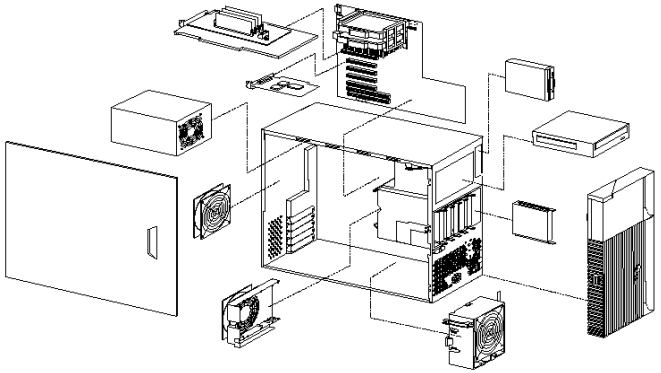
Department of Computer Science and Engineering
School of Science, Engineering & Technology



CSE 317: Computer Organization & Architecture

Wahidul Alam, Lecturer, CSE, SoSET, EDU

Topic 3 – A Top-Level View of Computer Function and Interconnection

- Components
- Computer Components: Top Level View
- Instruction Cycle
- Example of Program Execution
- Instruction Cycle State Diagram

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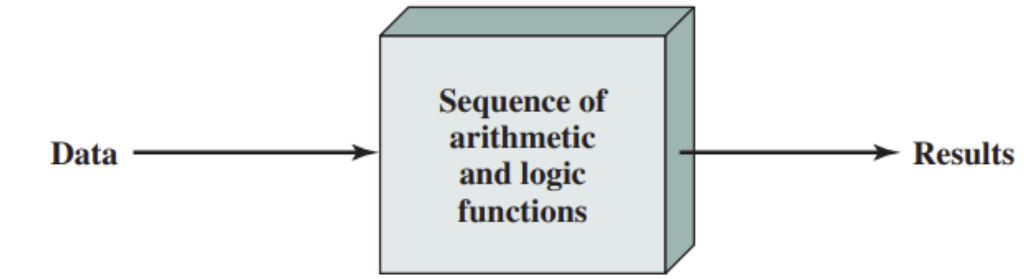
What is a program?

- A sequence of steps
- For each step, an arithmetic or logical operation is done
- For each operation, a different set of control signals is needed

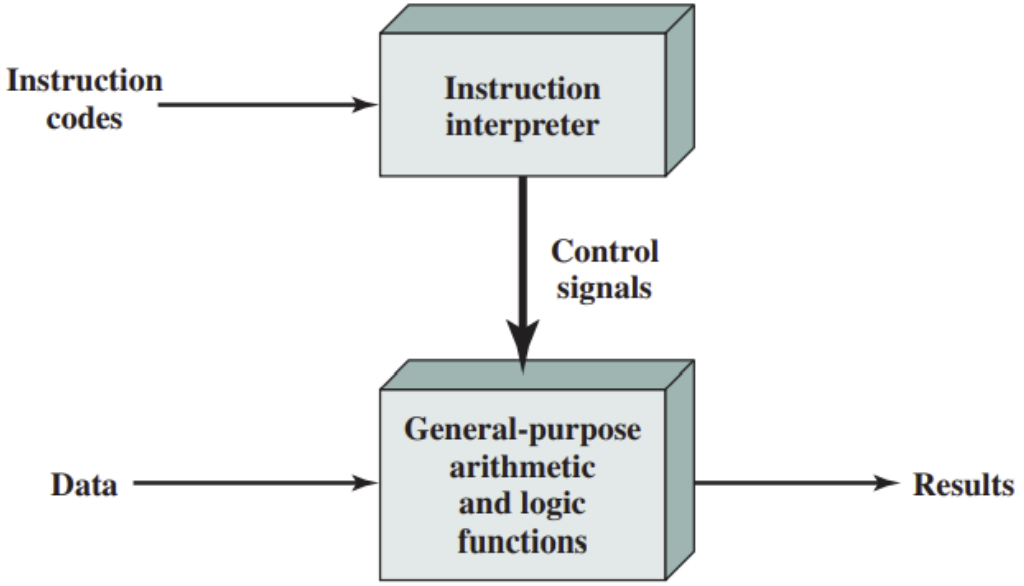
Program Concept

- Hardwired systems are inflexible
- General purpose hardware can do different tasks, given correct control signals
- Instead of re-wiring, supply a new set of control signals

Hardware and Software Program



(a) Programming in hardware



(b) Programming in software

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Function of Control Unit

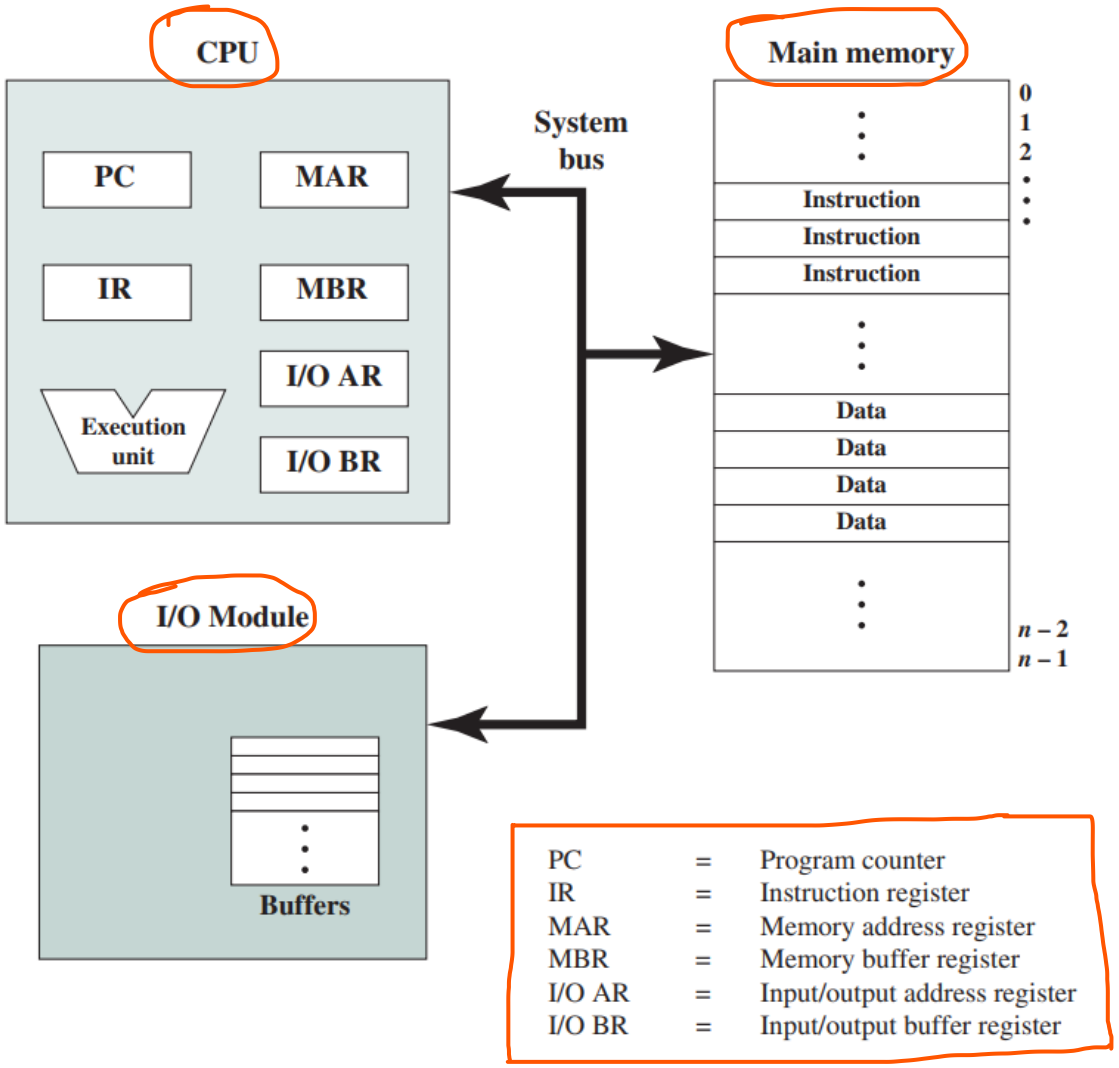
- For each operation a unique code is provided
  - e.g. ADD, MOVE
- A hardware segment accepts the code and issues the control signals

- We have a computer!

Components

- The Control Unit and the Arithmetic and Logic Unit constitute the Central Processing Unit
- Data and instructions need to get into the system and results out
  - Input/output
- Temporary storage of code and results is needed
  - Main memory

Computer Components: Top Level View



Memory address register (MAR) Specifies the address in memory for the next read or write.

Memory buffer register (MBR) Contains the data to be written into memory or receives the data read from memory.

I/O address register (I/OAR) Specifies a particular I/O device

I/O buffer register (I/OBR) Used for the exchange of data between an I/O module and the CPU

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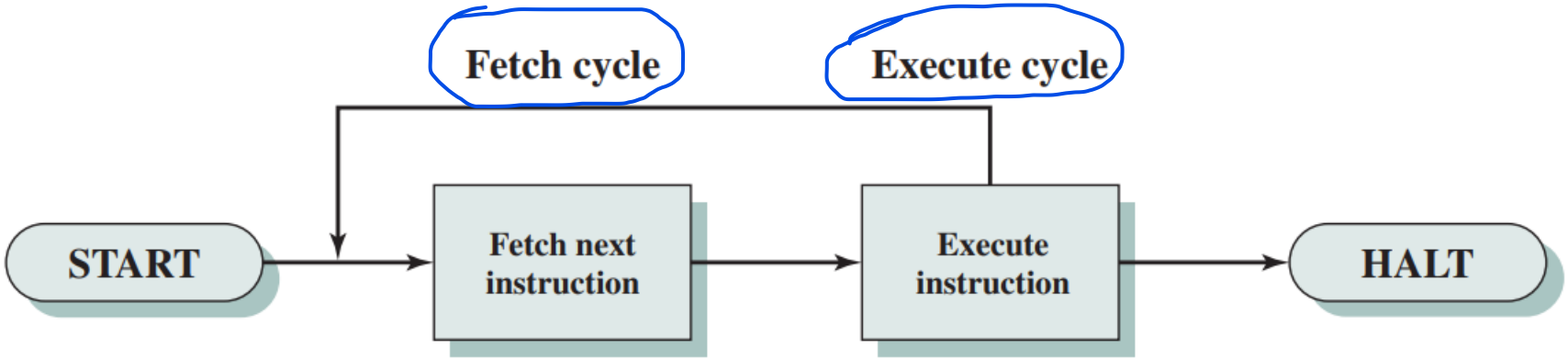
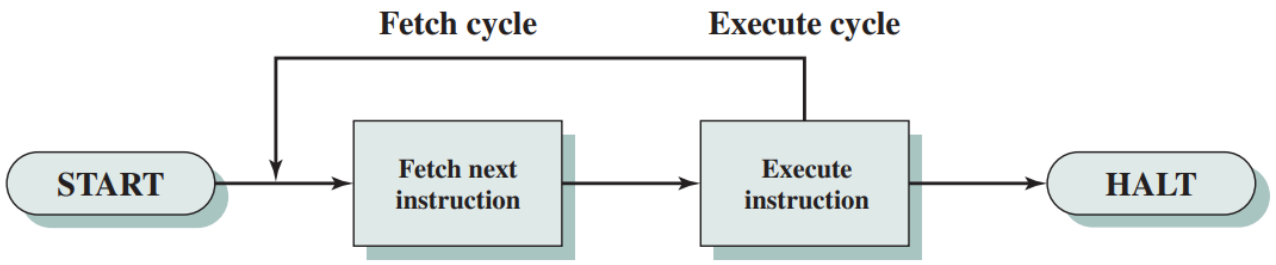
Instruction Cycle

- Two steps:
  - Fetch
  - Execute



Fetch Cycle

- Program Counter (PC) holds address of next instruction to fetch
- Processor fetches instruction from memory location pointed to by PC
- Increment PC
  - Unless told otherwise
- Instruction loaded into Instruction Register (IR)
- Processor interprets instruction and performs required actions



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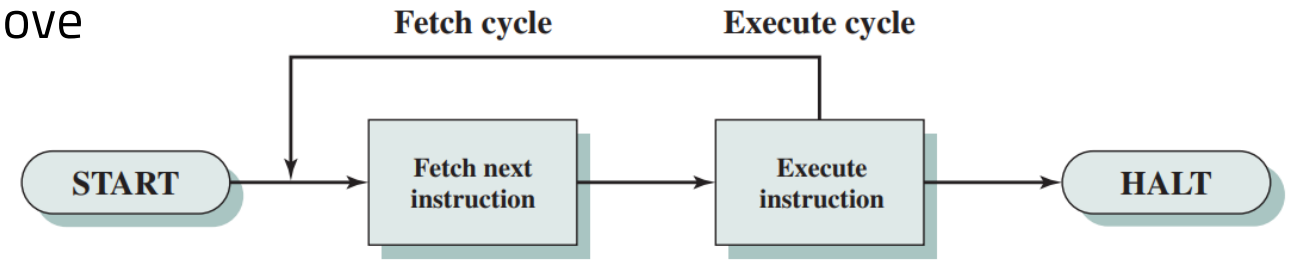
Execute Cycle

- Processor-memory
  - Data transfer between CPU and main memory
- Processor I/O
  - Data transfer between CPU and I/O module
- Data processing
  - Some arithmetic or logical operation on data
- Control
  - Alteration of sequence of operations
  - e.g. jump
- Combination of above



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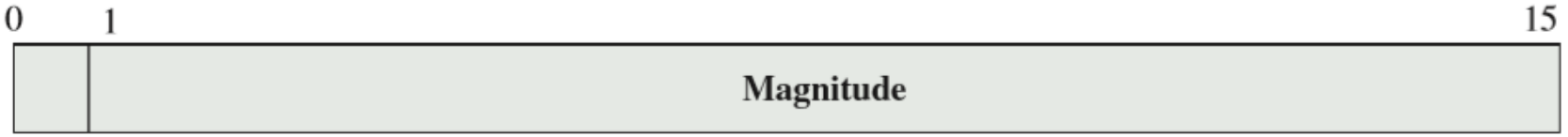
Characteristics of a Hypothetical Machine

(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

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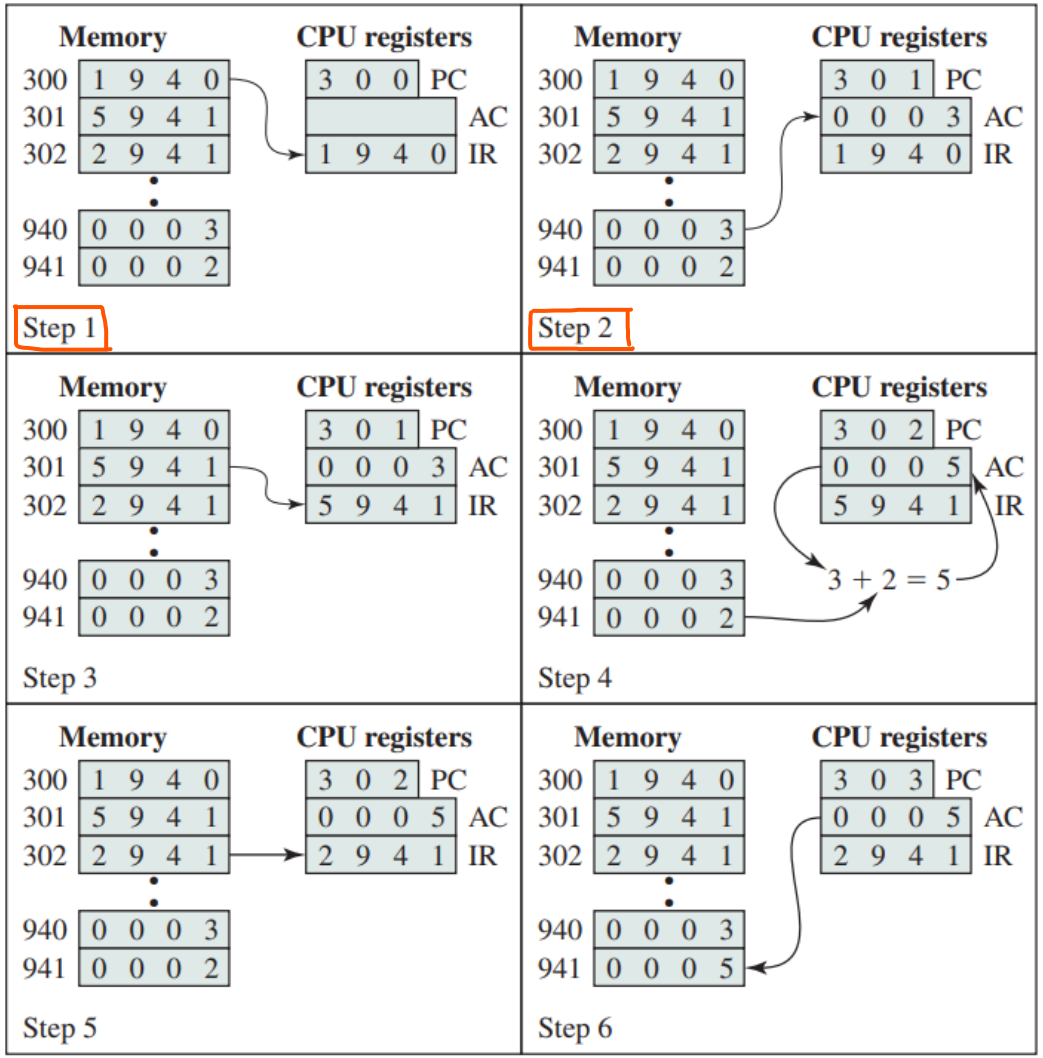
Example of Program Execution



Instruction Cycle State Diagram