Operating Systems Design (CSE323)

Lecture 1 & 2 (Date: 18/01/25)

Introduction to Operating System Design

OS Design Overview

Different tasks are often assigned to dedicated software. For example:

- **Chatting with friends/social media:** Use a web browser (e.g., Chrome).
- **Completing assignments:** Use a text editor (e.g., MS Word).

These types of software are **application-dependent**, meaning they are designed for specific tasks and are referred to as **application/user software.**

Computer Hardware Components:

- **CPU/Processor**
- **Memory/RAM**
- **I/O Devices** (Keyboard, Mouse, Printer, etc.)

The **Operating System (OS)** serves as an intermediary between application software and hardware, ensuring communication and resource management.

Key points:

- Users interact with application software, which in turn runs on hardware.
- The OS manages the execution of multiple software applications simultaneously.
- Users do not manually control resource allocation; the OS handles it.

The OS ensures that various processes such as memory management, security, and file management are handled efficiently. As software complexity increases, frequent OS updates are required.

A good OS is measured by how user-friendly and efficient it is.

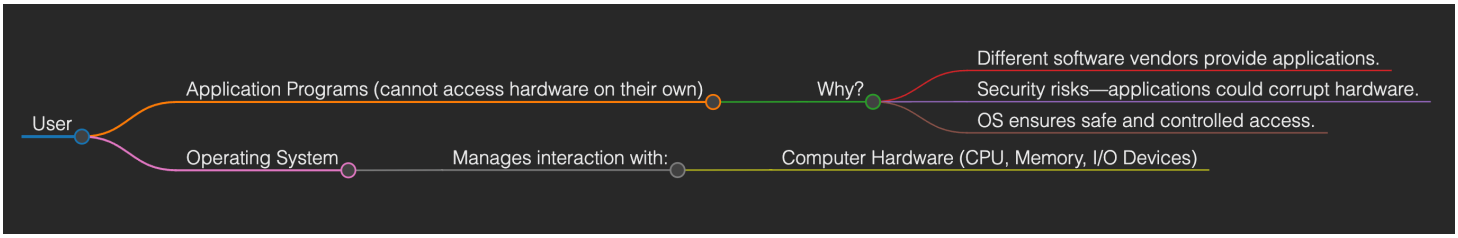
This course will explore **core concepts of operating system software**, which differ from application software development.

OS Concepts (Chapter 1)

A computer system can be divided into four major components:

1. **Hardware:**
   - Provides the basic computing resources (CPU, memory, I/O devices).
2. **Operating System:**
   - Manages hardware and serves as an intermediary for applications.
3. **Application Programs:**
   - Define how system resources are used (e.g., word processors, browsers).
4. **Users:**
   - People, machines, or other computers using the system.

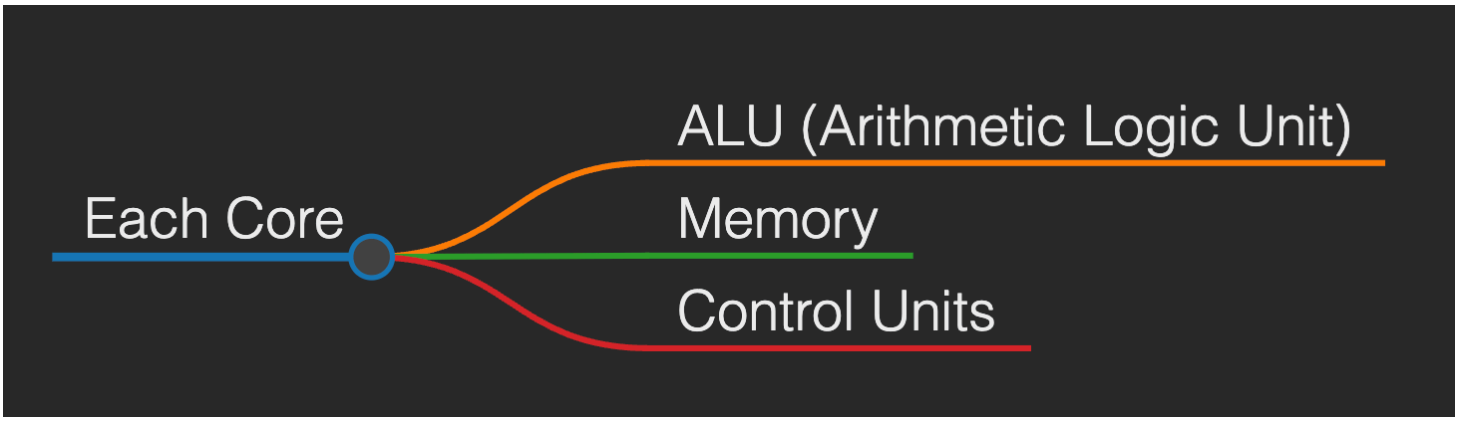
Abstract Hierarchical View



Goals of an Operating System

1. **User Convenience:**
   - Execute user programs efficiently.
   - Simplify problem-solving.
2. **System Utilization:**
   - Efficient use of hardware resources.

Example: Quad-core processors contain:



Due to hardware limitations, the OS optimally manages processing capabilities.

OS as a Resource Allocator

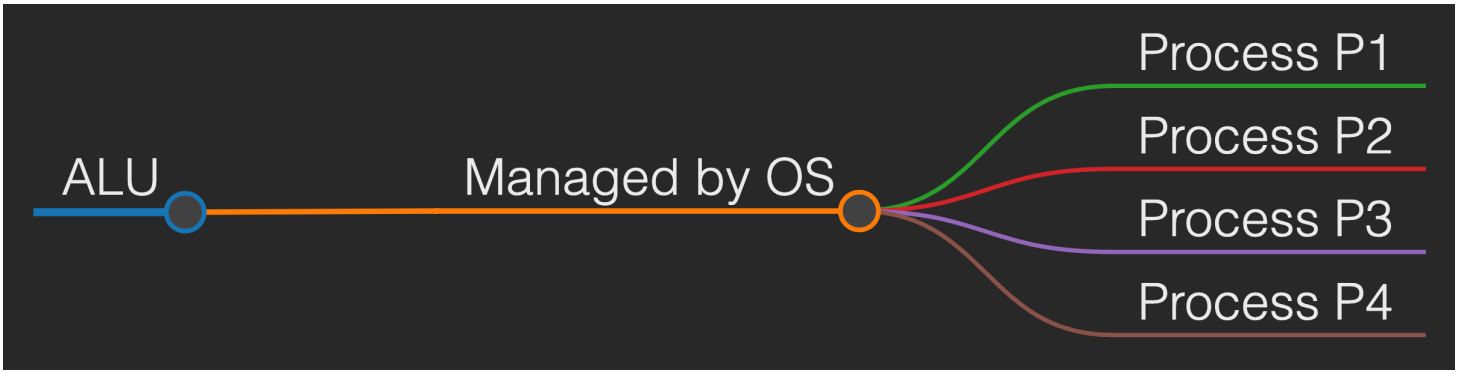
The OS must:

- Manage all resources efficiently.
- Resolve conflicting requests fairly.

Example of Resource Allocation

Software	Process	Resource Needed
Chrome	P1	Keyboard
PowerPoint	P2	Keyboard

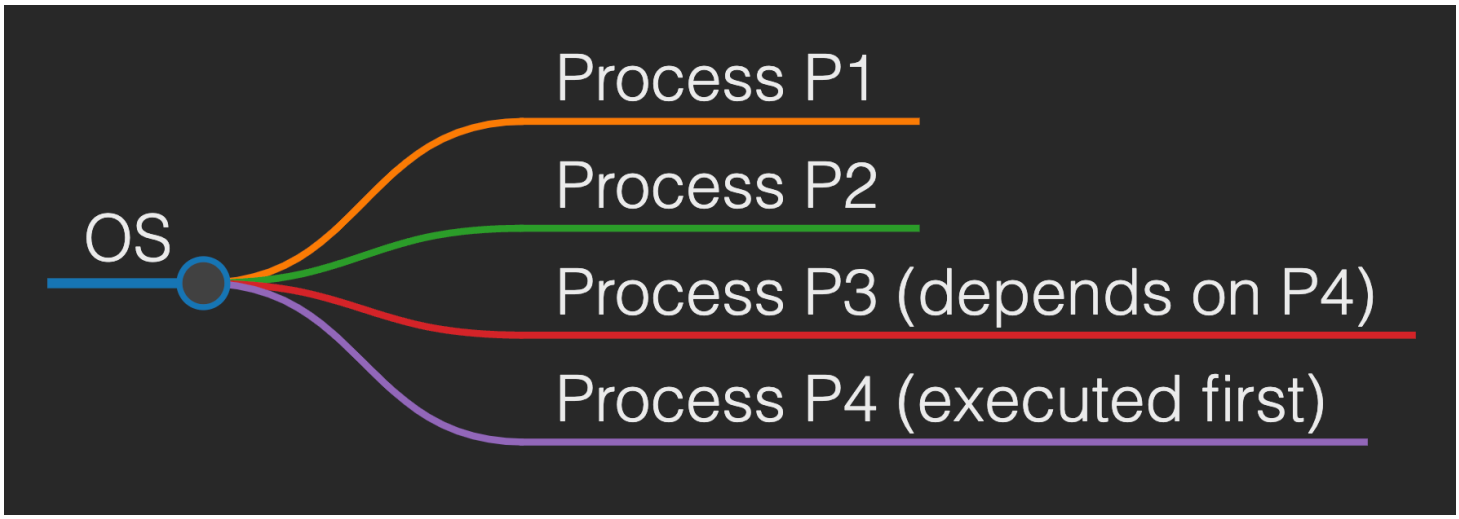
If multiple processes require the same resource (e.g., ALU), the OS schedules access logically, not simultaneously.



OS as a Control Program

The OS also prevents errors and improper usage by controlling process execution.

Example of process dependency:



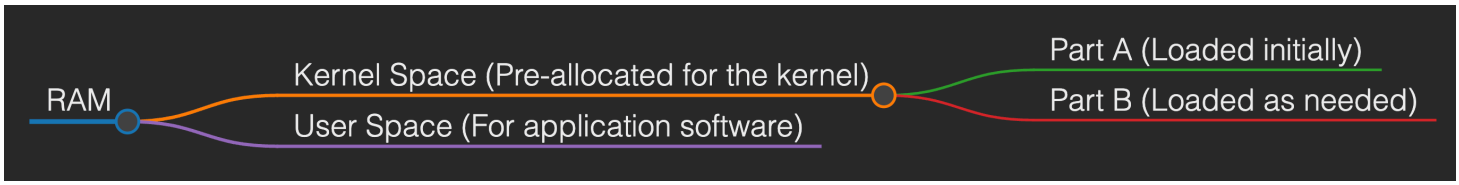
The Kernel

The **kernel** is the core of an OS and has full control over system operations.

Kernel Features:

- Loaded at startup (after the bootloader).
- Handles I/O requests and CPU instructions.
- Modular to optimize RAM usage.

Memory Allocation Overview



The **kernel space** and **user space** do not overlap, ensuring system stability and security.

OS Boot Process

Bootstrap Program (Bootloader):

- Stored in ROM (BIOS/firmware).
- Initializes system components.
- Loads the OS kernel into memory.

Functions of Bootstrap Program

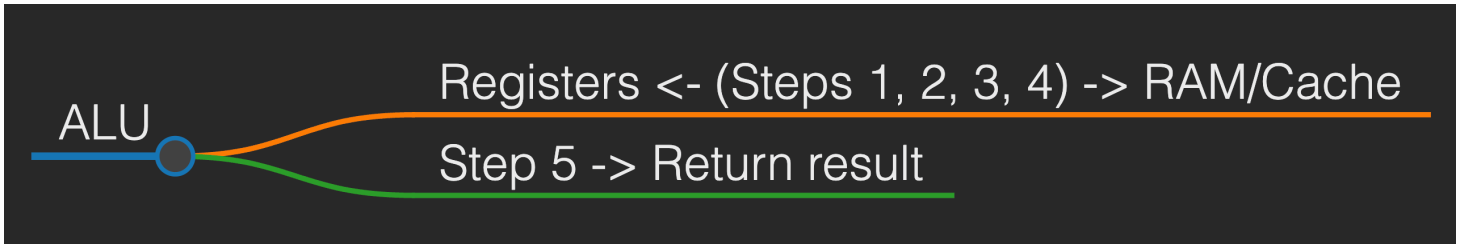
1. Load OS into memory.
2. Load essential drivers for peripherals.

Computer System Operation

The OS handles the **Fetch-Execute Cycle**:

1. Instruction Fetch (IF)
2. Instruction Decode (ID)
3. Data Fetch (DF)
4. Instruction Execution (EX)
5. Return Result (RR)

Visualization of Data Flow



Next Class: Computer System Architecture