



Information Technology Institute



Operating System Fundamentals

Chapter Three

OPERATING SYSTEM STRUCTURES

Table of Content

- 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.
 - 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

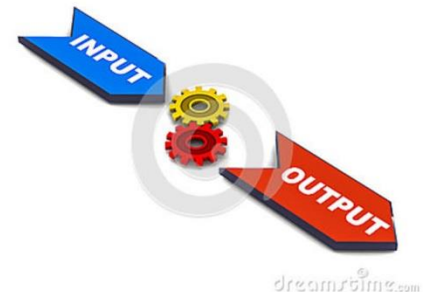


File Management

- A file is a collection of related information defined by its creator. Commonly, files represent programs 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.

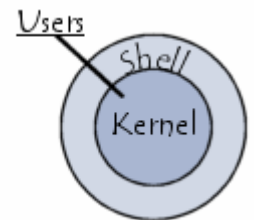


Command-Interpreter System

- 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.

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++)

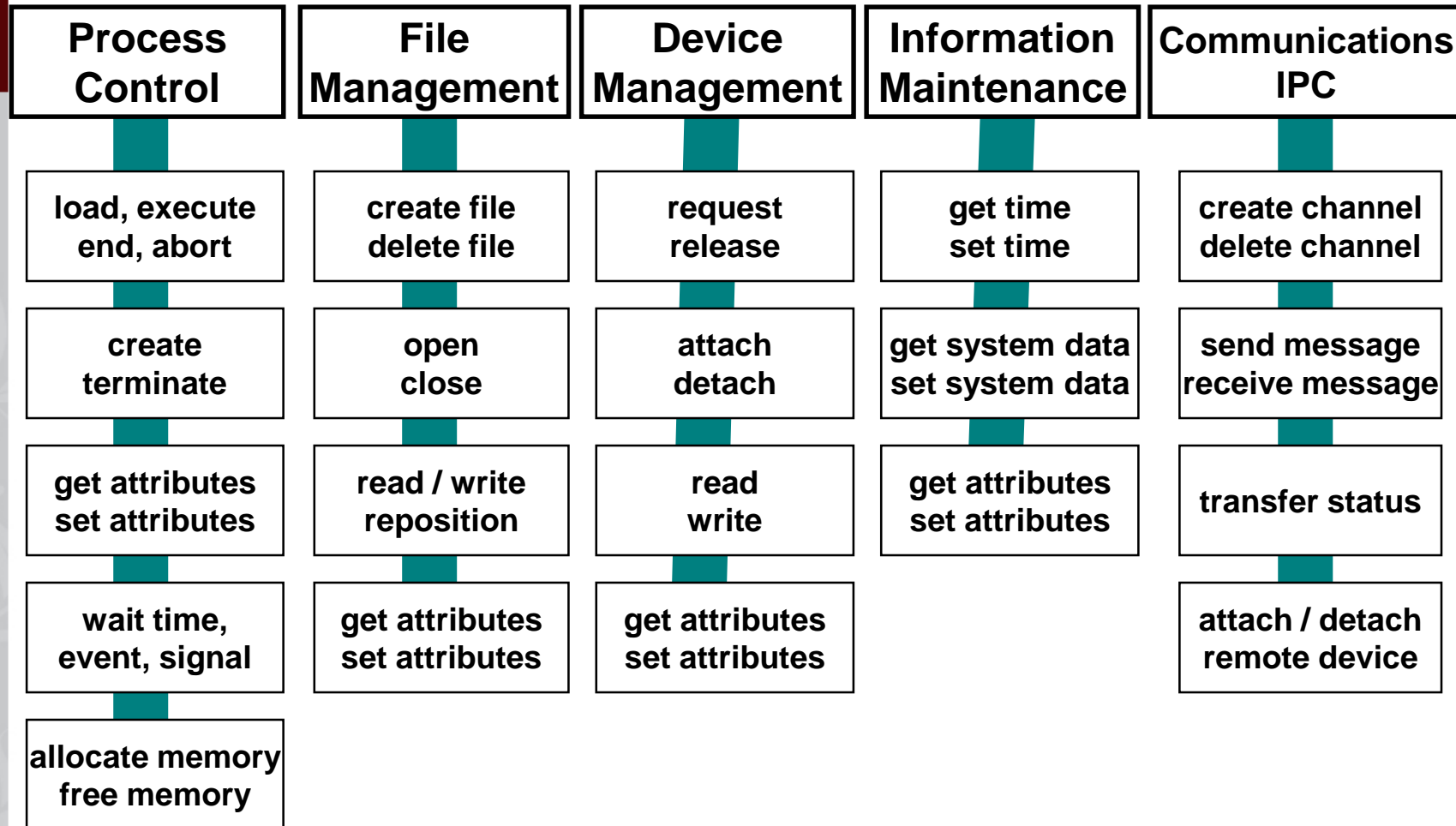
Copy Program Example

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

Types of System Calls

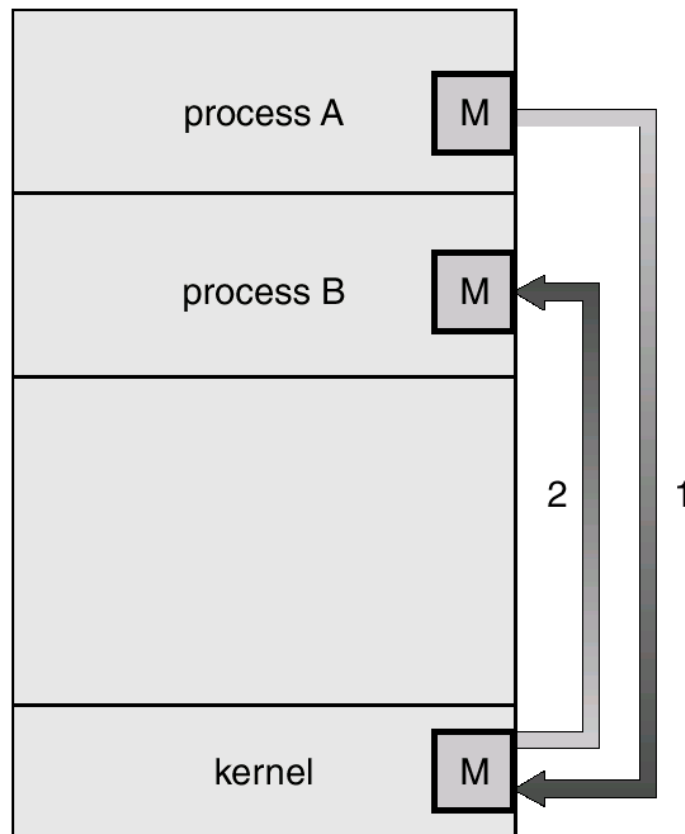
- Process control
- File management
- Device management
- Information maintenance
- Communications

System Calls Types

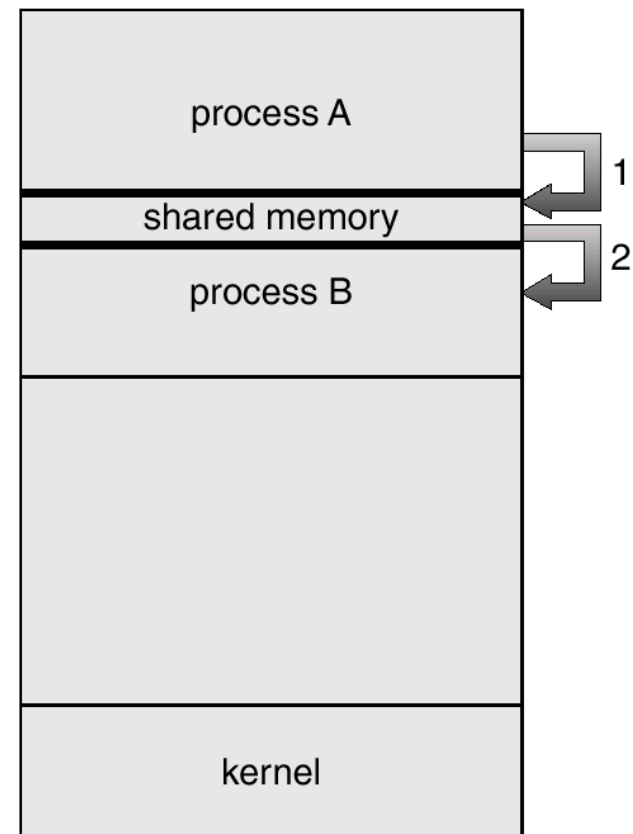


Communication Models

Message Passing



Shared Memory

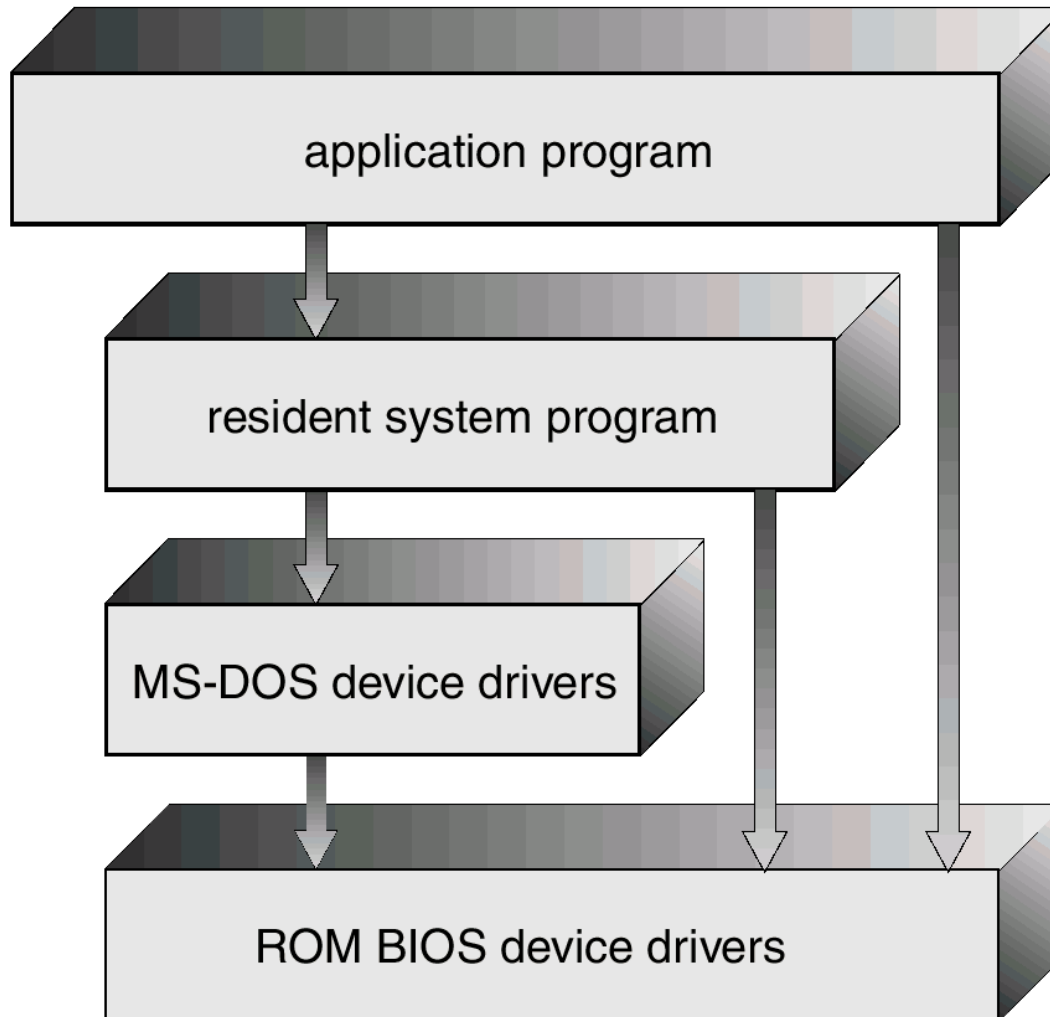


SYSTEM STRUCTURE

OS System Design Structure

- Simple structure
- Layered approach

MS-DOS 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

