Operating System Notes
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1. Introduction to Operating Systems
- **Definition:** An Operating System (OS) is software that acts as an intermediary between computer hardware and users. It manages hardware resources and provides services for application software.
- **Functions:**
  - Resource management
  - Process scheduling
  - Memory management
  - Device control
2. Types of Operating Systems
Batch Operating Systems
- **Definition:** Executes batches of jobs without user interaction.
- **Characteristics:**
  - Efficient for high-throughput
  - Jobs are collected and processed sequentially
- **Example:** IBM 7094
Time-Sharing Operating Systems
- **Definition:** Allows multiple users to interact with the computer simultaneously.
- **Characteristics:**
  - User programs share the processor time

  - Provides immediate response
- **Example:** UNIX
Distributed Operating Systems
- **Definition:** Manages a collection of independent computers and makes them appear as a single coherent system.
- **Characteristics:**
  - Resource sharing
  - Transparency
- **Example:** Amoeba
Real-Time Operating Systems
- **Definition:** Processes data as it comes in, typically without buffer delays.
- **Characteristics:**
  - Predictable response time
  - Used in embedded systems
- **Example:** VxWorks
3. Components of an Operating System
Kernel
- **Definition:** The core part of the operating system that manages system resources and communication between hardware and software.
- **Functions:**
  - Process scheduling
  - Memory management
  - Device management
User Interface
- **Types:**
  - Command-Line Interface (CLI)
  - Graphical User Interface (GUI)
- **Example:** Linux terminal (CLI), Windows desktop (GUI)
System Libraries
- **Definition:** Collections of standard functions available to applications for performing various tasks.
- **Role:** Provide functions for handling system calls and managing processes.
4. Process Management
Process Definition
- **Definition:** A program in execution. It contains the program code, current activity (represented by the value of the program counter), and process stack.
Process States
- **States:**
  - New
  - Ready
  - Running
  - Waiting
  - Terminated
Process Control Block (PCB)
- **Definition:** A data structure used by the operating system to store all the information about a process.
- **Contains:**
  - Process ID
  - Process state
  - Program counter
  - CPU registers
  - Memory management information
5. Memory Management

Memory Hierarchy
- **Levels:**
  - Registers (fastest, smallest)
  - Cache
  - Main Memory (RAM)
  - Secondary Storage (HDD/SSD)
Paging
- **Definition:** A memory management scheme that eliminates the need for contiguous allocation of physical memory and eliminates fragmentation.
- **Example:** A page table maps virtual addresses to physical addresses.
Segmentation
- **Definition:** Memory management technique that divides the memory into segments based on logical divisions.
- **Example:** Code, stack, data segments.
6. File Management
File System Structure
- **Definition:** A way to store and organize files on a disk.
- **Components:**
  - Directories
  - Files
  - Metadata
File Operations
- **Common Operations:**
  - Create
  - Read
  - Write
  - Delete
Access Methods
- **Types:**
  - Sequential Access
  - Random Access
7. Device Management
I/O Devices
- **Definition:** Hardware components that allow users to interact with the computer system.
- **Types:**
  - Input Devices (e.g., keyboard, mouse)
  - Output Devices (e.g., monitor, printer)
Device Drivers
- **Definition:** Software that allows the operating system to communicate with hardware devices.
- **Role:** Convert the OS's generic I/O instructions to device-specific codes.
8. Security and Protection
User Authentication
- **Definition:** Process of verifying the identity of a user or process.
- **Methods:**
  - Passwords
  - Biometric verification
  - Multi-factor authentication
Access Control
- **Definition:** Mechanisms that restrict access to resources based on permissions.
- **Types:**
  - Discretionary Access Control (DAC)

  - Mandatory Access Control (MAC)
Malware Protection
- **Types:**
  - Antivirus Software
  - Firewalls
- **Goal:** Protect systems from malicious software and unauthorized access.
9. Conclusion & Summary
Operating Systems are crucial for managing computer hardware and software resources. Different types of OS cater to specific environments and user needs. Understanding the components of an OS, such as process management, memory management, file systems, and security measures, is vital for effective system utilization and development.

This content can be expanded upon for specific sections as needed, but provides a crisp, organized approach towards studying Operating Systems.