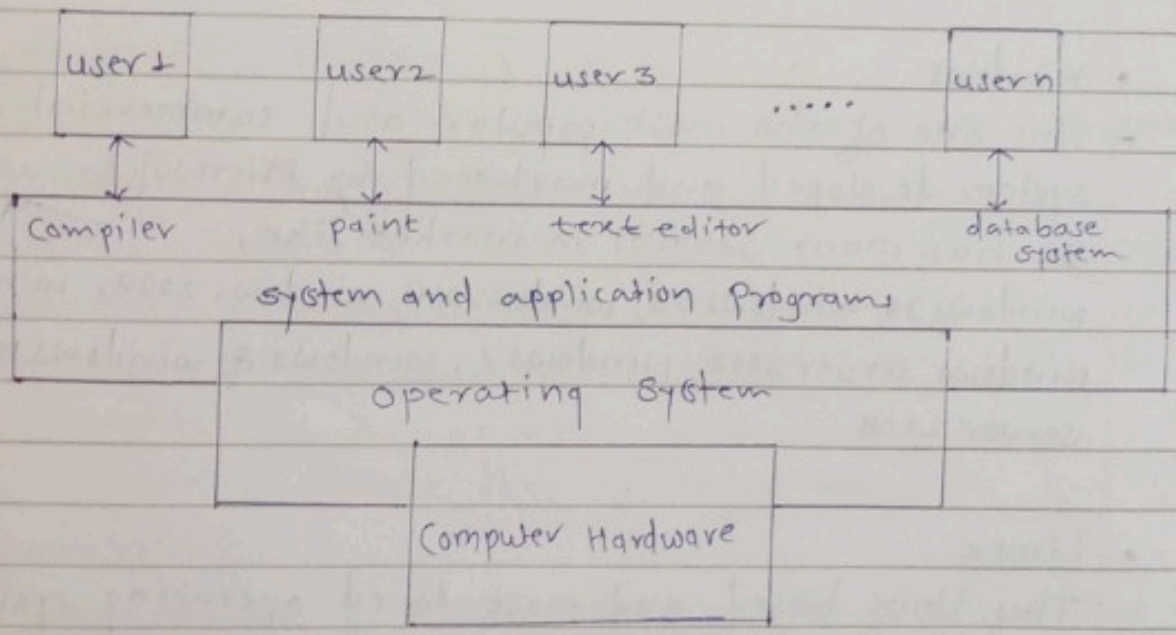
* Unit I Overview of Operating System.

1.1) Operating System Concept:

- An operating system (OS) is an interface between a computer user and computer hardware.
- An operating system is system software which performs basic task like file management, memory management, process management, I/O management, security & protection.
- A computer system can be divided into four components 1) Hardware 2) Operating system 3) Application programs 4) User.



(a)

Fig - Abstract view of the components of operating system.

1) Hardware - CPU, memory, Input/output devices (I/O) provides basic computing resources.

2) Appl^n programs - Word processors, spreadsheets, compilers, web browsers etc., defines ways in which these

resources are used to solve users problems.

3) Operating System: It controls and co-ordinates the use of H/W among various application run by users.

4) users - These are who use the overall computer system

* Operating System Example

There are plenty of operating systems are available in market today.

1) Paid (Licensed) 2) Unpaid (Free & open source [FOSS])

- Xlindows
- This one of the most popular and commercial operating system developed and marketed by Microsoft.
- It has many versions in market like, windows 95, windows 98, windows XP, windows 2000, windows NT, windows server 2003, windows 7, windows 8, windows 10, windows server 2008.

- Linux
- This Unix based and most loved operating system developed and released by Mr. Linus Torvalds.
- Today it has 30+ variants available in market like Redhat, Fedora, Opensuse, Ubuntu, Kali, CentOS etc.
- This is free and open source operating system.

- MacOS
- This is another kind of Unix operating system developed and marketed by Apple Inc.

- **iOS**
This is a mobile operating system developed by Apple inc. exclusively for its mobile devices like iPhone and iPad.

- **Android**
This is mobile operating system based on modified version of Linux OS and other open source software, designed for smartphones and tablets.

* **Functions/Operations of operating system**
- Following are some of important functions of an operating system.

1) **Memory management:**
- Memory management refers to management of primary memory or main memory.
- Main memory provides a fast storage that can be accessed directly by CPU
- To execute any program, that program must be in the main memory.
- An operating system does following activities for memory management.

a) Keeps tracks of primary memory that is what part of it is in use and what parts are not in use.
b) It decides which process will get memory when and how much.
c) Allocates the memory when process request it and de-allocates the memory when a process no longer need it or terminates.

2) **I/O device management:**

- An OS manages device communication via their respective drivers
- It does following activities to manage devices,

a) Keeps track of all devices
b) Decides which process gets the device when and for how much time.
c) Performs allocation and deallocation of devices as per process requirement.

3) File Management:

- A file is a collection of user data.
- File system normally organized into directories for easy navigation.
- These directories may contains files or other directories
- Operating system does following activities for file mgmt.

a) Keeps track of information, location, usage, status etc collectively known as file system.
b) Allocation and deallocation of file resource.
c) File and directory creation and deletion

4) Process management:

- A process is program in execution or a fraction of program loaded into main memory.
- A process needs certain resources like CPU, memory, files, I/O to complete its execution.
- Operating system does following activities for process management.

a) create, load, execute, suspend, resume and terminate processes
b) Switch system among multiple processes loaded in

main memory.

c) Provides interprocess communication so that processes can communicate with each other.

d) Provide synchronization mechanism to control concurrent access and data consistency.

e) Allocation and deallocation of resources to avoid deadlock and starvation

5) Secondary Storage management.

- The main memory is too small to permanently accommodate data and programs so computer system must need secondary storage to backup main memory.
- Most program are stored on disk until loaded into the memory
- Operating system does following activities

a) Free space management.

b) Storage allocation.

6) Protection and Security Management.

- It has mechanism which can be used to ensure that files, memory, CPU and other resources can be operated by those processes that have proper authorization.
- It is the job of security to protect the system from external attacks like viruses, worms, theft of a service etc.
- The system should distinguish between all its users most operating systems maintain a list of authorized users.

* Types of operating Systems.

1) Batch operating system.

- Batch operating system is responsible for executing batch of jobs having similar resource requirement.
- The users of batch operating system donot interact directly with computer system.
- Each user prepares his job on an offline device like punch cards/paper cards and submit it to operator.
- The programmers leave their programs with the operator and the operator then sorts the programs with similar resource requirement into batches

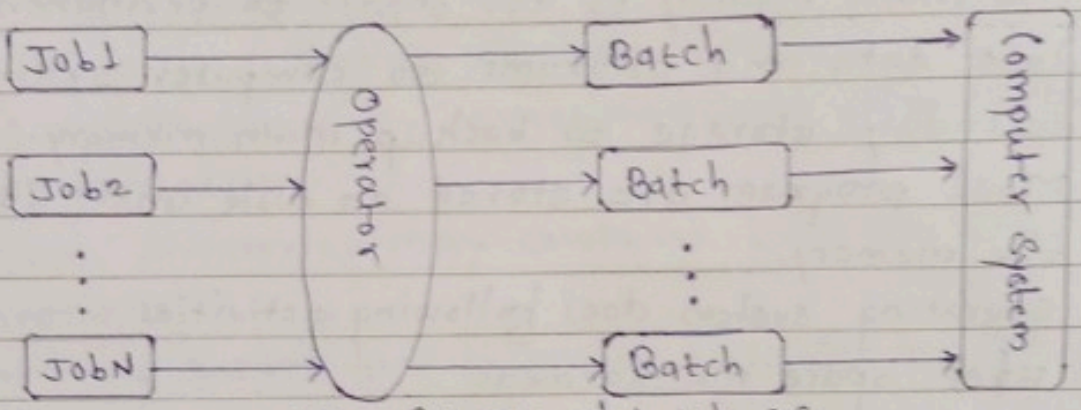


Fig. Concept of batch OS

* Problems with batch operating system
- No interaction between user and system
- No switching between jobs as it performs sequential execution of jobs.
- CPU is often idle because the speed of I/O devices is slower than CPU

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2) Multiprogramming operating system

- Multiprogramming OS is capable of executing multiple jobs or programs simultaneously or concurrently.
- In this case operating system keeps several jobs in memory simultaneously.

- The operating system picks and begins to execute one job from memory. Eventually the job may have to wait for some task like I/O operation.
- Then OS simply switches to another job and start its execution, when that job needs to wait, the CPU is switched to another job and so on...
- This way in multiprogramming CPU never remains idle as it has at least one job to execute.

*Advantages

- Makes optimum utilization CPU
- Makes efficient memory utilization
- As CPU never remains idle, it increases performance.

3) Time Sharing / Multitasking operating system

- Time Sharing or multitasking is logical extension of multiprogramming operating system.
- Here processor's time is shared among the multiple users located at various terminals
- Time Sharing OS focuses on reduction in response time where response time is time gap between the request raised to first response we get back from CPU
- In time sharing OS, system switches rapidly from one user to next user, each user thought that entire computer system is dedicated to his use though it is being shared among many users.
- Here operating system uses CPU scheduling and multi-programming to provide each user with a small portion of time for execution of his job.

* Advantages
- Provides quick response.
- Reduces CPU idle.
- Optimizes utilization of resources.

4) Multiprocessor OS:
- These systems have two or more processors within a system.
- It allows multiple processors sharing of computer bus, memory, clock and peripheral devices.
- The main advantage of this system is increased execution speed which results execution of maximum processes within less period of time.

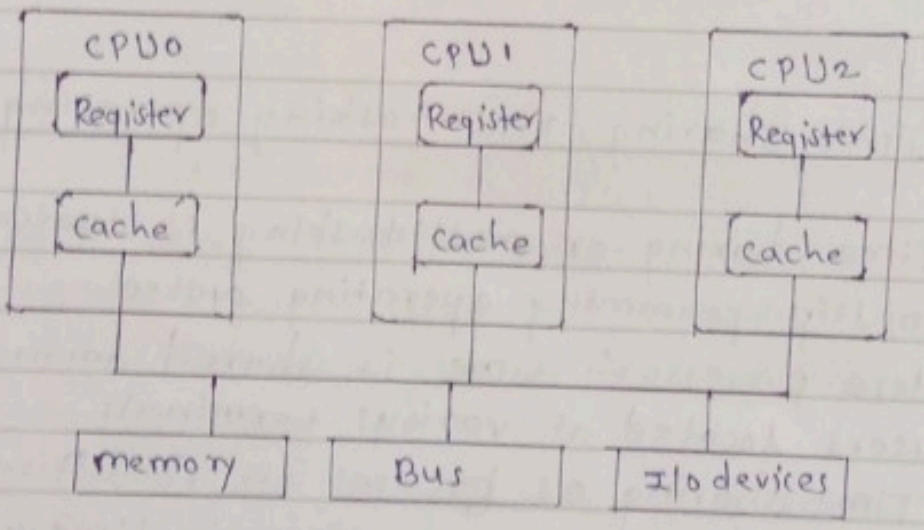

Fig. Multiprocessor System.

- This system is reliable because if functions can be distributed properly among several processors then failure of one processor will not halt the entire system only slow it down.

5) Asymmetric Multiprocessing

- Asymmetric multiprocessing in which each processor is assigned specific task.
- Here master processor controls the system; the other processors either look to the master for instruction or they have predefined task.
- This scheme defines master-slave relationship. The master processor schedules and allocates work to slave processors.

4) Symmetric Multiprocessing

- Symmetric multiprocessing in which each processor performs all tasks within the system.
- SMP means all processors are peers and no master-slave relationship exists between processors.

5) Distributed operating system.

- A distributed system is collection of physically seperate, heterogeneous computer systems that are connected/networked to provide access to users to access resources.
- Access to shared resources increases computation speed, data availability, functionality and relinbility.

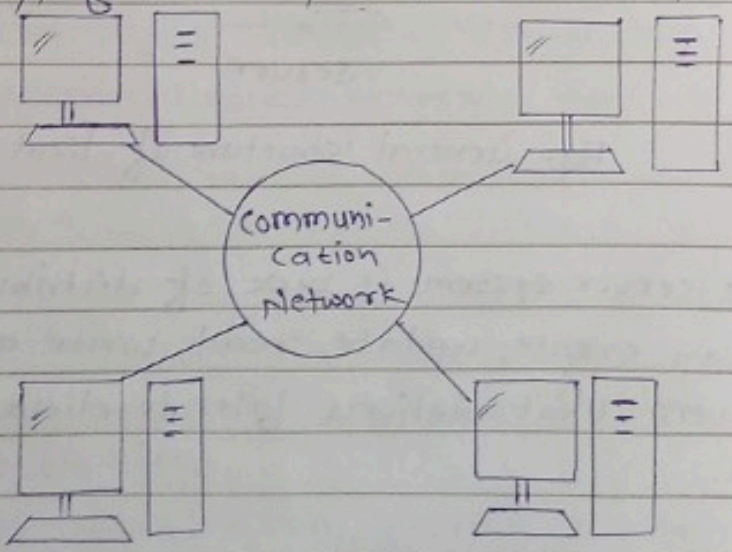

Fig. Distributed system

- Distributed systems depends on networking for functionality.
- Network vary by protocol used, the distances between nodes, transport media.
- Most distributed systems uses TCP/IP as networking protocol, also n/w are characterized by distances between nodes such as LAN, WAN, MAN etc.

* Types of distributed System

a) Client-server Computing.

- As pcs became faster and more powerful designers have shifted away from centralized system architecture.
- Todays systems (centralized system) act as server systems to satisfy requests generated by client systems.
- This is a form of specialized distributed system called client server system.

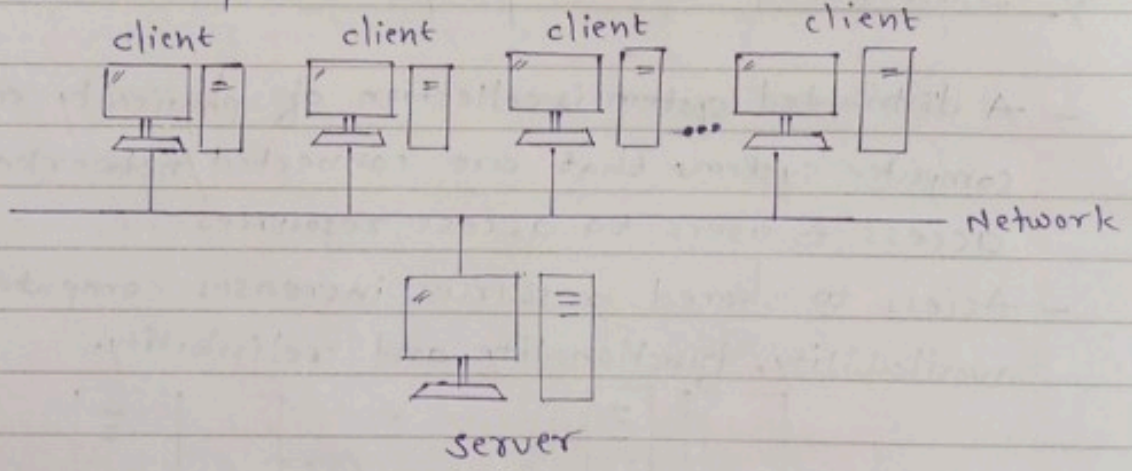

Fig. General Structure of client server system

e.g.) The File server system is type of distributed system where client can create, update, read, write and delete files.
) Web servers that delivers files to clients running web browsers.

6) Peer-Peer Computing

- Another structure for a distributed system is peer-peer (P2P system model.
- In this model, clients and servers arenot distinguished from one another instead all nodes within the system are considered peers and each may act as a client or a server.
- In client server system, the server is bottleneck but in peer-peer system, services can be provided by several nodes distributed throughout the network.

7) Real time embedded systems (RTOS)

- A real time system is defined as a data processing system in which the time required to process and respond to input is so small.
- The time taken by system to respond to ~~system~~ input and display of required output is termed as response time.
- A real time system has well defined and fixed time constraint, processing must be done within defined constraint or system fails.
- Real time systems are medical imaging system, scientific experiments, air traffic control system, robots, weapon system, missile launching system etc.

Types of Realtime OS

a) Hard real time system:

- Hard realtime systems guarantee that critical tasks complete on time
- e.g. Flight control system, missile guiding system, weapons defend system, railway signaling, medical system etc.

b) Soft realtime system

- In soft realtime system the meeting of deadline is not compulsary for every task but process should get processed and give result.
- Examples of soft RTOS
  Online transaction system, set top boxes, washing machines, mobile communication, audio-video systems, web browsing etc

8) Mobile OS

i) Android OS (open source)

- Android operating system is one of the popular software developed for mobiles.
- The interface of android was developed in such way that it fulfills all user requirements.
- It is a modified version of Linux kernel and other open source software designed primarily for touchscreen mobile devices and tablets.
- Android has many versions like Android cupcake, Donut, Eclairs, Froyo, Gingerbread, Honeycomb, Icecream Sandwitch, Jellybean, Kitkat, Lollipop, Marshmallow etc.

ii) Apple iOS (closed source)

- Another popular operating system designed by Apple Inc. for mobile phones and devices like iPhone, iPad.
- It is the world's second most widely installed mobile operating system after android.
- It is a proprietary software mostly closed source.
- iOS is Apple's mobile version the OS X operating system used in Apple computers.

Views of OS:

a) User's view:

- The user's view depends on system interface that is used by users.

i) If user using his/her personal computer consisting of a monitor, keyboard, mouse & system unit such system is designed for one user.
In this case some attention paid to performance and none attention paid to resource utilization.

ii) A user sits at a terminal connected to network and other users accessing same resources then operating system is designed to maximize resource utilization and it should assure that all available CPU, memory, I/O devices are used efficiently by users.

iii) Some computers have little or no users view e.g. embedded system in home devices and automobiles may have numeric keypad and may turn indicator lights on or off to show status.

b) System view:

- From computer's point of view the operating system is a program most involved with hardware.
- System can view operating system as resource allocator.
- A computer system has many resources that may required for process execution like CPU time, memory space, file, I/O devices etc. The operating system acts as the resource managers.
- Facing numerous requests for resources operating system must decide how to allocate them to programs so that it can use them efficiently and fairly.

- An operating system is control program which manages the execution of user programs to avoid errors and improper use of computer.

* Command Lined Operating Systems.
[DOS and Unix]

- Operating systems include the command interpreter program in the Kernel.
- Command Interpreter listens to user's terminal and translate the action requested by the user.
- The command interpreters are known as "shell", on unix and Linux there are several shells are available user may choose from Bourne shell, Bourne Again shell (BASH), C shell, Korn Shell etc.
- The main function of CLI is to get and execute user specified command.
- The MS-DOS and Unix are two command line based operating system, the MS-DOS and Unix shells operate in this way.
- Multiple command can be executed by creating shell script (.sh file on Unix/Linux) where (.bat file on DOS)

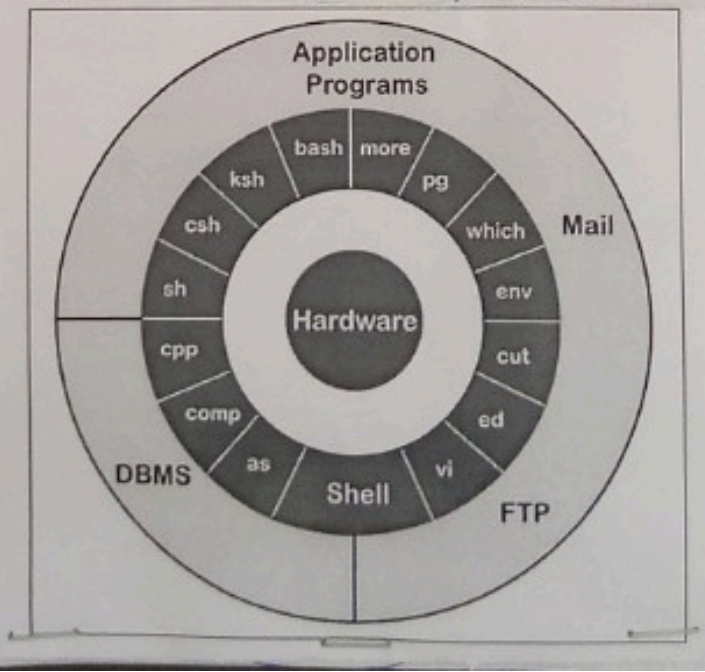

Fig. Unix Architecture

1) Kernel: It is heart of operating system. It interact with hardware and performs resource management

2) Shell: The shell is program that processes your requests commands, utilities.
When you type a command on terminal the shell interprets the command and calls program you want.
e.g. bash, korn shell, C shell

3) Command & utilities.
- There are various commands are used to complete your task.
- All commands comes with various options.
e.g. cal, mv, cat, cd, date, mkdir, rmdir, rm, wc etc.

* GUI base OS
[Windows and Linux]
- Second strategy for interfacing with operating system is a user friendly graphical user interface (GUI).
- Instead of giving command through CLI, GUI provides mouse based window and menu system as interface.
- GUI provides desktop where by using mouse pointer, clicking a button on mouse we can execute a program, select file or directory or pull down, pull up menu.
e.g. K Desktop environment (KDE) and GNOME desktop are GUI based environments run on Linux.

- The choice of whether to use a CLI or GUI is mostly one of personal preference.
- Many unix users prefer a command line interface alternately most windows users use window GUI environment and almost never use MS-DOS shell interface.