

# Operating Systems - Introduction

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# Slide Credits

- Most of the slides are adapted from the companion lecture slides of the text book by Avi Silberschatz, Peter Baer Galvin, Greg Gagne
- Some figures are taken from the text book by William Stallings

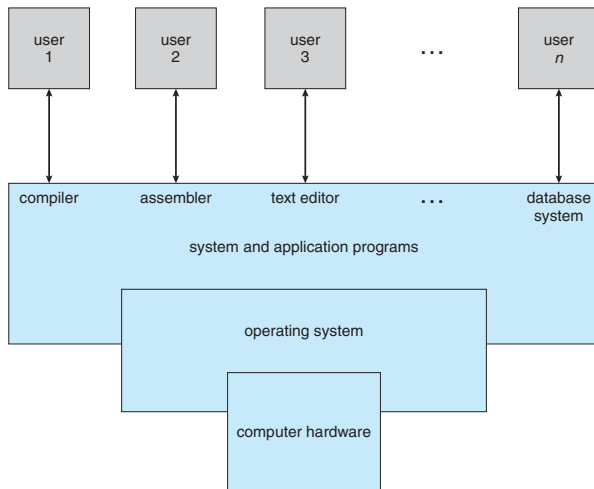
# What is an Operating System?

- A program that acts as an intermediary between a user of a computer and the computer hardware
- Operating system goals:
  - Execute user programs and make solving user problems easier
  - Make the computer system convenient to use
  - Use the computer hardware in an efficient manner

# Computers System Components I

- 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 and 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

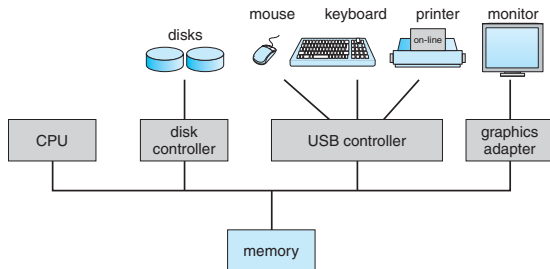
# Computers System Components II



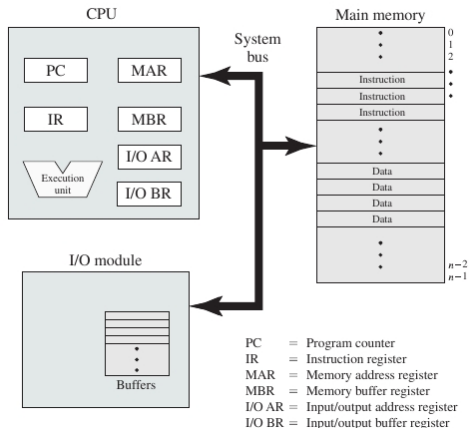
Abstrcat View

# Computer System Organization

- One or more CPUs, device controllers connect through common bus providing access to shared memory
- Concurrent execution of CPUs and devices competing for memory cycles



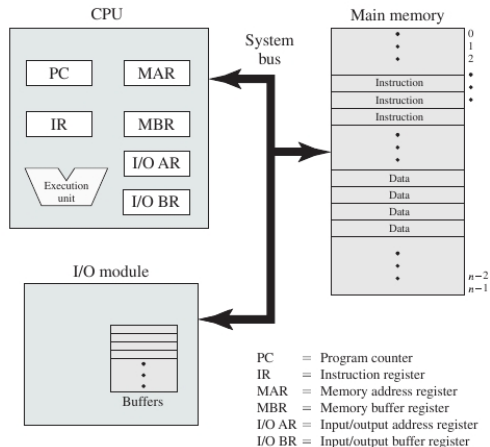
# Central Processing Unit I



## • Processor Registers

- User-visible registers: Enable programmer to minimize main memory references by optimizing register use
- Control and status registers: Used by processor to control operating of the processor; Used by privileged OS routines to control the execution of programs

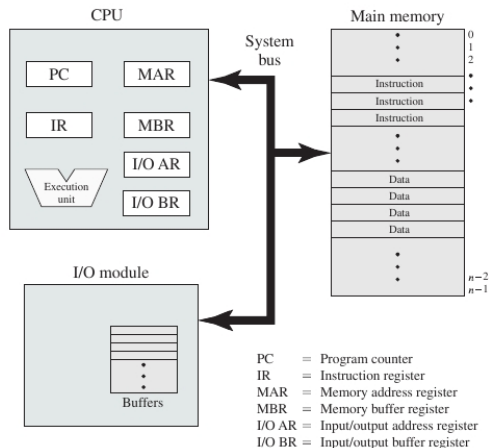
# Central Processing Unit II



- User-visible registers
  - May be referenced by machine language
  - Available to all programs
  - Data registers
  - Address registers
    - **Index register:** Adding an index to a base value to get the effective address
    - **Segment pointer:** When memory is divided into segments, memory is referenced by a segment and an offset
    - **Stack pointer:** Points to top of stack



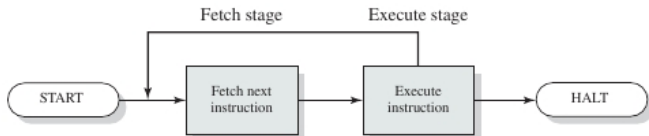
# Central Processing Unit III



## Control and Status Registers

- Program counter (PC): Contains the address of an instruction to be fetched
- Instruction register (IR): Contains the instruction most recently fetched
- Program status word (PSW): Contains status information and condition codes or flags
  - Bits set by processor hardware as a result of operations
  - Example: Positive, negative, zero, or overflow result

# Instruction Execution



- Two steps
  - Processor reads (fetches) instructions from memory
  - Processor executes each instruction
- The processor fetches the instruction from memory
- Program counter (PC) holds address of the instruction to be fetched next
- PC is incremented after each fetch
- Fetched instruction is loaded into instruction register
- Instruction categories
  - Processor-memory, processor-I/O, data processing, control

# A Hypothetical Machine



(a) Instruction format



(b) Integer format

Program counter (PC) = Address of instruction  
Instruction register (IR) = Instruction being executed  
Accumulator (AC) = Temporary storage

(c) Internal CPU registers

0001 = Load AC from memory  
0010 = Store AC to memory  
0101 = Add to AC from memory

(d) Partial list of opcodes

# Example of Program Execution

