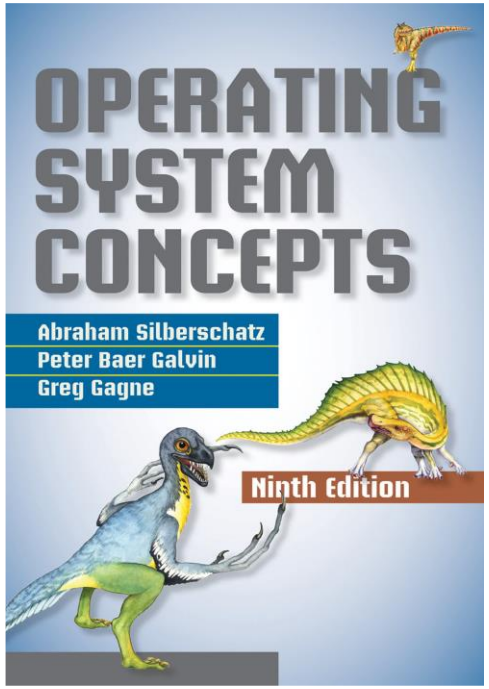
Operating System

Saroj Shivagunde

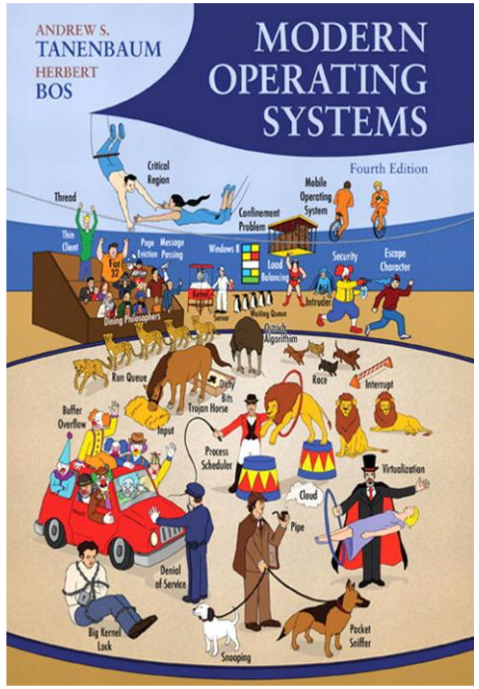
Overview

- Components of A Computer
- Modes of Software Operation
- Resource Management
- Types of Operating Systems
  - Single User vs. Multi-user Systems
  - Other Types of OS
- Single-Processor vs. Multi-processor Systems
- Parallel Systems vs. Concurrent Systems
- Distributed Systems
- Real-time Systems

Books to Refer

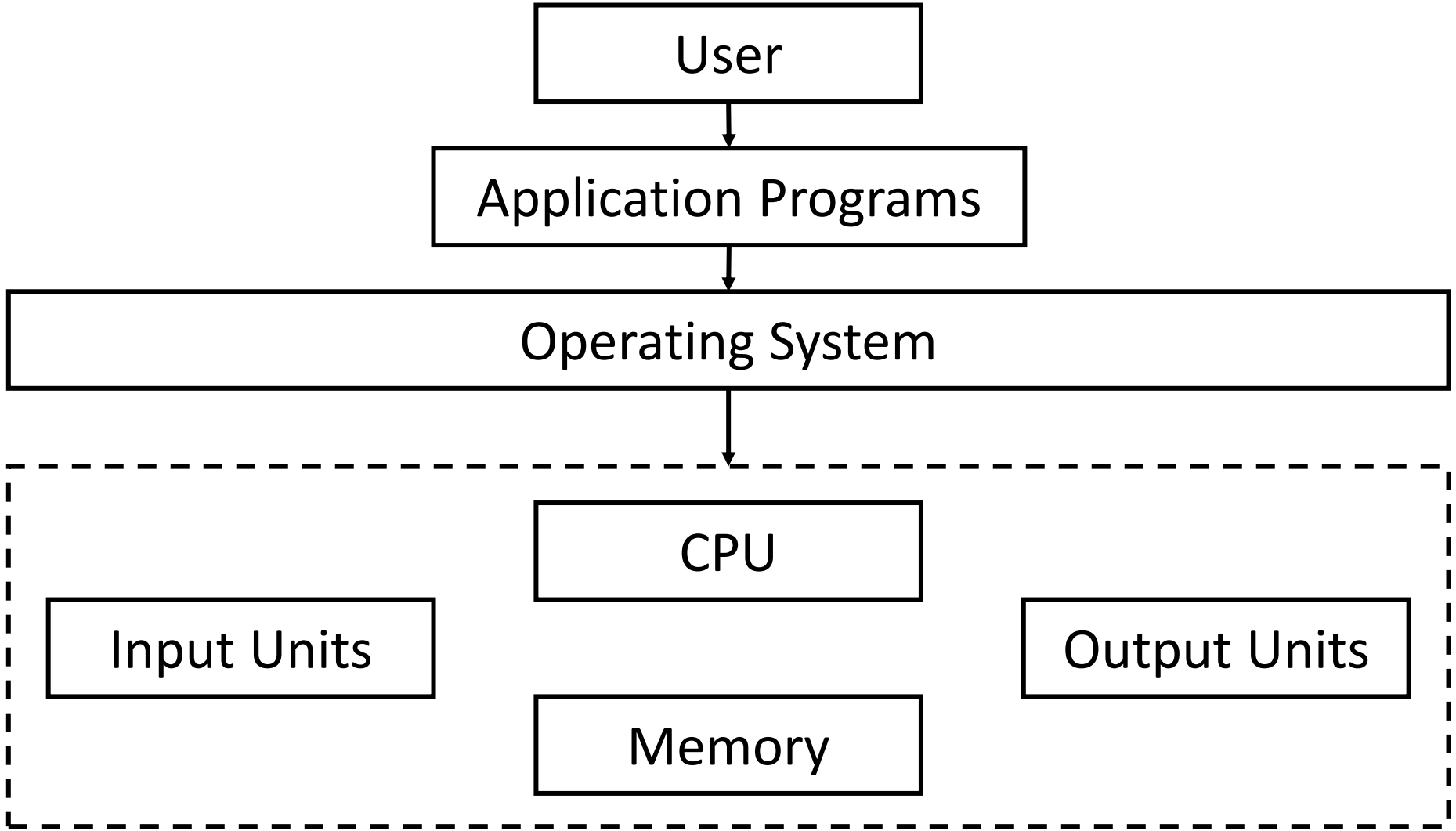


Operating System Concepts
by
Silberschatz, Galvin, Gagne



Modern Operating Systems
by
Tanenbaum, Bos

Components of A Computer



Modes of Software Operation

- Kernel Mode
  - The operating system runs in kernel mode
  - This mode has access to all the hardware components
  - It can execute any instruction possible with the given components
- User Mode
  - All the software, other than the OS, run in user mode
  - This mode has limited access of machine instructions
  - The instructions that may affect the system or I/O operations are not allowed in this mode

Resource Management

- Time Multiplexing
  - Many processes fully share one resource in different time intervals
  - **Example-** 3 processes share one printer
  - Here, it is not possible for these processes to use the printer in parts at the same time
  - One process will use it, then one of the remaining processes can use the printer
  - This is called as time multiplexing
- Space Multiplexing
  - Many processes share one resource in at a time in parts
  - **Example-** 3 processes share the memory space
  - Here, it is not wise to give one process the whole memory and after its completion allocate the whole memory to another process
  - Multiple processes can reside in the memory at the same time
  - This is called as space multiplexing

Single User vs. Multi-user Operating Systems

- Single user Systems
  - Only one user accesses all the resources of the system
  - Hence, the system is designed for ease of use and/or performance
  - Here, not much attention is needed to be paid to resource utilization
  - **Example-** Personal Computers, Laptops, etc.
- Multi-user Systems
  - Multiple users access the same system via different terminals
  - Hence, the system is designed to maximize resource utilization
  - Here, each user is given access to CPU, I/O devices and memory by keeping in mind the needs of other users
  - **Example-** Servers, Mainframe computers, etc.

Other Types of OS

- Hybrid Mode OS
  - This is a combination of Single-user and Multi-user system
  - Here, each user has their own resources, but they also share other resources with other users over the network
  - So, the OS needs to find the middle-ground between individual usability and resource utilization
- OS for Mobile / Handheld Devices
  - OS for these devices needs to pay more attention to user interface as these devices rely heavily on the user interactions
  - The rest of the functionality is same as single-user system
- OS for Embedded Systems
  - These systems do not have or have very minimal user interaction
  - So, the OS is designed to perform without or minimal user intervention
  - Example- ACs, Washing machines, Thermostats, etc.

Single-Processor vs. Multi-processor Systems

- Single-processor Systems
  - Only one process can run at a time as there is only one core available
  - If multiple processes are to be run on such a system, time multiplexing can be used
  - Such an arrangement is called as multi-tasking
- Multi-processor Systems
  - Multiple processes can run at a time on different cores of the same CPU, or a single process can also be divided and sped up using multiple cores
  - The throughput of these systems is more than the single processor systems as multiple processes can run at the same time
  - Cost of n multi-processor systems is less than the combined cost of n single-core systems
  - Having multiple processors helps in sharing the load in case of failure of one core

Parallel Systems vs. Concurrent Systems

- Parallel Systems
  - Parallel Systems can perform more than one process parallelly
  - Multiple processes run on multiple CPUs or multiple cores
  - Here, the parallelism is not an illusion
  - The number of parallelly executable processes depends on the number of CPUs/cores available for computation
- Concurrent Systems
  - Concurrent systems create an illusion of parallelism by rapidly switching from one process to another
  - Multiple processes run one after other on one core only
  - The number of concurrently running processes

Distributed Systems

- Distributed Systems is a collection of physically separate computer systems that are accessible by multiple users via network
  - These separate computer systems can be homogeneous or heterogeneous
  - They together form one distributed system
- Some systems treat network access as a form of file access, others may require explicit network access
- Examples-
  - Multiple computer systems, servers, printers, etc on university campus connected by a LAN
  - Two devices connected by Bluetooth

Real-time Systems

- Real-time system is used when rigid time requirements have been placed on the operation of a processor or the flow of data
- A real-time system functions correctly only if it returns the correct result within its time constraints
- Examples-
  - Any driving System Module (Car, Airplane, etc.)
  - Scientific Experiment Controllers
  - Medical Imaging Systems
  - Industrial Control Systems
  - Automobile-engine fuel-injection Systems
  - Home-appliance Controllers
  - Weapon Systems

End