

# Introduction to Operating Systems

## Introduction to Operating Systems

Course?level overview – concise, organized, and easy to read

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## 1. What Is an Operating System (OS)?

| Aspect        | Description                                                                                                                                                          |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Definition    | System software that manages hardware resources and provides services for application programs.                                                                      |
| Primary Goals | <ul style="list-style-type: none"><li>• Efficient resource utilization</li><li>• Protection &amp; security</li><li>• Convenience for users and programmers</li></ul> |
| Examples      | Windows, macOS, Linux, Android, iOS, FreeBSD, QNX, etc.                                                                                                              |

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## 2. Core Functions of an OS

| Function               | Key Responsibilities                                                                                                                                                                                      |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Process Management     | <ul style="list-style-type: none"><li>• Create, schedule, and terminate processes</li><li>• Context switching</li><li>• Inter?process communication (IPC)</li></ul>                                       |
| Memory Management      | <ul style="list-style-type: none"><li>• Allocate/deallocate RAM</li><li>• Virtual memory &amp; paging</li><li>• Protection (address space isolation)</li><li>• Organize data on storage devices</li></ul> |
| File System Management | <ul style="list-style-type: none"><li>• Provide hierarchical namespace (directories)</li><li>• Access control &amp; metadata</li></ul>                                                                    |
| Device I/O Management  | <ul style="list-style-type: none"><li>• Abstract hardware via drivers</li><li>• Buffering, caching, spooling</li><li>• Interrupt handling</li></ul>                                                       |
| Security & Protection  | <ul style="list-style-type: none"><li>• Authentication, authorization</li><li>• Access control lists (ACLs)</li><li>• Isolation of user and kernel mode</li></ul>                                         |

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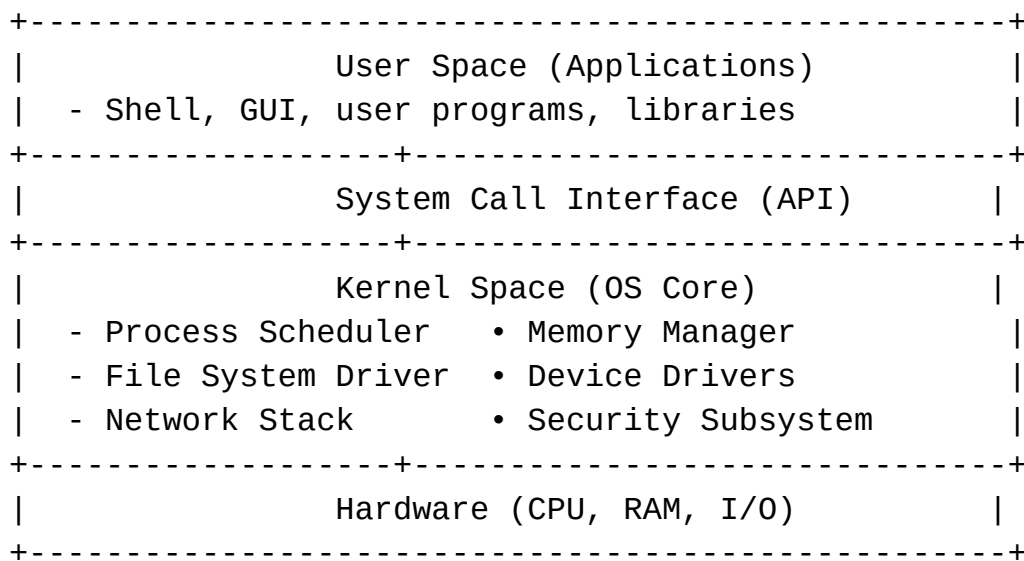
## Function

## Key Responsibilities

### User Interface

- Command-line shells (CLI)
- Graphical user interfaces (GUI)
- APIs for applications (system calls)

## 3. System Architecture



- **User mode** – limited privileges; crashes stay confined.
- **Kernel mode** – full access to hardware; only trusted code runs here.

## 4. Process vs. Thread

| Concept            | Process                                                  | Thread                                                                |
|--------------------|----------------------------------------------------------|-----------------------------------------------------------------------|
| Definition         | Independent execution entity with its own address space. | Lightweight unit of execution within a process; shares address space. |
| Resource Ownership | Owns memory, file descriptors, etc.                      | Shares process resources (memory, open files).                        |
| Creation Cost      | Higher (requires new address space).                     | Lower (just a control block).                                         |
| Typical Use        | Isolate applications.                                    | Parallelize tasks inside an application.                              |

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## 5. Scheduling Basics

| Scheduling Type        | Description                                                                    | Typical Algorithms                                                          |
|------------------------|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Long-term (admission)  | Controls degree of multiprogramming; decides which jobs enter the ready queue. | Batch, interactive mix.                                                     |
| Short-term (CPU)       | Picks the next ready process for CPU execution.                                | FCFS, Round Robin, Shortest Job First, Priority, Multilevel Feedback Queue. |
| Medium-term (swapping) | Moves processes between main memory and secondary storage to balance load.     | Not always present (e.g., in modern OSes).                                  |

*Key metrics:* CPU utilization, throughput, turnaround time, waiting time, response time.

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## 6. Memory Management Techniques

| Technique | How It Works | Advantages