





Information Technology Institute



# Computer Operating System Concepts



## Chapter Three

# OPERATING SYSTEM STRUCTURES

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- System Components
- Operating System Services
- System Calls
- System Structure

# **SYSTEM COMPONENTS**

# System Components

- Process management
- Main memory management
- File system management
- I/O system management
- Secondary storage management
- Networking
- Protection
- Command interpreter

# Process Management

- A process is a program in execution. A process needs certain resources, including CPU time, memory, files, and I/O devices, to accomplish its task.
- The operating system is responsible for the following activities in connection with process management.
  - Process creation and deletion.
  - process suspension and resumption.
  - Provision of mechanisms for:
    - process synchronization
    - process communication



# Main-Memory Management

- Memory is a large array of bytes, each with its own address. It is a repository of quickly accessible data shared by the CPU and I/O devices.
- Main memory is a volatile storage device. It loses its contents in the case of system failure.
- The operating system is responsible for the following activities in connections with memory management:
  - Keep track of which parts of memory are currently being used and by whom.
  - Decide which processes to load when memory space becomes available.
  - Allocate and de-allocate memory space as needed



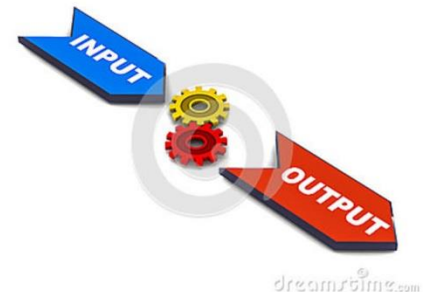
# File Management

- A file is a collection of related information defined by its creator. Commonly, files represent programs (both source and object forms) and data.
- The operating system is responsible for the following activities in connections with file management:
  - File creation and deletion.
  - Directory creation and deletion.
  - Support of primitives for manipulating files and directories.
  - Mapping files onto secondary storage.
  - File backup on stable (non-volatile) storage media.



# I/O System Management

- OS hide particularities of I/O devices
  - Device drivers
    - Input: retrieve block of data
    - Output: hardware instructions for controller
- I/O subsystem
  - Memory management: spooling
  - Drivers for specific hardware



# Secondary-Storage Management

- Since main memory (primary storage) is volatile and too small to accommodate all data and programs permanently, the computer system must provide secondary storage to back up main memory.
- Most modern computer systems use disks as the principle on-line storage medium, for both programs and data.
- The operating system is responsible for the following activities in connection with disk management:
  - Free space management
  - Storage allocation
  - Disk scheduling



# Networking (Distributed Systems)

- A *distributed* system is a collection processors that do not share memory or a clock. Each processor has its own local memory.
- The processors in the system are connected through a communication network.
- Communication takes place using a *protocol*.
- A distributed system provides user access to various system resources.
- Access to a shared resource allows:
  - Computation speed-up
  - Increased data availability
  - Enhanced reliability



# Protection System

- *Protection* refers to a mechanism for controlling access by programs, or users to system resources.
- The protection mechanism must:
  - distinguish between authorized and unauthorized usage.
  - specify the controls to be imposed.

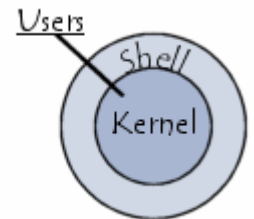


# Command-Interpreter System

- Many commands are given to the operating system by control statements which deal with:
  - process creation and management
  - I/O handling
  - secondary-storage management
  - main-memory management
  - file-system access
  - Protection
  - networking

# Command-Interpreter System Cont'd

- The program that reads and interprets control statements is called variously:
  - command-line interpreter
  - shell (in UNIX)
- Its function is to get and execute the next command statement.



# **OPERATING SYSTEM SERVICES**

# Operating System Services

- **Program execution**
  - System capability to load a program into memory and to run it.
- **I/O operations**
  - Since user programs cannot execute I/O operations directly, the operating system must provide some means to perform I/O.
- **File-system manipulation**
  - Program capability to read, write, create, and delete files.



# Operating System Services Cont'd

- **Communications**
  - Exchange of information between processes executing either on the same computer or on different systems tied together by a network. Implemented via shared memory or message passing.
- **Error detection**
  - Ensure correct computing by detecting errors in the CPU and memory hardware, in I/O devices, or in user programs.

# Operating System Services Cont'd

- Additional functions exist not for helping the user, but rather for ensuring efficient system operations.
  - Resource allocation
    - Allocating resources to multiple users or multiple jobs running at the same time.
  - Accounting
    - Keep track of and record which users use how much and what kinds of computer resources for account billing or for accumulating usage statistics.
  - Protection
    - Ensuring that all access to system resources is controlled.

# SYSTEM CALLS

# System Calls

- System calls provide the interface between a running program and the operating system.
  - Generally available as assembly-language instructions.
  - Languages defined to replace assembly language for systems programming allow system calls to be made directly (e.g., C, C++)

# Copy Program Example

- Variable initialization
- open ( file1 )
- create ( file2 )
- read ( file1 )
- write ( file2 )
- close ( file1 )
- close ( file2 )

# Types of System Calls

- Process control
- File management
- Device management
- Information maintenance
- Communications

# Process Control System Calls

- end, abort
- load, execute
- create, terminate
- get attributes, set attributes
- wait for time
- wait event
- allocate & free memory

# File Management System Calls

- create file, delete file
- open, close
- read, write, reposition
- get file attributes, set file attributes



# Device Management System Calls

- request device, release device
- read, write
- get device attributes, set device attributes
- logically attach or detach device

# Information Maintenance Calls

- get time or date, set time or date
- get process, file, or device data
- set process, file, or device data

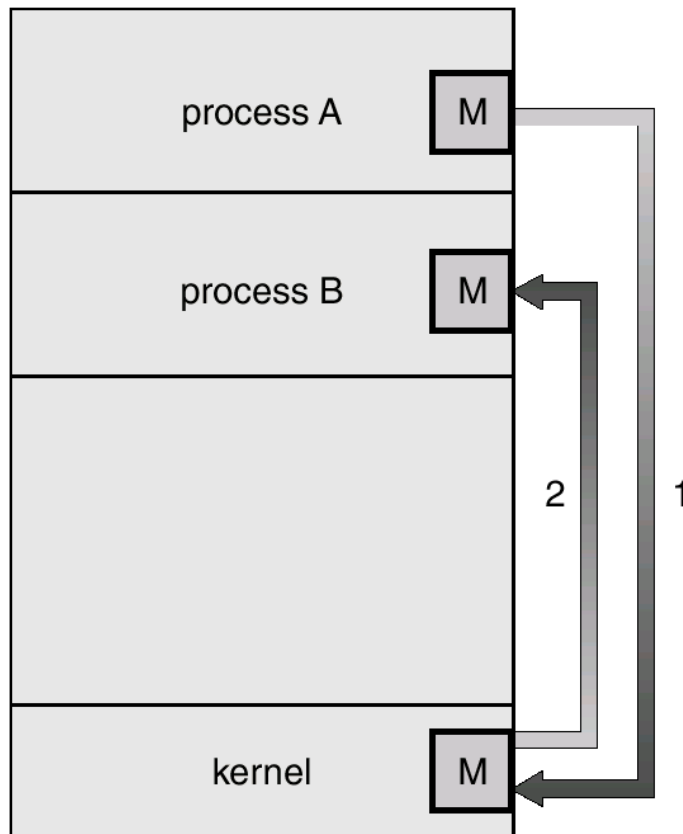
# Communication System Calls

- create, delete communication connection
- send, receive messages
- transfer status information
- attach or detach remote device

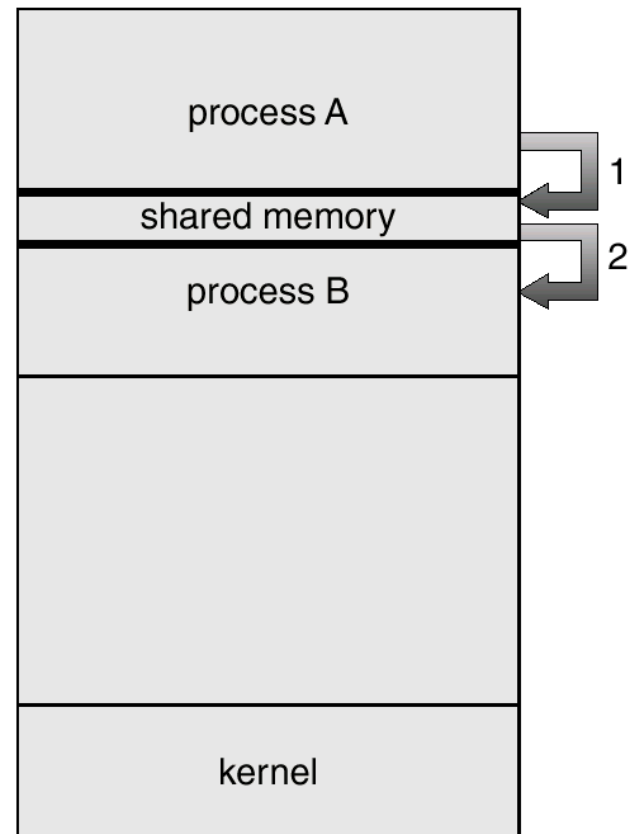
# Communication Models

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## Message Passing



## Shared Memory



# System Calls Types

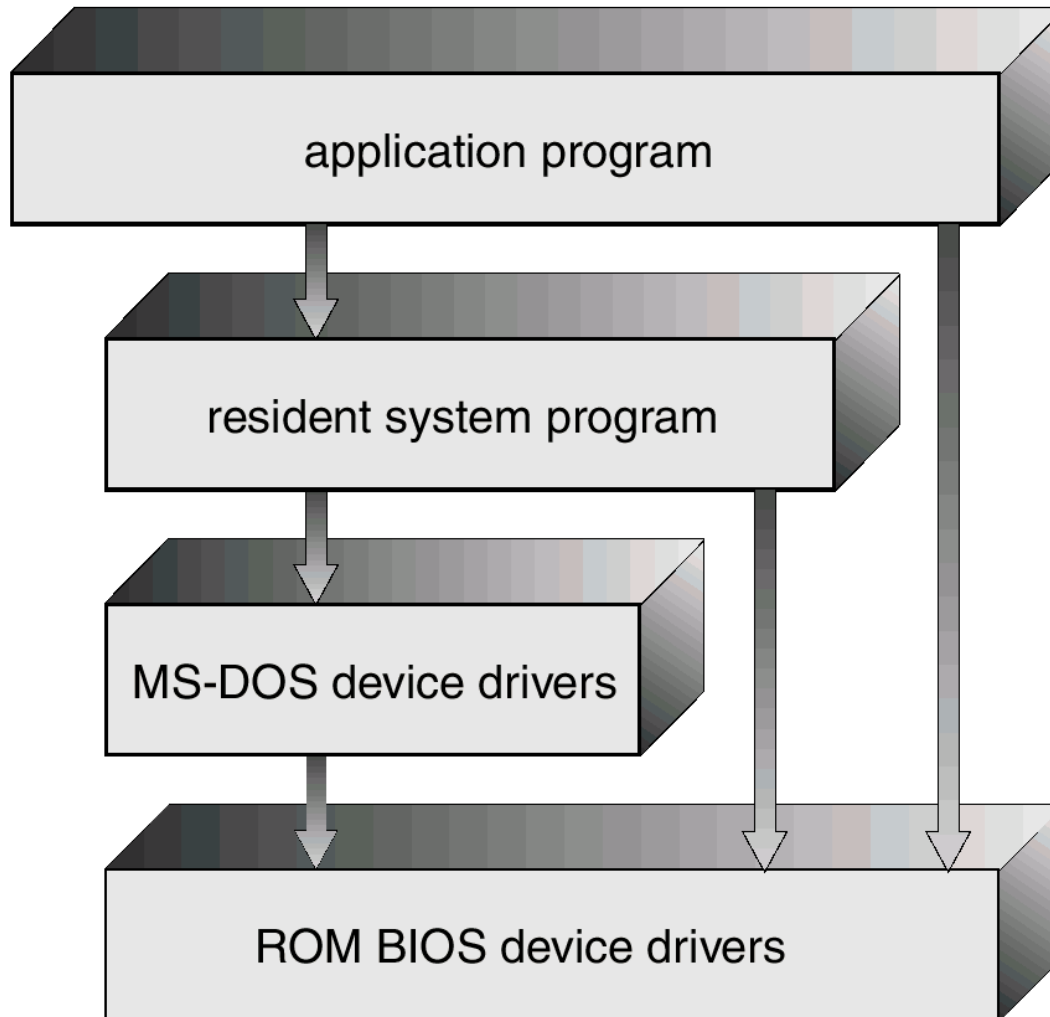
Process Control	File Management	Device Management	Information Maintenance	Communications IPC
load, execute end, abort	create file delete file	request release	get time set time	create channel delete channel
create terminate	open close	attach detach	get system data set system data	send message receive message
get attributes set attributes	read / write reposition	read write	get attributes set attributes	transfer status
wait time, event, signal	get attributes set attributes	get attributes set attributes		attach / detach remote device
allocate memory free memory				

# **SYSTEM STRUCTURE**

# OS System Design Structure

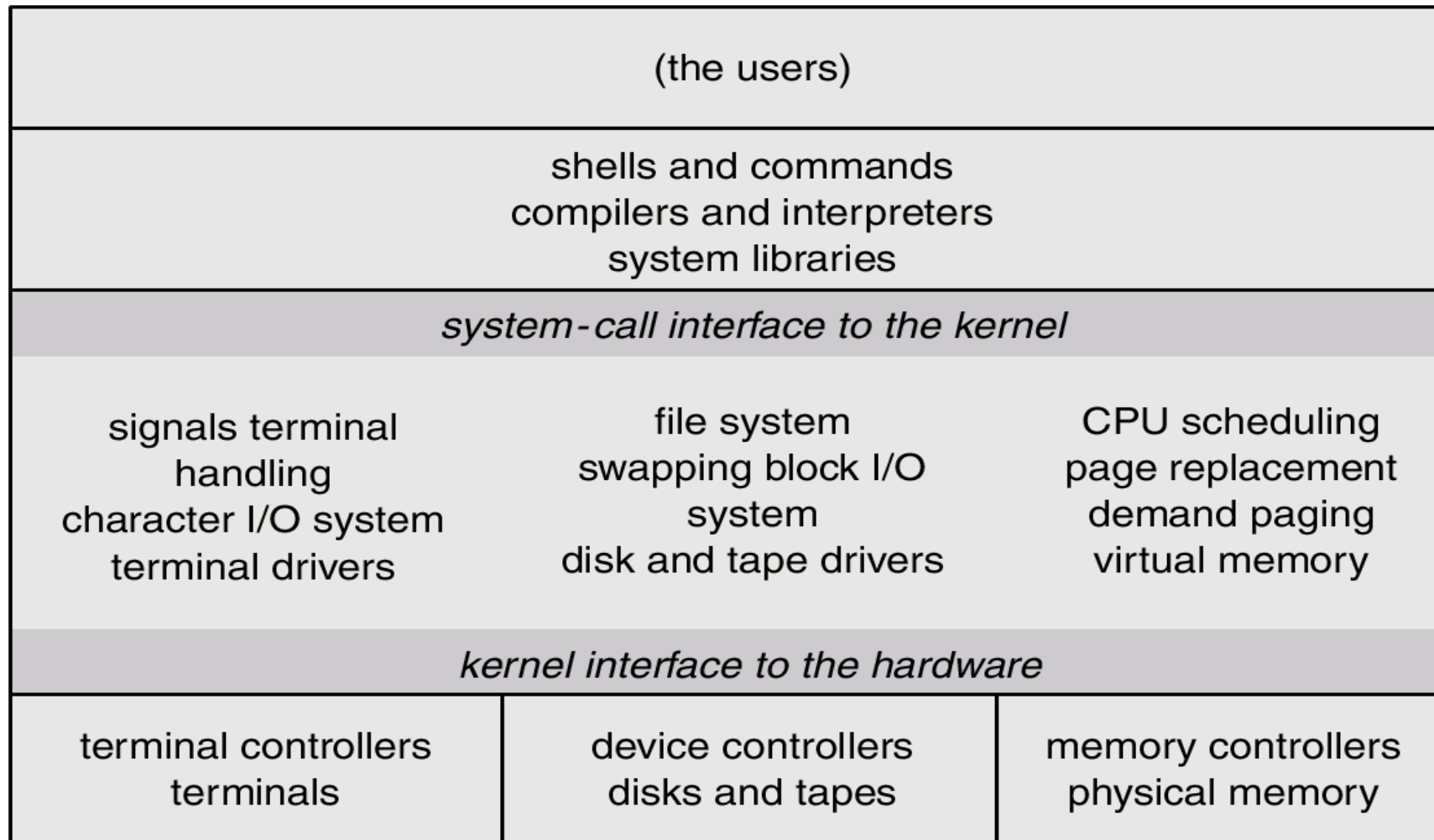
- Simple structure
- Layered approach

# MS-DOS Structure





# UNIX System Structure



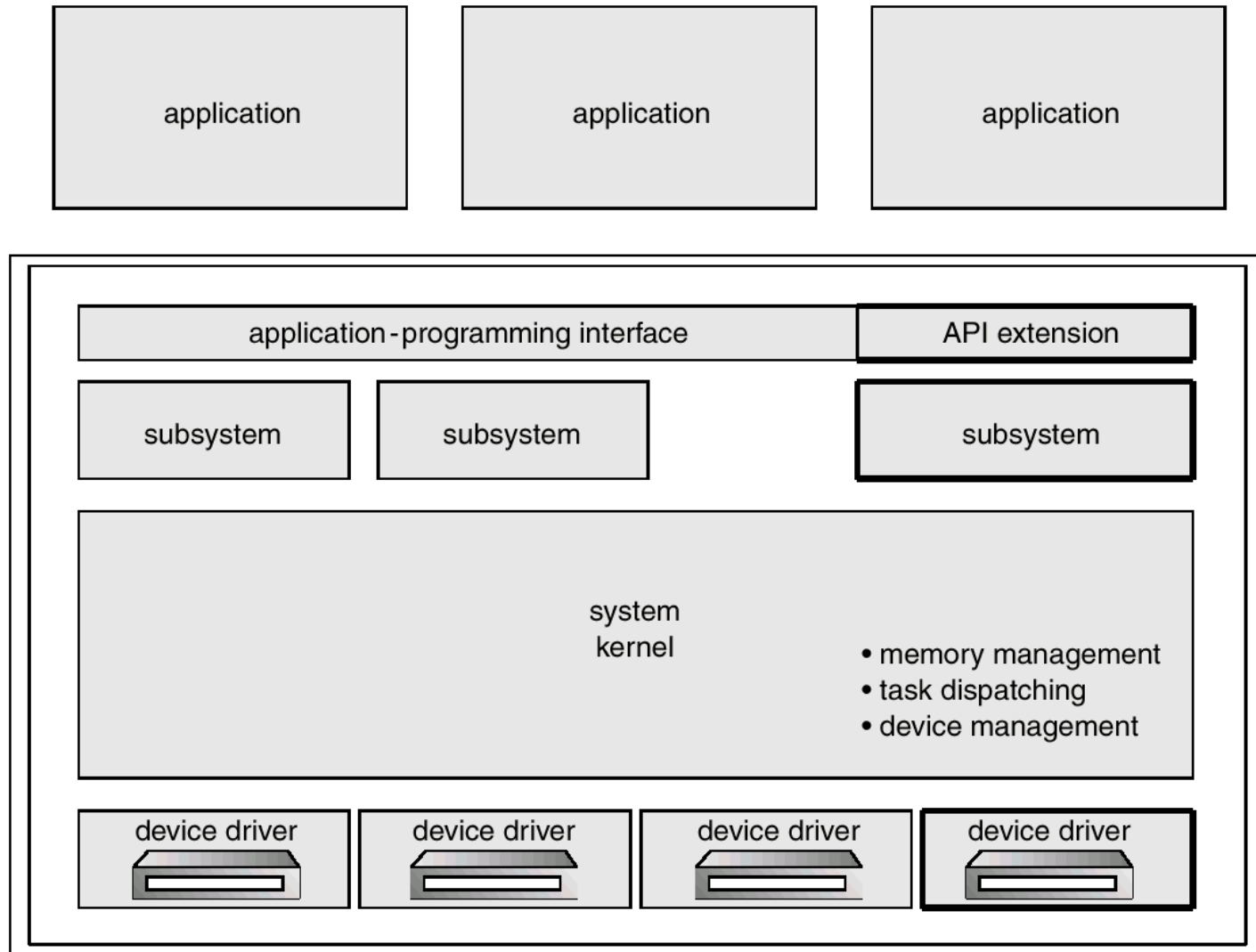
# Layered Approach

- The operating system is divided into a number of layers (levels), each built on top of lower layers. The bottom layer (layer 0), is the hardware; the highest (layer N) is the user interface.
- With modularity, layers are selected such that each uses functions (operations) and services of only lower-level layers.

# Layered Approach Cont'd

- **Advantage:**
  - Modularity
  - Debugging
  - Modification
- **Disadvantage:**
  - Layering overhead to the system call

# OS/2 Layer Structure





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