The Islamia University of Bahawalpur Pakistan

Introduction to Computer

Computer System Architecture

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بِسْمِ اللهِ الرَّحْمٰنِ الرَّحِيْمِ

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Operating System
&
Hardware Management

Operating System

What is Operating System:

- An Operating System Is A Software That Provides An Interface For User To Interact With Computer. It Controls The Execution Of All Type Of Program. A computer Can Not Do Anything Without Operating System. An Operating System Is Responsible To Allocate System Resources The Resources Are Memory , Processor , Disk Space & External Devices Like Monitors Printers And Modems etc.

User Interface(UI)

The User Interface is how we interact with the computer.

- **Command Line Interface (CLI):**

This is text-based, where users type commands to perform tasks. CLI is powerful but can be harder for beginners.

- **Graphical User Interface (GUI):**

This is the visual interface, with icons and buttons, making it easier for users to interact with the OS (e.g., Windows, macOS).

Core Function

- **Process Management:** The OS manages different tasks (processes) that are running. It decides which task gets the CPU and when, so everything works without lagging

- **Memory Management**: The OS keeps track of where each program's data is stored in the computer's memory (RAM). It makes sure programs don't overwrite each other's data.

- **File Management:** The OS organizes files, helps you save or open documents, and keeps track of their locations on the hard drive. Security: The OS protects your data from unauthorized access, managing who can access files .

Kernel vs. Shell

- **Kernel:** The kernel is the core part of the OS that directly manages the hardware, like CPU, memory, and devices. It's like the OS's brain, handling essential functions.

- **Shell:** The shell is the outer layer of the OS that users interact with. It translates user commands into actions for the kernel to perform.
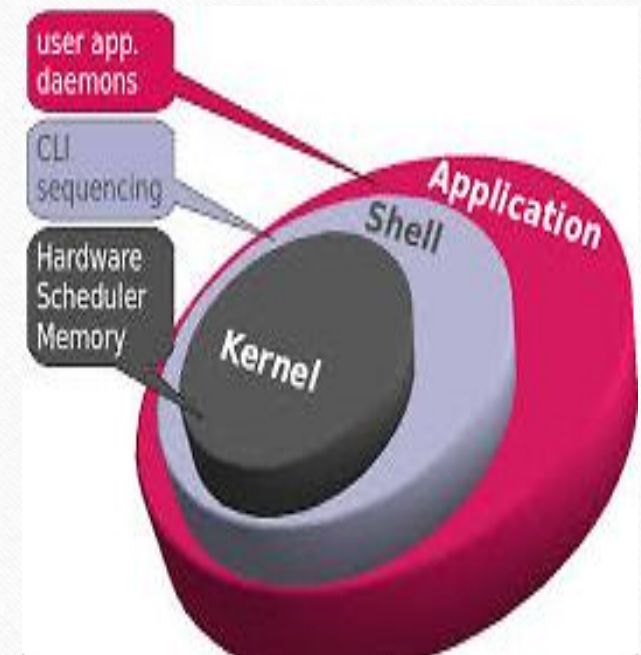
Types of Operating Systems

- 1. Batch Operating Systems
- 2. Time-Sharing Operating Systems
- 3. Network Operating Systems:
- 4. Real-Time Operating Systems (RTOS)
- 5. Distributed Operating Systems
- 6. Embedded Operating Systems
- 7. Mobile Operating Systems
- 8. Server Operating Systems
- 9. Desktop Operating Systems
- 10. Hybrid Operating Systems

Types of Operating Systems

- **Batch Operating Systems**: Used in early computing for batch processing without user interaction

- **Time-Sharing Operating Systems**: Allows multiple users to use the system concurrently by dividing CPU time

- **Network Operating Systems**: Designed for network environments, providing features like file sharing and network resource management.

- **Real-Time Operating Systems (RTOS):** Guarantees prompt response to events, used in critical systems like aerospace and medical devices.

- **Distributed Operating Systems**: Manages distributed computing environments, coordinating multiple processors and nodes.

Types of Operating Systems

- **Embedded Operating Systems**: Used in devices like smartphones, appliances, and automotive systems.

- **Mobile Operating Systems**: Designed for mobile devices, providing touch interfaces and power management.

- **Server Operating Systems**: Optimized for server environments, providing features like scalability and reliability.

- **Desktop Operating Systems**: Designed for personal computers, providing graphical user interfaces and productivity applications.

- **Hybrid Operating Systems**: Combines features of different OS types, like real-time and embedded systems.

Memory Manage Hardware:

- Operating systems work as an interface between the user and the computer hardware.

- It is a software which performs the basic tasks like input, output, disk management, controlling peripherals etc.

- Windows, Linux etc. are some examples of operating systems.
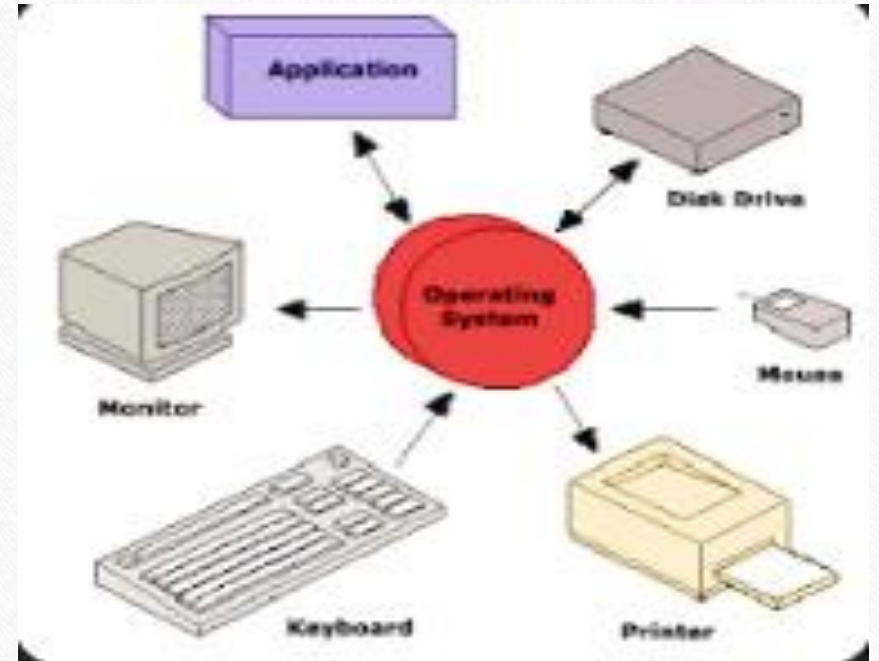
How OS Manages Hardware:

- Memory management

- Device management

- Processor management

- File Management

- I/O Management

- Fans and Cooling

- Networking
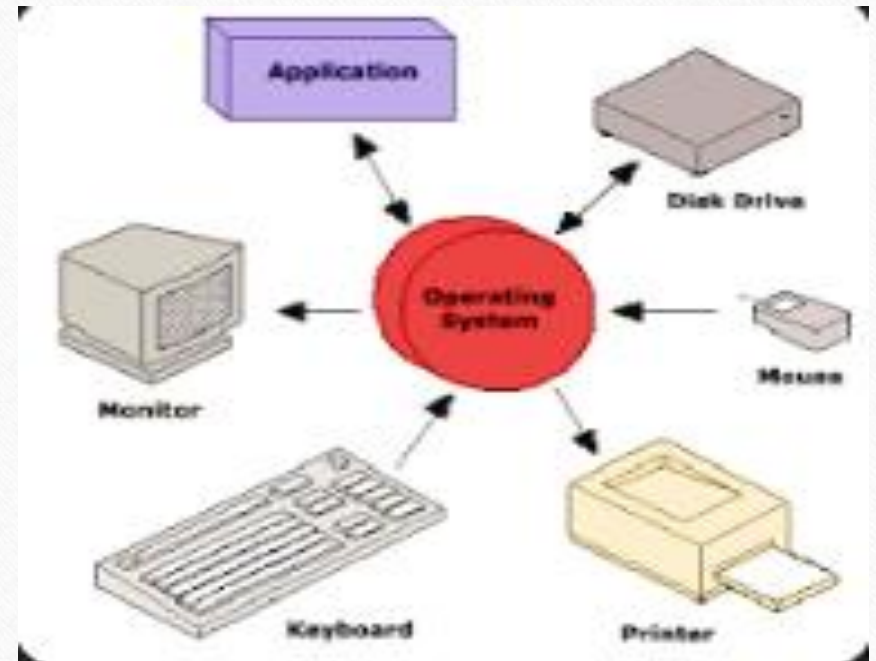
Memory Management

The OS organizes and manages the computer's memory (RAM).It decides where to store data and applications so that they don't interfere with each other.

Memory management refers to the management of the primary memory

- Each executing process resides in main memory.

- OS keeps track of memory,

- Allocates memory between processes,

- Deallocates the memory when the process does not require the memory.

Device Management

The OS manages all the hardware devices, like the printer, keyboard, and mouse. It uses software called drivers to help communicate with each device and makes sure they work well with the computer.

- OS keeps track of devices

- Allocates these devices to different processes as per the request made by the processes.

- De-allocates these devices to different processes as per the request made by the processes.

Processor Management

- Like memory and devices, managing the processor is one of the important tasks of an OS.

- It allocates the processor to different processes in main memory to do so the OS uses some scheduling algorithms also these are like First Come First Serve, Priority Scheduling, Shortest Job First, etc.

File Management

- The operating system also keeps track of the file system of a computer normally the file system is divided in directories which can be handled by the OS.

I/O Management

- I/O management is one of the important tasks of the operating system. OS manages the IO devices like mouse, keyboard, printer, display, LED's etc.

- I/O devices can be of two types which are as follows −

- **Synchronous I/O** − Here, the CPU waits for the i/o device

- **Asynchronous I/O** − Here, the CPU execution takes place parallel to the IO device.

- The operating system helps the processor in communicating to the IO devices. These communications are Special instruction I/O, Memory-mapped I/O, Direct memory access.

Fan & Cooling Management

- In a computer system, one of the important hardware components is the cooling system. The CPU fan helps the CPU from overheating. Overheating sometimes causes permanent damage to a CPU.

- The operating system plays role in communicating with both the CPU and the fan which helps to ensure that the system stays cool.

- This process is also done by the motherboard's internal controls, called the BIOS, and can be overwritten by applications running in the OS.

Storage Management

- Operating Systems manage storage devices:

- **Disk Scheduling:** Optimizing disk access and performance.

- **File Systems:** Organizing and managing files (FAT, NTFS, exFAT, etc.).

- **Storage Virtualization:** Abstracting storage resources.

- **Data Redundancy and Backup:** Ensuring data availability.

Hardware Management

Operating Systems interact with hardware components:

- **Device Drivers:** Managing hardware devices.

- **Interrupt Handling:** Managing hardware interrupts.

- **Memory Management:** Allocating and deallocating memory.

- **Power Management:** Optimizing power consumption.

Network Management

- Networking plays an important role in distributed system environment where a group of processors can memory, hardware devices, or a clock.

- The processors communicate with one another with the help of the network only.

Security and Protection

- The OS protects data and resources, making sure only authorized users and programs can access certain files or settings.

- It keeps applications separate so they don't mess with each other's data or cause errors.