Operating Systems for Computer Science Students

From Processes and Memory to Real-World System Design

Website Name: haas.dev
Website Link: https://dev-roast-app.vercel.app

Introduction

An Operating System (OS) is the most critical software layer in any computer system.
It manages hardware resources, executes programs, and ensures efficient and secure operation.

For computer science students, understanding operating systems is **essential** for system-level thinking, performance optimization, and building scalable applications.

Why Operating Systems Matter

- Core subject in CS degrees
- Frequently tested in technical interviews
- Required for backend, systems, cloud, and DevOps roles
- Foundation for understanding performance, concurrency, and resource management

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What Is an Operating System?

An Operating System is software that acts as an **interface between hardware and user applications**.

Examples:

- Windows
- Linux
- macOS
- Android
- iOS

Main Functions of an Operating System

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- Process management
- Memory management
- File system management
- Device management
- Security and access control

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1. Processes and Threads

Process

A process is a program in execution.

States of a process:

- New
- Ready
- Running
- Waiting
- Terminated

Thread

A thread is the smallest unit of execution inside a process.

Why threads are used:

- Faster execution
- Efficient multitasking
- Better resource utilization

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2. CPU Scheduling

CPU scheduling determines **which process runs next**.

Common Scheduling Algorithms

- First Come First Serve (FCFS)
- Shortest Job First (SJF)

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- Round Robin
- Priority Scheduling

Goal:
Maximize CPU utilization and minimize waiting time.

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3. Memory Management

Memory management controls how memory is allocated and deallocated.

Key Concepts

- RAM vs Virtual Memory
- Paging
- Segmentation

Page Replacement Algorithms

- FIFO
- Least Recently Used (LRU)
- Optimal

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4. Deadlocks

A deadlock occurs when processes wait indefinitely for resources.

Deadlock Conditions

1. Mutual exclusion
2. Hold and wait
3. No preemption
4. Circular wait

Deadlock Handling

- Prevention
- Avoidance (Banker's Algorithm)
- Detection and recovery

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5. File Systems

The file system organizes and stores data on storage devices.

Common Operations

- Create
- Read
- Write
- Delete

File System Types

- FAT
- NTFS
- ext4

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6. Input/Output (I/O) Management

The OS manages communication between hardware devices and applications.

Examples:

- Keyboard
- Mouse
- Disk drives
- Printers

Uses **device drivers** for hardware interaction.

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7. Virtualization

Virtualization allows multiple operating systems to run on a single machine.

Examples:

- Virtual Machines (VMs)
- Containers

Used heavily in:

- Cloud computing
- DevOps
- Server management

Mini Project Ideas (OS-Based)

1. **CPU Scheduling Simulator**
2. **Memory Management Simulator**
3. **Process Management Tool**
4. **Deadlock Detection Program**
5. **File System Simulation**

These projects are suitable for **final year projects** and system-level practice.

Common Mistakes CS Students Make

- Memorizing theory without understanding flow
- Ignoring scheduling and memory concepts
- Not practicing OS-based problems
- Treating OS as irrelevant to development

Key Takeaways

- Operating Systems manage all system resources
- Processes, memory, and scheduling are core concepts
- OS knowledge improves system design skills
- Practical simulations strengthen understanding

Next Learning Recommendation

To complete the core CS foundation, continue with:

- **Database Management Systems (DBMS)**

- **Software Engineering**
- **Distributed Systems**

Visit **haas.dev** for structured CS guides, operating system tutorials, and final year project resources.

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