

# DIPLOMA WALLAH

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## OPERATING SYSTEM AND ADMINISTRATION



Complete Notes Based on Full Syllabus

- Diploma Engineering  
4<sup>th</sup> Semester



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Notes prepared by Sangam



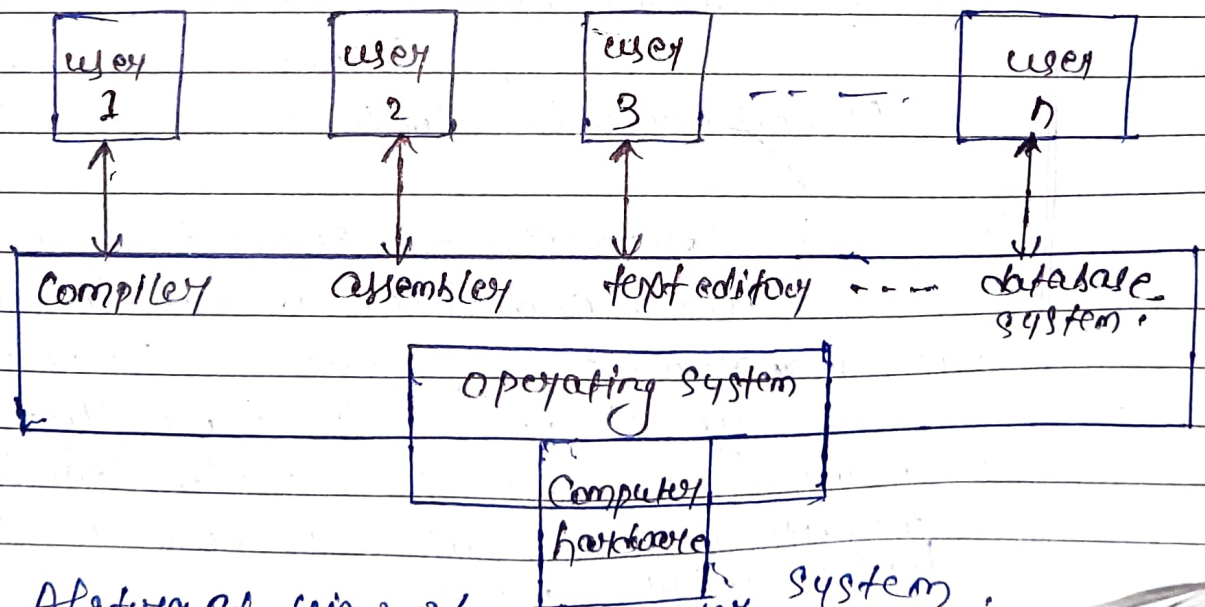
## Operating System

An operating system is a program that manages the computer hardware. It also provides a basis for application programs and acts as an intermediary b/w the computer user and the computer hardware.

Operating systems for hand held computers are designed to provide an environment in which a user can easily interface with the computer to execute program.

Thus some operating system are designed to be ~~convenient~~ convenient (efficiency, accessibility) other to be efficient (of resources, processes) and they are combination of two.

Mainframe OS are designed primarily to optimize utilization of hardware. personal computer (PC) operating system support complex games, business application, and everything in between.



Abstract view of a computer system.

## \* Need for OS

An operating system is essential for managing computer hardware and software efficiently.

- It acts as an intermediary b/w users and hardware, ensuring resources are utilized effectively.

### Need

#### 1. Resources management:—

Allocates CPU, memory and storage to processes optimally.

#### 2. User Interaction:— provides a user-friendly interface (GUI or CLI) to interact with the system.

#### 3. Process management:—

Schedules and controls execution of multiple tasks efficiently.

#### 4. Memory management:—

Ensures effective utilization of RAM, avoiding conflicts and wastage.

#### 5. Security & protection:— prevent unauthorized access and protect data integrity.

#### 6. File management:— organize, store, and retrieve files systematically.

#### 7. Hardware Abstraction:— Enable seamless interaction with devices without needing direct hardware programming.

## \* Structure of OS

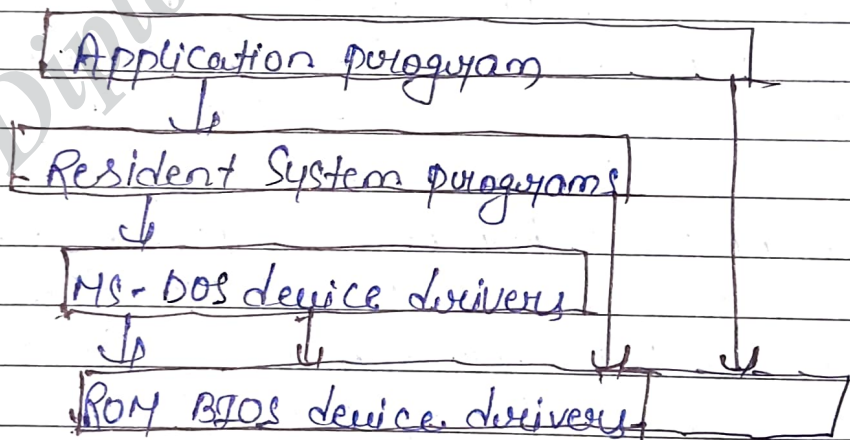
A system of an operating system is like the blueprint of how an OS is organized and how its different parts interact with each other. Because operating systems have complex structures, and we want a structure that is easy to understand.

\* The operating system is a component of every segment.

### Types of OS Structure:-

- **Simple Structure:-** Simple structure. Operating system do not have well-defined structure and small, simple and limited.

Ex - MS-DOS



- \* **Advantage:-**
- provide better application performance.
  - Easy for kernel developers of OS.

### \* **Disadvantage:-**

- Structure is very complicated, no clear boundaries.
- It does not enforce data hiding in the OS.

process management, memory management, file system!

• Monolithic Structure

A monolithic structure is a type of OS architecture where the entire OS is implemented as a large process in a single large process in kernel mode. Ex - Linux, Unix

Advantage:

- performance fast, everything runs in a single block.
- easier to build because all part in same block.

Disadvantage

- hard to maintain as a small output
- some security issues in monolithic architecture.

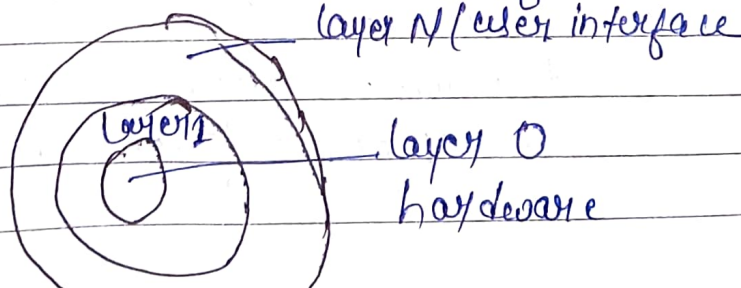
Kernel Contains micro-kernel structure

IPC ← at design the OS by removing all non-essential components from the kernel and implementing them as system and kernel. Ex - MINIX, QNX

low-level hardware control • Layered Structure

An OS is broken into piece and retain much more control over the system.

In this structure OS is broken into a number of layers (levels). The bottom layer (0) is the hardware, and the topmost layer (layer N) is the user interface.



## \* Hybrid - kernel Structure

Hybrid - kernel Structure is nothing but a combination of both Monolithic - kernel Structure and micro - kernel Structure.

Basically it combines properties of both Monolithic and micro - kernel and make a more advance and helpful approach.

Ex - windows NT.

## Advantage

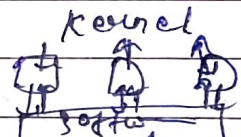
- It offers good performance as it implements the advantage of both Structure in it.
- Supports wide range of hardware.
- Provide better isolation and security.

## Disadvantage

- Increase overall complexity of system by implementing both Structure.

## \* Exo - kernel Structure

Exo kernel is an operating system developed at MIT to provide application - level management of hardware resources.



## Advantage

- Support for improved application control.
- Separate management of security.

## Disadvantage:

- Decline in consistency.
- Exo kernel interfaces have a complex architecture.

## Types of operating system

Operating system can be categorized according to different criteria like whether an operating system is for mobile device (example Android and ios) or desktop (example windows and linux).

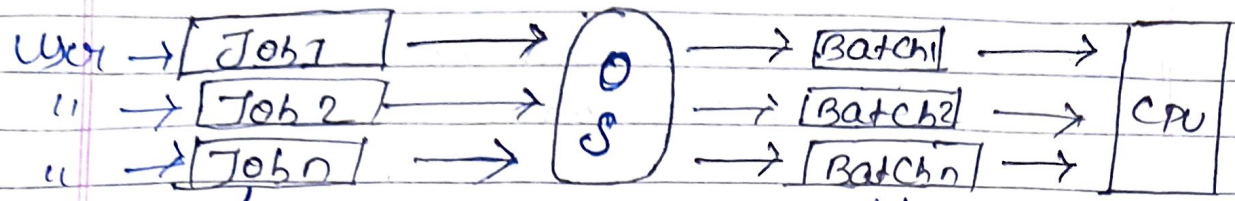
8 main operating system types: categorized by purpose and functionality

1. Batch operating system
2. Multiprogramming operating system
3. Multiprocessing operating system
4. Multi-user operating system
5. Distributed operating system
6. Network operating system.
7. Real-time operating system
8. Mobile operating system.
9. Time sharing OS.

### 1. Batch operating system (1950s - 1960s)

It does not interact with the computer directly. There is an operator which takes similar jobs having the same requirement and groups them into batches. It is the responsibility of the operator to sort jobs with similar need.

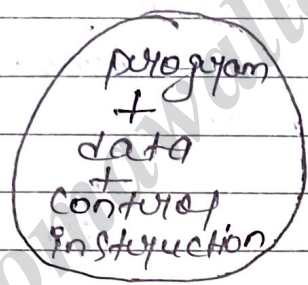
Hardware may be  
Ex - Bakery transaction



↳ task on program.

↳ All process are grouped then given CPU.

- Computers like IBM 1401 and IBM 7094 used this system.
- programming use done using assembly lang, COBOL or FORTRAN.
- Input was given using punch cards, tapes or magnetic drums.



### \* Architecture of Batch OS

- output handler
- Job Scheduler
- JCL Interpreter (Job Control language)
- Input Handler
- Device Drivers.

### \* Core Components

- Job Queue: Holds submitted jobs before execution.
- Job Scheduler :- decide which job to run next.
- Job Control language (JCL) :- Script that tells the OS how to run a job.

- Spooling System:- manages input/output files, improve performance.
- Monitor program:- A special resident program that control batch execution.
- Input/output control system:- Handles device communication.

### \* Key features

- Automatic job execution:- No manual start required.
- No user interaction:- Fully autonomous once batch starts.
- Sequential processing:- One job at a time (in order).
- JCL Dependency:- JCL Commands control job execution.
- Spooling:- Input and output are managed in secondary storage.
- Efficient for repetitive tasks:- Best for similar or predictable job types.

## Advantage

### • Increased CPU utilization:-

The CPU constantly busy jobs are processed one after another without waiting for user input. This minimize CPU idle time.

### • Efficient for similar jobs:-

Jobs with similar types (eg - Salary calculation or report generations) can be grouped and processed together, which improves efficiency and reduce overhead.

### • Automation of Execution:-

Once the jobs are submitted the system handles execution automatically without the need for human involvement reducing manual error and workload.

### • Lower Turnaround Time for Bulk jobs:-

Since multiple jobs are processed in one go, the time taken for completing large volumes of similar tasks is less compared to processing them one by one.

### • Better Error management in Batches:-

The system can manage or isolate errors at the batch level, so failed jobs don't always affects the entire system or other jobs.

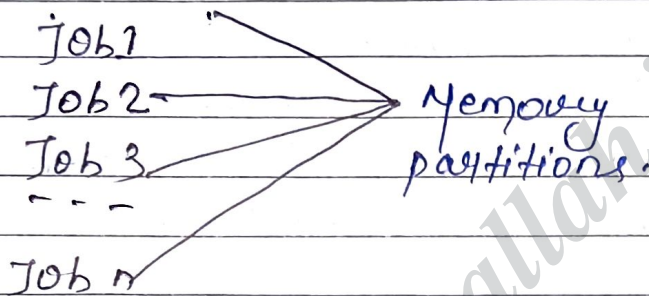
## Disadvantage

- **Non-Real time user interaction:-**  
Once a job is submitted, the user cannot interact with it. This is a problem if the job needs real time inputs or changes during execution.
- **Difficult to debug errors:-** If a job fails the error is only discovered after the whole is complete.
- **High Turnaround Time for small jobs:-**  
Small or urgent jobs may have to wait for the entire batch to complete, leading to delays even if they take only a few seconds to run.

**Application:-** payroll system, bank statement processing, bill generation, data backup system, tax calculation system, university result processing etc.

## ② Multi-programming operating system:-

It can be simply illustrated as more than one program is present in the main memory and any one of them can be kept in execution. This is used for better utilization of resources.



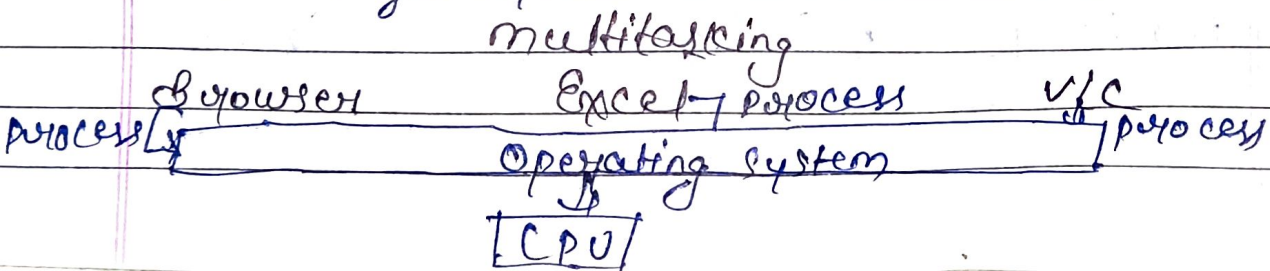
### Advantage

- CPU is better utilized and overall performance of the system improves.
- It helps in reducing the response time.

### \* Multi-tasking / Time sharing operating system:-

Type of multiprogramming system with every process running in round robin manner. Each task is given some time to execute so that all the ~~ten~~ tasks work smoothly.

Each user gets the time of the CPU as they use a single system.



## Advantage

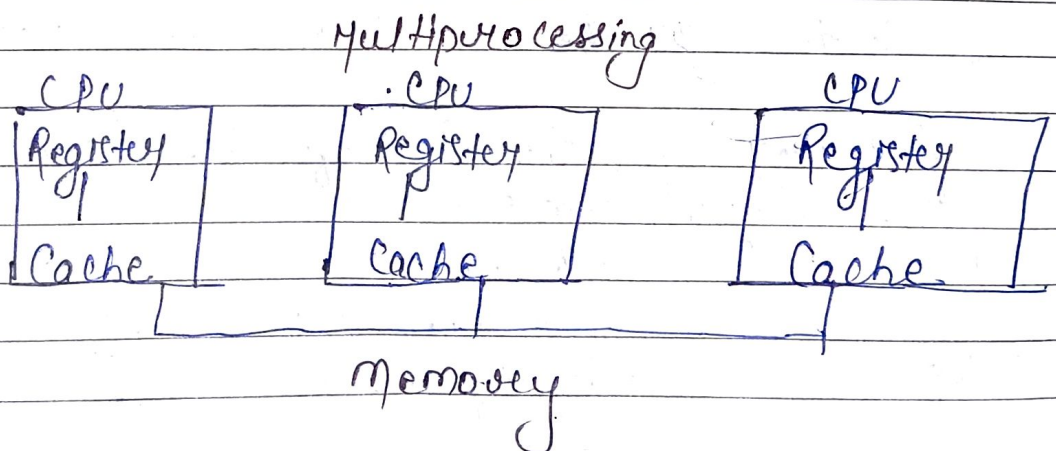
- Each task get an equal opportunity.
- Fewer chances of duplication of software.
- CPU idle time can be reduced.
- Resource Sharing
- Improved productivity
- Improved user experience.

## Disadvantage

- Reliability problem.
- One must take care of the security and integrity of user program and data.
- Data Communication problem.
- Complexity
- Security Risk

## 3. Multi-processing operating system:-

• This is a type of OS in which more than one CPU is used for the execution of the processes. It better the throughput of the system.



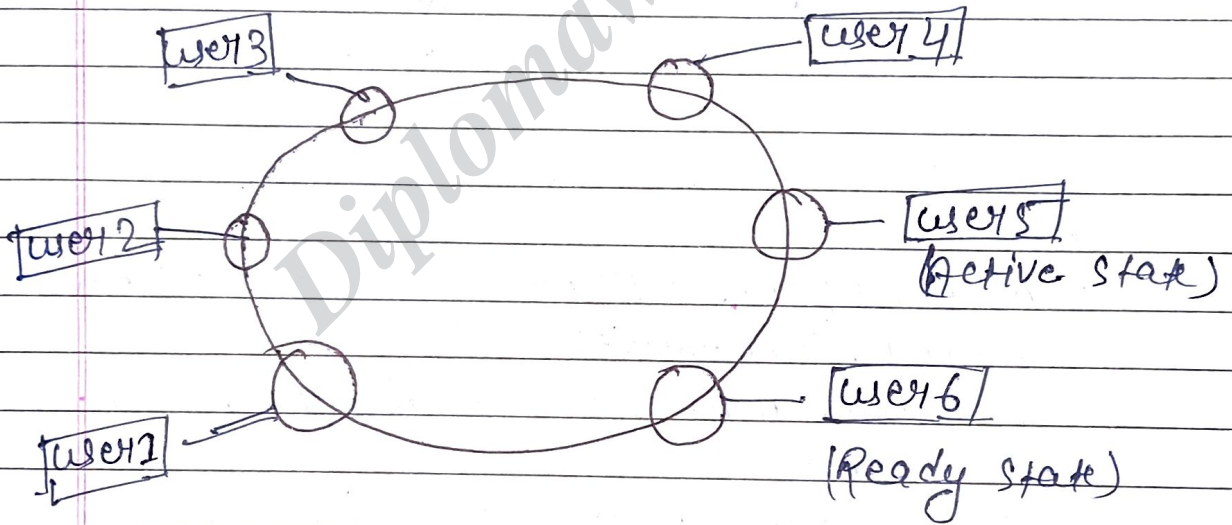
### Advantage

- Increases the throughput of the system as processes can be parallelised.
- It has several processors, so, if one processor fails we can proceed with another processor.

### 40 Multi-user operating system.

These system allow multiple user to be active at the same time.

This system can be either a multiprocessor or a single processor with interleaving.



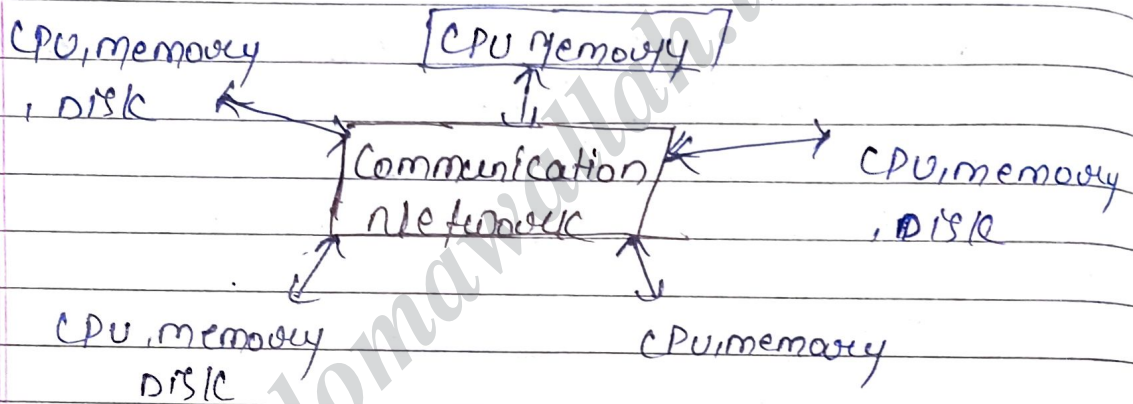
### 50 Distributed operating system: —

- latest operating system are recent advancement in the world of computer technology.
- various autonomous interconnected computers communicate with each other using a shared communication network.

→ Independent Systems possess their own memory unit and CPU systems.  
These systems are different in size and function.

→ Remote access is enabled within the device connected to that network.

### Architecture of Distributed OS



#### Advantage:-

- Failure of one will not affect the other network communication.
- Electronic mail increase the data exchange speed.
- Since resources are being shared, computation is highly fast and durable.
- Load on host computer reduces.

#### Disadvantage

- Failure of the main network will stop the entire comm.
- To establish distributed system, the language is not yet well defined.

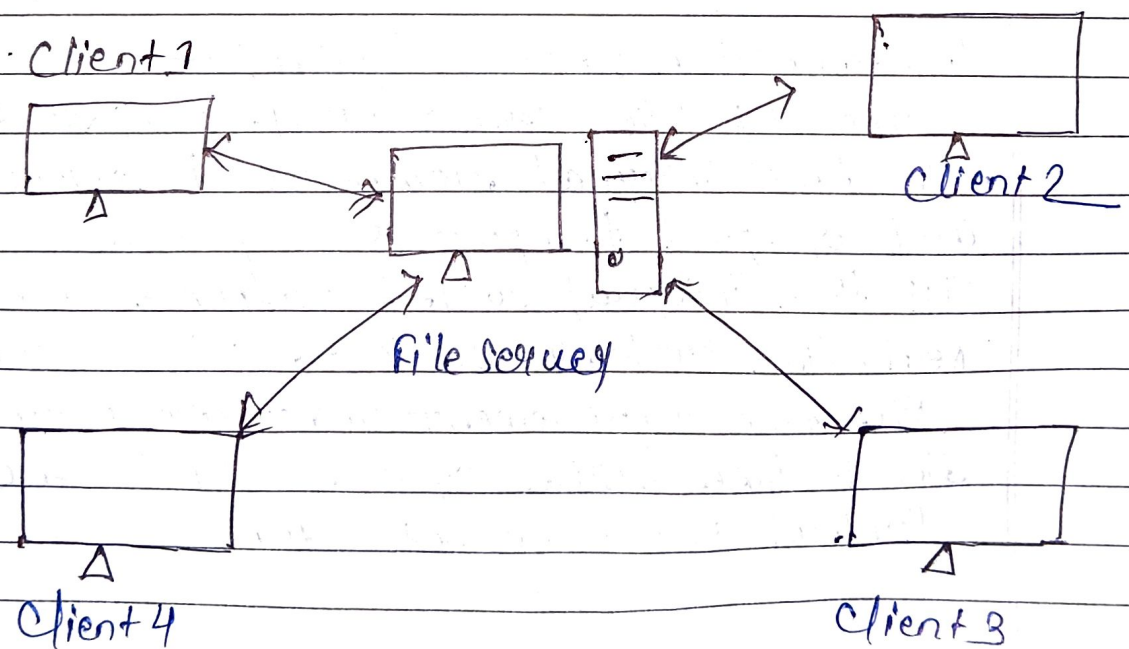
Example:- LOCUS

## 6. Network operating System:-

These system run on a server and provide the capability to manage data, users, groups, security, application and other networking functions.

These type of operating systems allow shared access to files, printers, security, applications, and other networking function over a small private network.

Network OS is that all the users are well aware of the underlying configuration of all other users within the network, their connections etc and that's why these computers are popularly known as tightly coupled systems.



## Advantage

- Highly stable, centralized servers.
- Security concerns are handled through servers.
- New technologies and hardware upgrades are easily integrated into the system.
- Server access is possible remotely from different locations and types of system.

## Disadvantage

- Servers are costly.
- The user has to depend on a central location for most operations.

## Example:—

Microsoft Windows Server 2003,  
 " " " " 2008,  
 UNIX, Linux, Mac OS X, Novell network,  
 BSD etc.

## 7. Real-Time Operating System:—

Types of OSs serve real-time system

- The time interval required to process and respond to input is very small. This time interval called response time.

Real-time systems are used when there are time requirement that are very strict like missile system, air traffic control system, robots etc.

## Types

- Hard Real-Time System
- Soft Real-Time System

## Advantage

- maximum Consumption
- Task Shifting
- Focus on Application
- Error-free
- memory Allocation

## Disadvantage

- limited Tasks
- use heavy system resources
- complex Algorithm

## Example :-

Scientific experiments, medical imaging system, industrial control system, weapon system, robots, air traffic control system etc.

## 8. Mobile Operating System :-

Mobile OS are designed specifically for mobile devices such as smartphones & tablets.

Ex - Android and iOS.

These OS manage hardware and software resources device, providing platform for running applications.

## Advantage.

- user-friendly Interfaces
- Extensive app Ecosystem
- Connectivity options,
- Regular updates.

## Disadvantage.

- Battery life Constraints: → Despite a advancement in power management.
- Security Risks,
- Fragmentation
- Limited hardware Resources.

## Dual mode operation

Why dual mode is needed

Dual mode operation is essential to ensure the security, stability and control of a computer system.

1. Protection of system resource  
user programs should not have direct access to hardware, memory, or I/O devices. If there is no separation a faulty or malicious program can corrupt the system. Kernel mode restricts this by allowing only the OS to perform critical tasks.

2. Preventing system crashes

- If every program had full access, a bug could crash the whole system.
- user mode isolates application from directly damaging the core system.

3. Safe system call.

- When a program needs to do something important (like read a file), it uses a system call.
- This triggers a mode switch from user mode → kernel mode → user mode.

#### 4. Operating System Security

- Sensitive operation like Changing passwords, managing users, Accessing restricted files must only be done in kernel mode.

To ensure the proper execution of the operating system, there are two modes of operations

##### (1) user mode: -

When computer system runs by user application like creating a text document or using any application program then the system is in user mode. When the user application requests for a service from the operating system or an interrupt occurs or system call, then there will be transition from user to kernel mode to fulfill the request.

Note: - To switch from kernel mode to user mode, the mode bit should be 1.

- user mode programs are less privileged than kernel mode application and are not allowed to access the system resources directly.

For instance, if an application under the user mode wants to access system resources it will have to first go through the operating system kernel by using syscalls.

- It protect the system by preventing user program from performing unauthorised or harmful actions.

### Key characteristics

1. Restricted Access:— cannot access hardware, memory or kernel instruction directly.
2. Controlled Execution:— limited to a specific set of CPU instruction.
3. User-level program only:— Application like browser, games, media player run in user mode.
4. No I/O permission:— Needs OS intervention (system call) to perform I/O tasks.
5. Mode Switching:— If privileged action needed switches to kernel mode.

## working

1. CPU start in user mode when running normal application.
2. If the program need to Read/write file, Allocate memory, communicate with devices then it make a system call to the Operating system.
3. The OS than switch to kernel mode, perform the tasks, and returns to user mode.

## System call:-

System call is the gateway b/w user mode and kernel mode. When a program needs to perform something that only the OS can do (like accessing files, memory or devices) it uses system call.

## Types of system call (with examples)

Category	Purpose	Examples
1. File management	→ create, delete, read, write files	→ open(), read(), write(), close, unlink
2. process control	→ Start/stop / Suspend process	→ fork(), exec(), exit(), wait()
3. device management	→ use hardware devices	→ ioctl(), read(), write()

4. Information → user/set system info → get pid ()  
maintenance
5. memory management → Allocate/free memory — fork (),  
mmap (),  
sleep ()

## Kernel and Microkernel

What is a kernel?

The kernel is the core (main part) of an operating system.

It controls everything in the system. Such as:-

- CPU
- Memory
- Input/output devices (keyboard, printer)
- File management
- processes (apps/program)

It runs in kernel mode (which we learned in "dual mode operation")

\* Core function:-

The kernel primary responsibility is to manage the system resources and facilitate communication, ensuring the computer runs smoothly :-

## 1. Process Management:-

- Scheduling:- Decides which of the many running programs (processes) get access to the CPU and for how long.
- Process Isolation:- Ensure that processes run independently and don't interface with each other's memory or resources.

## 2. Memory Management

- Allocation and deallocation:- manages the computer's RAM, allocating memory space to running processes as needed and deallocating it when no longer required.
- Virtual Memory:- creates a virtual space for each program.
- Memory protection.

## 3. Device Management

Manages the device drivers and input/output operations.

## 4. File System Management:-

Organise how data stored, accessed and managed on storage device. (hard drive, SSD).

## 5. Networking:-

Implementing network protocols (like TCP/IP), allowing communication over local area network (LANs) and the internet.

## \* Microkernel

- Keeps only essential services in the kernel (CPU, memory).
- Other services (file system, devices) are moved to user mode. Or separate programs.
- ~~pros~~ —
  - More secure and stable.
  - Easier to update/maintain.
- Cons: —
  - Slightly slower due to more communication between user and kernel mode.

Example: — Minix, QNX, MacOS (partly).

## \* Corporate

Corporate vs personal Needs.  
Every person in organization uses a computer or device differently. So their requirement from an operating system also change.

we divided into two categories: —

1. Personal Needs: — Individual users.
2. Corporate Needs: — Business/company users.

## 1. personal needs

It refers to the individual requirement, desires and aspiration of an employee within and outside the professional context.

Characteristics: →

- Focus on Individuality
- pschy

Feature	personal needs	Corporate Needs
* user-type	Individual users	Multiple user/employees
* Usage purpose	Web browsing, entertainment, basic productivity.	Business operations, file sharing, server roles, enterprise application.
* Security	Basic antivirus, firewall	Advanced Security (encryption, VPN)
* user management	Single user management	multi-user with role-based access and group policies.
* System updates	Automatic updates from the OS vendor	Controlled updates to avoid system disruption.
* Data Backup	local or personal cloud backup.	Regular scheduled backups.
* Networking	Basic home or public networks.	Corporate network with domains, VPNs, firewalls.

performance	Optimized for personal tasks.	optimized for performance, scalability and uptime.
Software licensing	Single user license but forever.	Volume licensing, enterprise software agreements

### \* Types of OS Installation :-

1. Clean Installation
2. Upgrade Installation
3. Dual-Boot Installation
4. Remote Network Installation
5. Dual Boot Installation
6. Virtual Installation
7. OEM Installation
8. Recovery Installation
9. Image based Installation
10. Custom Installation

① Clean Installation :- It means erasing everything on the drive and installing a fresh copy of the OS.

Step by Step process:-

- ① Backup your data:- Save all personal files, documents, and S/w keys to USB or cloud storage.
- ② Create bootable media:- Use tool like Rufus or the official OS media creation tool to make a bootable USB or DVD.
- ③ Insert Boot media:- Plug in the USB drive or insert the DVD containing the OS.
- ④ Restart the Computer:- Press the power button and boot into BIOS/UEFI (F2, DEL, etc).
- ⑤ Change boot order and Start Installation.
- ⑥ Choose Language & Region and select "Custom Installation", (Install Windows only [advanced] or similar).
- ⑦ Delete old partitions. (Create new partition from unallocated space and format it).
- ⑧ Start Installing (The PC will restart several times to complete setup).
- ⑨ Set up user info, install drivers & updates, Restore files & Apps.

## ⑪ Upgrade Installation

An upgrade installation keeps your personal files, apps, and settings while installing a newer version of the OS over the existing one.

It is smoother than a clean install and is often used for version upgrades (Windows 10 → Windows 11)

Step by Step: —

- ① Check System Requirements  
→ Ensure your hardware meets the minimum requirements for the new OS.
- ② Backup your data (optional but recommended)  
→ just in case, back up files to USB, external drive, or cloud.
- ③ Get the Installation Media  
Use the official OS upgrade assistant or ISO file (e.g. - Windows Update Assistant).
- ④ Run the Installer - Double click the Setup.exe
- ⑤ Choose upgrade option: —  
Select "Upgrade: keep files, apps, and settings".
- ⑥ Download updates: — The installer will check for and download necessary updates and drivers.
- ⑦ Accept License Agreement: — Read and accept the conditions.
- ⑧ System compatibility check - Installer checks app/hardware compatibility.
- ⑨ Start Installation: — The system will copy files, install new OS version.
- ⑩ Post-installation
- ⑪ Re-check data & APP
- ⑫ Update drivers.

(ST)

\* Monolithic kernel:- OS ka poora kaam (process management, file system, device drivers, memory management, etc.) ek hi large kernel ke andar hota hai.

\* Microkernel - Sirf basic functionalities (Inter-process communication, Basic Scheduling & Basic Memory management) kernel ke andar hoti hai, baaki services user space me run hoti hain.

Difference

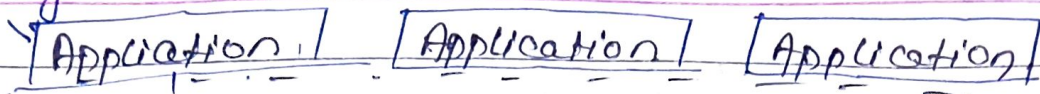
Aspect	monolithic kernel	Microkernel
* Definition	Large kernel contains all OS services inside kernel space.	Small kernel contains only essential services. rest in user space.
* Size	Large (multi-MB).	Small (few KB to MB).
* performance	Fast - direct function calls inside kernel.	Slightly slower - need message passing b/w kernel & user space.
* Reliability	less reliable - one bug can crash the whole system.	more reliable - crash in one service doesn't affect the whole system.
* Security	lower - all codes run in kernel mode.	Higher - limited code in kernel mode, rest isolated in user space.
* Communication	Internal func. calls.	message passing (slower)
* Ex- XP, MS-DOS	linux, unix, windows	minix, QNX, I4, macOS
* Best for	High performance system	High reliability, embedded system.

# Architecture 10

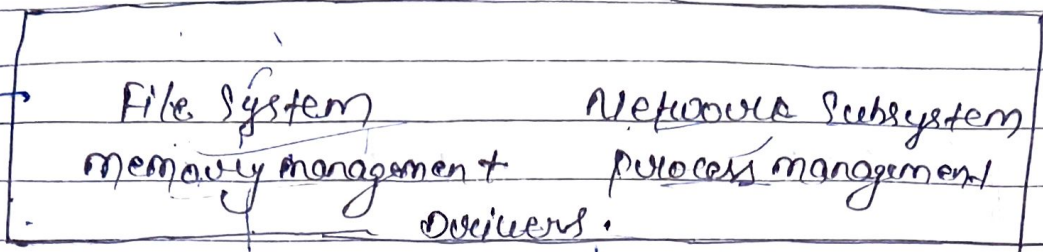
## Monolithic kernel system



unprivileged mode

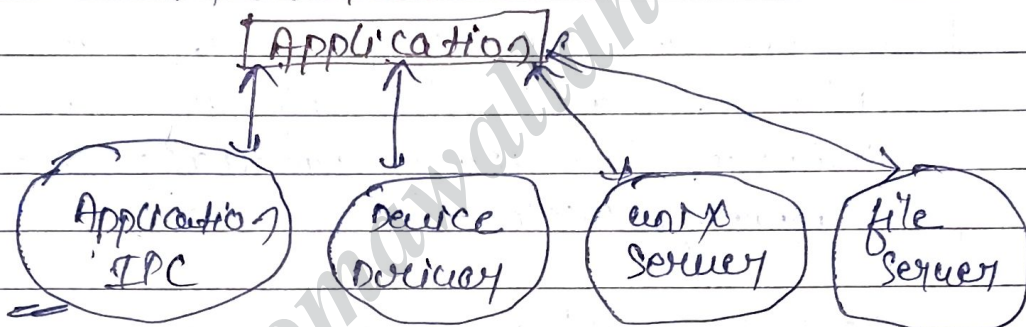


privileged mode



## Microkernel OS

non-privileged user



inter process communication

