MODULE 9: Software Systems and Tools

Lecture 9.1
Operating Systems

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Lecture 9.1 Objectives

- Describe the role of the operating system (OS) in a computer system
- Describe the role of the operating system kernel
- Describe the four key OS services, namely human interface, process management, resource management, security and protection

Perspectives on Operating Systems

- Hardware vendors' perspective – OS is the interface between software and hardware that allows user and system software to control hardware resources
- Programmers' perspective – OS provides programming abstractions of hardware and other system resources
- Users' perspective – OS facilitates use and management of system resources (displays, file system, accounts, etc.)

Operating System Evolution

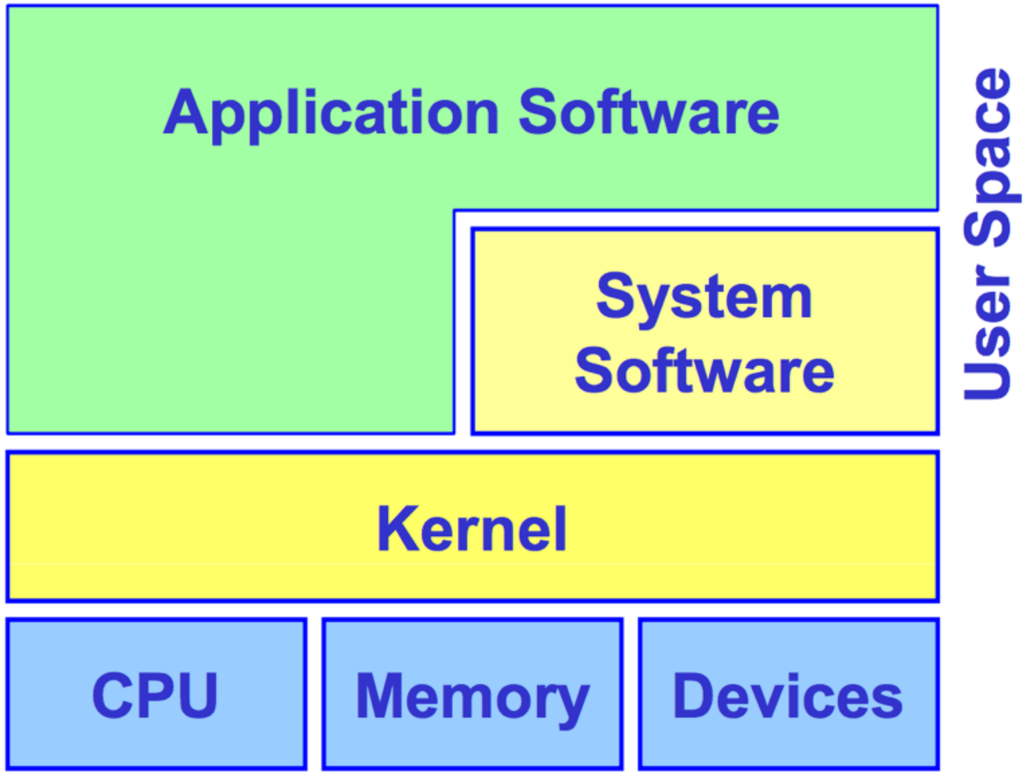
- Operating systems have evolved from:
  - Being closely tied to each specific computer model
  - To being relatively stable across a computer family
  - To being relatively stable across a variety of hardware platforms
- Focus of operating systems has evolved from:
  - The effective utilization of hardware resources
  - To, also, managing user programs
  - To optimizing the “user experience”

Operating System Evolution (continued)

- Types of systems with operating systems have evolved from:
  - General-purpose computers
  - Multi-processor and distributed systems
  - To personal computers
  - To real-time and embedded processors
  - To smartphones and other mobile appliances

Operating System Kernel

- The kernel is the operating system's core
- Functions
  - Scheduling
  - Synchronization
  - Protection and security
  - Memory management
  - Interrupt handling



OS Kernel Designs

- Monolithic kernel – Single process to perform kernel functions
  - Large kernel, less system software
- Microkernel – Provide very basic services and use other components perform specific tasks
  - Small kernel, more system software

CHECK POINT

As a checkpoint of your understanding, please pause the video and make sure you can do the following:

- Describe the role of the operating system (OS) in a computer system
- Describe the role of the operating system kernel

If you have any difficulties, please review the lecture video before continuing.

Operating System Services

- Basic categories of operating system services
  - Human interface
  - Process management
  - Resource management
  - Security and protection
- These services are, of course, interrelated

Human Interface

- Command line interface
- Graphical user interface

Process Management

- Synchronization between processes
- Long-term scheduling to admit processes
- Short-term scheduling to select process for current execution
- Manage process context switches

Scheduling in Operating Systems

- When is a new process scheduled?
  - Non-preemptive: the currently running process actively gives up control of the CPU (e.g., to wait for I/O to complete)
  - Preemptive: Current process is just swapped out and put in a waiting state
- Which process is selected to execute next?
  - First-come, first-served scheduling
  - Shortest job first scheduling
  - Round-robin scheduling
  - Priority scheduling

Resource Management

- Manages shared (expensive) resources
- Memory management
- Input/output management
- CPU is managed by the scheduler

Security and Protection

- User and process authentication
- Ensuring authorized access to resources
- Protecting resource from intentional and unintentional improper use
- Multi-level security

CHECK POINT

As a checkpoint of your understanding, please pause the video and make sure you can do the following:

- Describe the four key OS services, namely human interface, process management, resource management, security and protection

If you have any difficulties, please review the lecture video before continuing.

Summary

- Operating systems have evolved over time to provide more services across a greater variety of computer systems
- The kernel is the core of the operating system
  - Microkernel minimizes functionality of the kernel itself
  - Monolithic kernel is a highly integrated kernel with full or almost full operating system functionality
- The operating system provides four key services
  - Human interface
  - Process management, including scheduling
  - Resource management
  - Security and protection

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