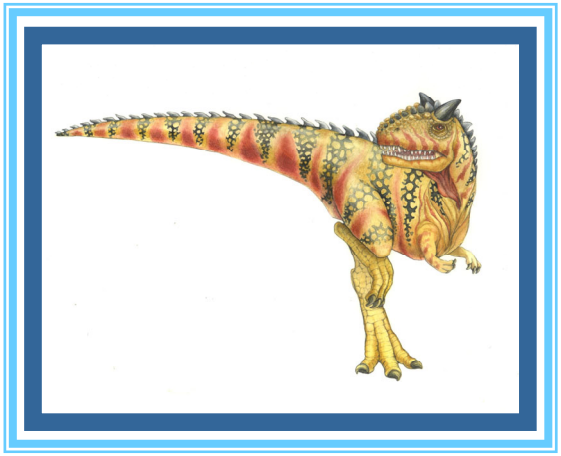
Chapter 1: Introduction



Chapter 1: Introduction

What Operating Systems Do

Computer-System Organization

Computer-System Architecture

Operating-System Operations

Resource Management

Security and Protection

Virtualization

Distributed Systems

Objectives

Describe the general organization of a computer system and the role of interrupts

Describe the components in a modern multiprocessor computer system

Illustrate the transition from user mode to kernel mode

Discuss how operating systems are used in various computing environments

Computer System Structure

Computer system can be divided into four components:

Hardware – provides basic computing resources

- CPU, memory, I/O devices

Operating system

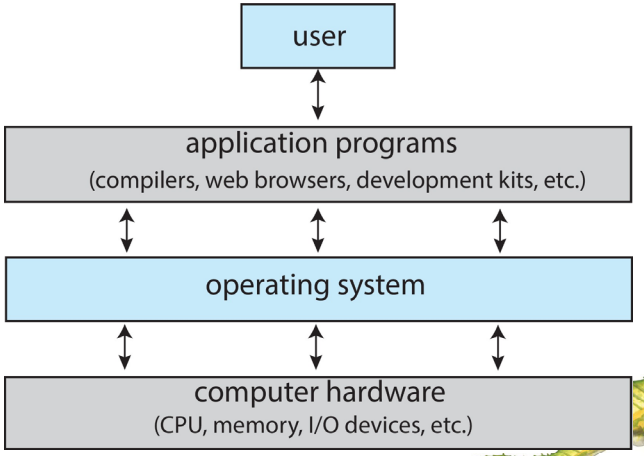
- Controls and coordinates use of hardware among various applications for users

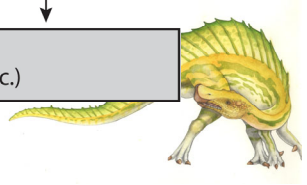
Application programs – define the ways in which the system resources are used to solve the computing problems of the users

- Word processors, compilers, web browsers, database systems, video games

Users

- People, machines, other computers





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What Operating Systems Do

Depends on the point of view

User View

- Users want **convenience**, **ease of use** and **good performance**
  - Don't care about **resource utilization**
  - Mobile user interfaces such as touch screens, voice recognition
  - Some computers have little or no user interface, such as embedded computers in devices and automobiles
    - » Run primarily without user intervention

System View

- Operating system is a **resource allocator** and **control program** making efficient use of HW and managing execution of user programs

Defining Operating Systems

Term OS covers many roles

- Because of myriad designs and uses of OSes
- Present in toasters, ships, spacecraft, game machines, TVs and industrial control systems
- Born when fixed-purpose military computers evolved into general-purpose machines
  - Need resource management and program control

Operating System Definition (Cont.)

No universally accepted definition

"Everything a vendor ships when you order an operating system" is a good approximation

"The one program running at all times on the computer" is the **kernel,** part of the operating system

- Three objectives : Convenience, Efficiency, Ability to evolve
- The most important software that runs on a computer
- A computer is useless without a kernel(operating system)

Everything else is either

- **System program**
- **Application program**

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Computer System Organization

Processor

- Controls the operation of the computer
- Performs the data processing functions
- Referred to as the Central Processing Unit (CPU)

Main Memory

- Stores data and programs
- Typically volatile
  - Contents of the memory is lost when the computer is shut down
- Referred to as real memory or primary memory

Computer System Organization

I/O Modules

Move data between the computer and its external environment

- Secondary memory devices (e.g. disks)
- Communications equipment
- Terminals

I/O devices and the CPU can execute concurrently

System Bus

Provides for communication among processors, main memory, and I/O modules

Computer System Organization

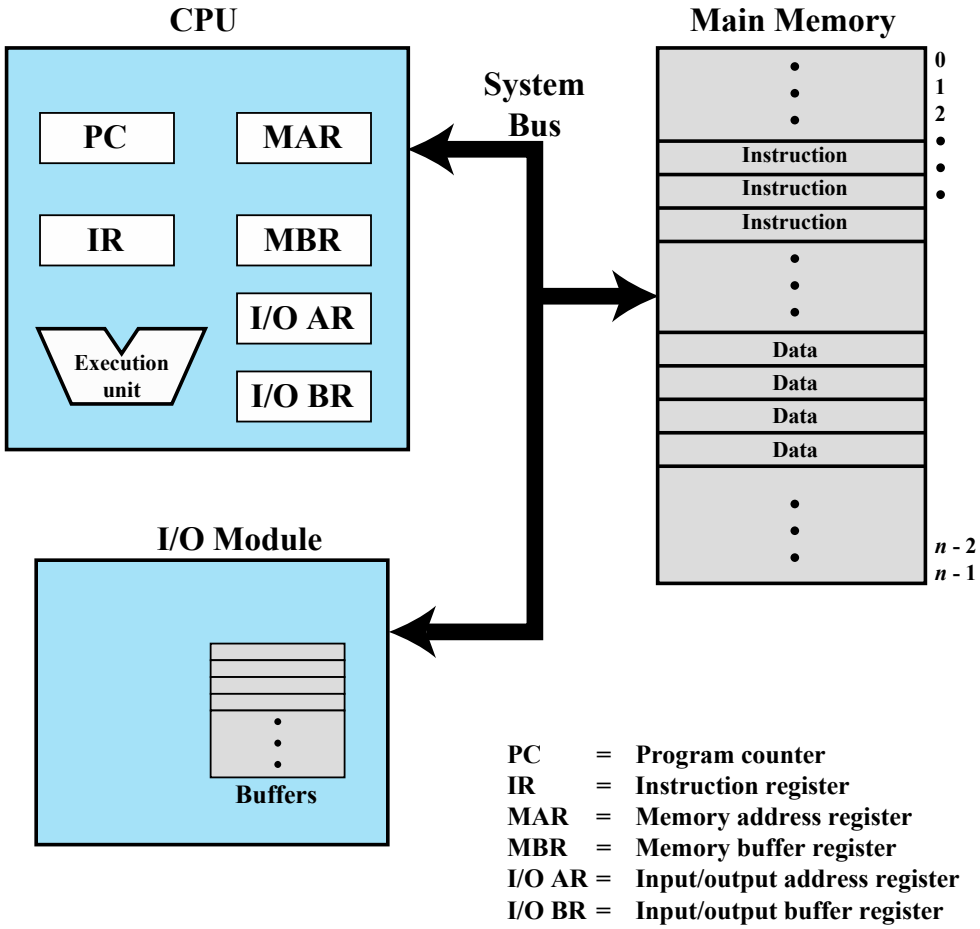
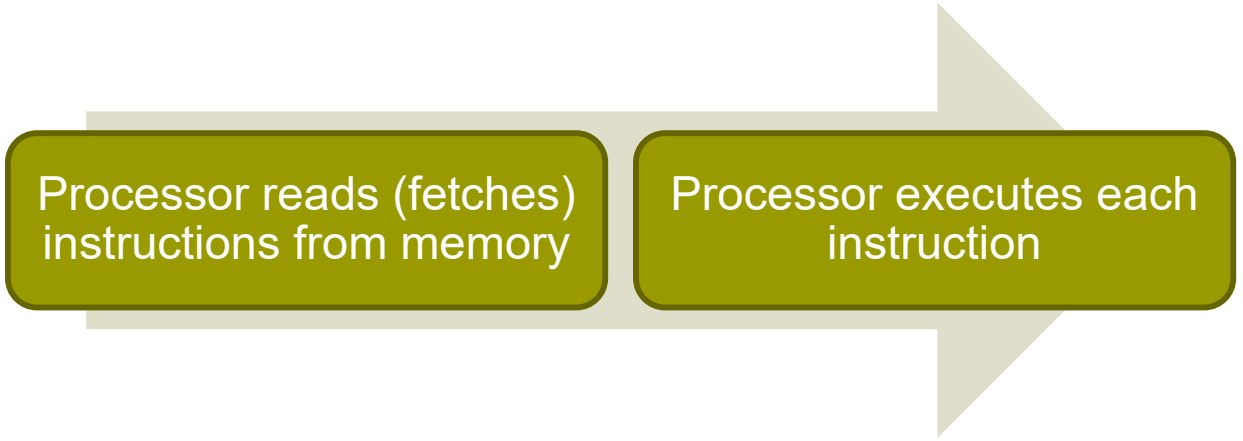


Figure 1.1 Computer Components: Top-Level View

Instruction Execution

A program consists of a set of instructions stored in memory



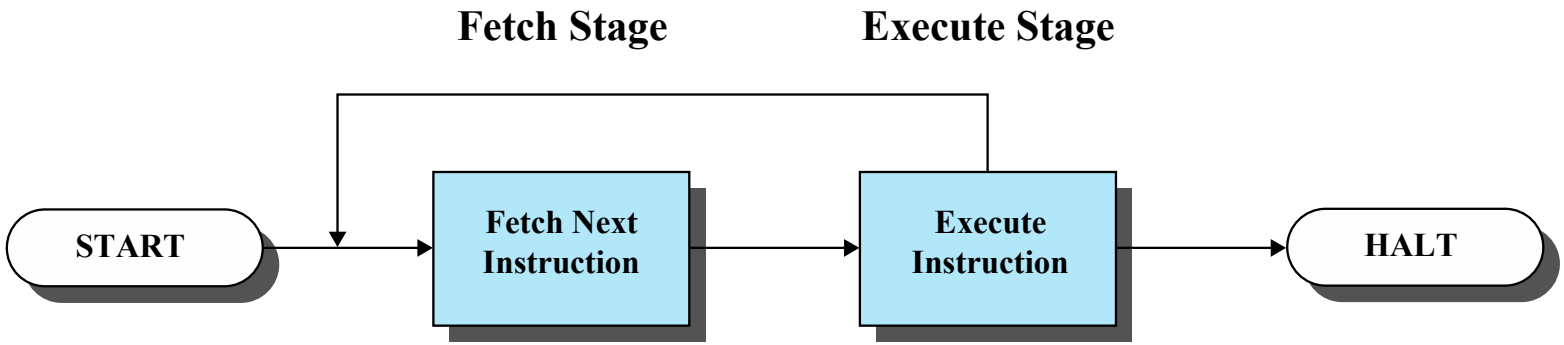
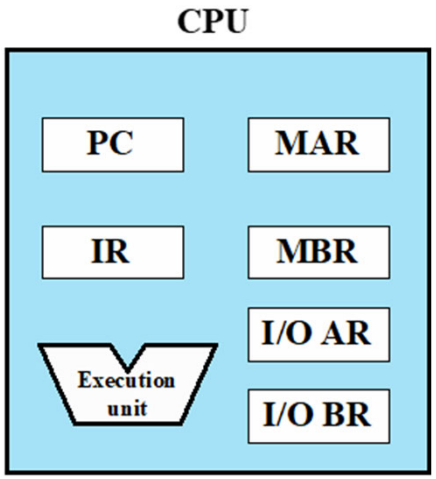


Figure 1.2 Basic Instruction Cycle

Instruction Execution

The processor fetches an instruction from memory

Typically the program counter (PC) holds the address of the next instruction to be fetched



Interrupts

An operating system is **interrupt driven**

A mechanism by which other modules (I/O, memory) may interrupt the normal sequencing of the processor

Provided to **improve** processor utilization

Most I/O devices are **slower** than the processor

Processor must **pause** to wait for device's completion

- The length of this pause may be on the order of many thousands or even millions of instruction cycles
- Wasteful use of the processor

Interrupts

Classes of Interrupts

Program	Generated by some condition that occurs as a result of an instruction execution, such as arithmetic overflow, division by zero, attempt to execute an illegal machine instruction, and reference outside a user's allowed memory space.
Timer	Generated by a timer within the processor. This allows the operating system to perform certain functions on a regular basis.
I/O	Generated by an I/O controller, to signal normal completion of an operation or to signal a variety of error conditions.
Hardware failure	Generated by a failure, such as power failure or memory parity error.