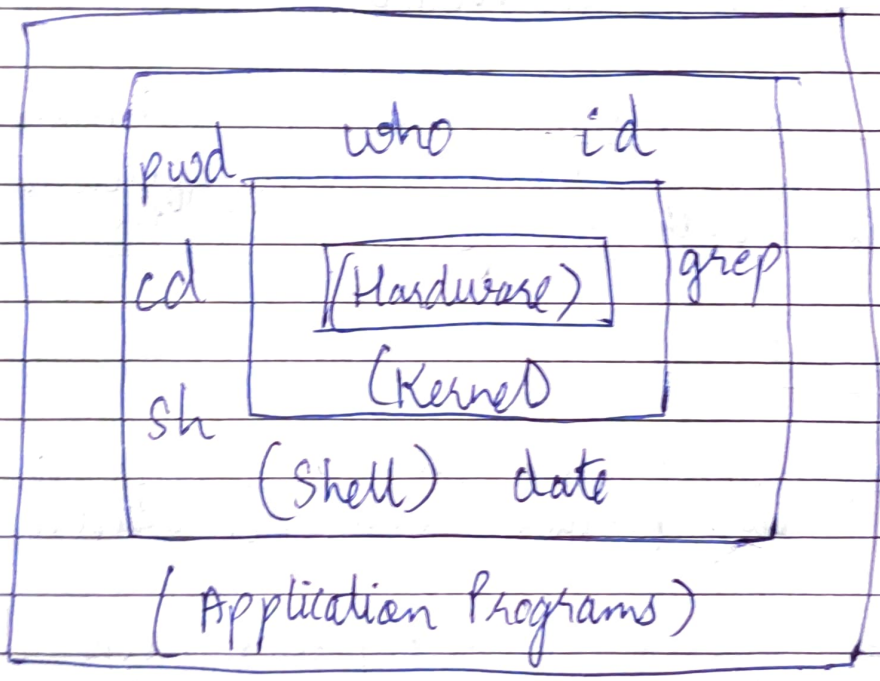
(i) **Multiuser support**: It allows multiple users to simultaneously access same system & resources.

(ii) **Multitasking**: It is capable of running multiple processes at same time.

(iii) Shell scripting: UNIX provides powerful scripting language that allows users to automate tasks.

(iv) Security: Security model includes file permissions, user accounts etc.

(v) Portability: It can run on wide variety of hardware platforms from small embedded systems to large mainframe computers.



UNIX layers

- Layer-1: (Hardware) It consists of all hardware related info
- Layer-2: (Kernel) It interacts with hardware & most of the tasks like memory management, task scheduling are done by kernel.
- Layer-3: (Shell) It is utility that processes your request. When you type a command at terminal, the shell interprets the command and calls the programs that you want. Eg: (cp, mv, cat, grep).
- Layer-4: Application Layer Outermost layer that executes the given external applications.

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Advantages :-

- **Stability**: UNIX is known for its stability & reliability
- **Security**: UNIX has a robust security model that includes file permissions, user accounts, and network security features.
- **Scalability**: It can be scaled up to handle large amounts of workload.
- **Command line Interface (CLI)**: Its command line interface allows for powerful and efficient interaction with the system.

Disadvantages :-

- **Complexity**: UNIX can be complex & difficult to learn for users who are used to GUI
- **Cost**: UNIX systems can be expensive, especially when compared to open source alternatives like LINUX.