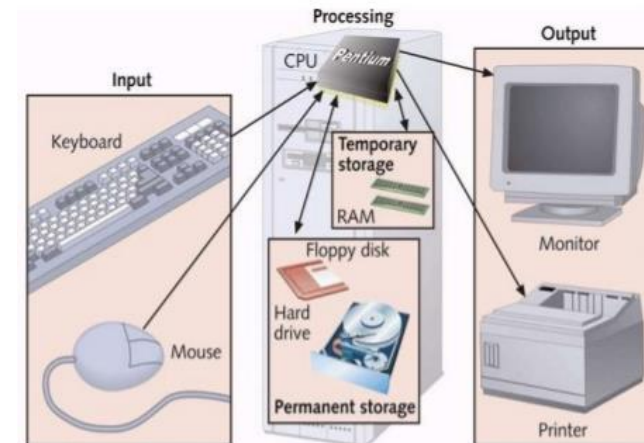


6. A Top-Level View of Computer Functions

Chapter 3

Functions of a Computer



Computer activity consists of input, processing, storage, and output

Sections 3.1, 3.2 (up to Interrupts)

- Reading: pp.66-74
- Good problems to work: 3.1, 3.2, 3.3



COMPUTER COMPONENTS

Top-Down View of a Computer

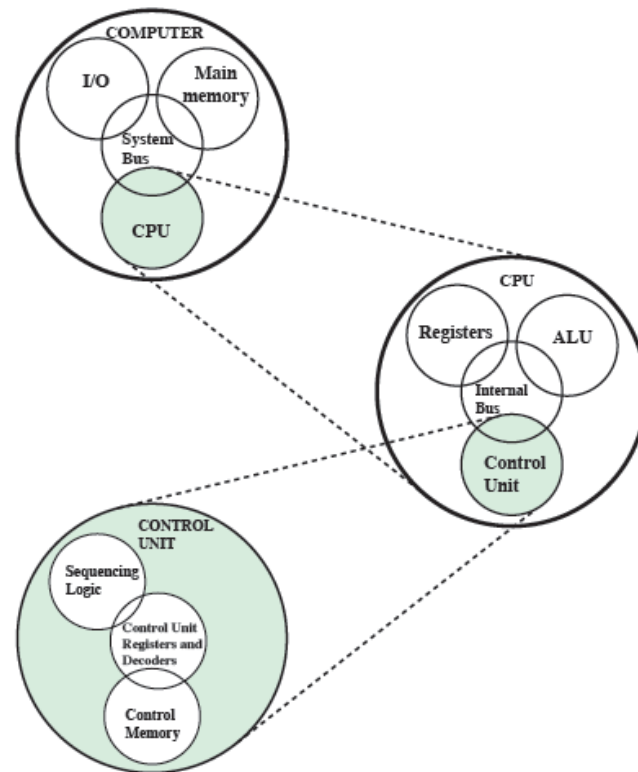
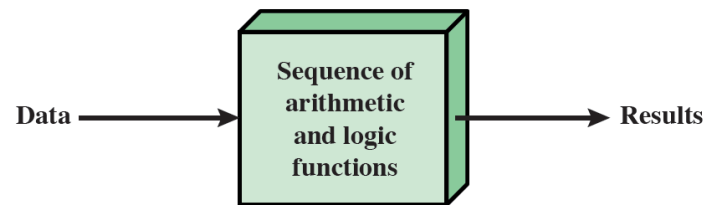


Figure 1.4 A Top-Down View of a Computer

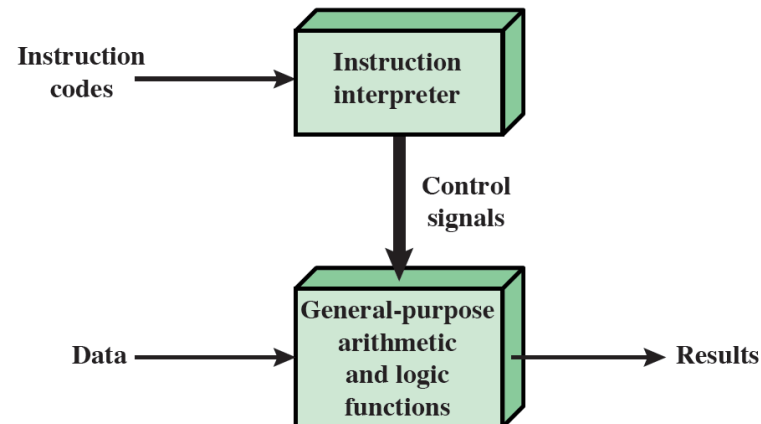
von Neumann Architecture

- Store data and instructions in memory
- Memory is addressable by location
- Execution happens sequentially

Hardware vs. Software Programming



(a) Programming in hardware



Computer Components Top-level View

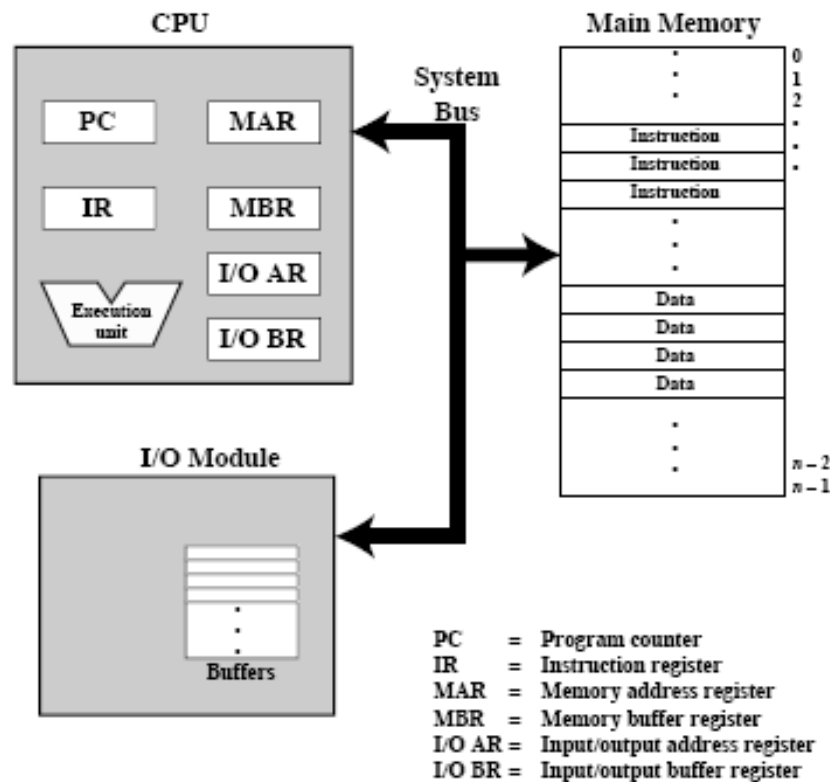
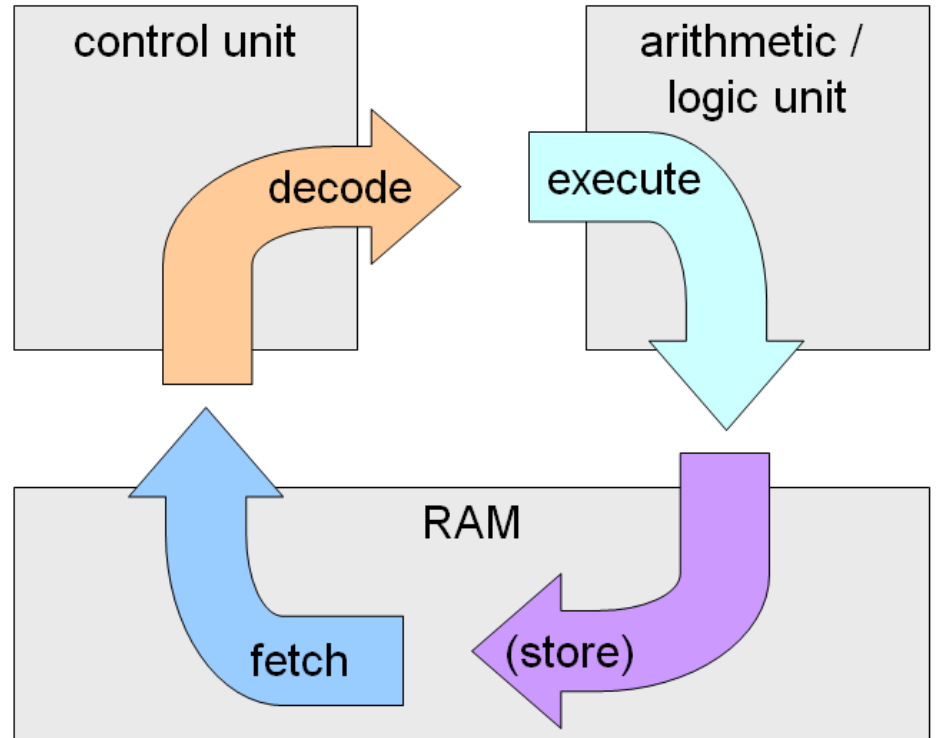
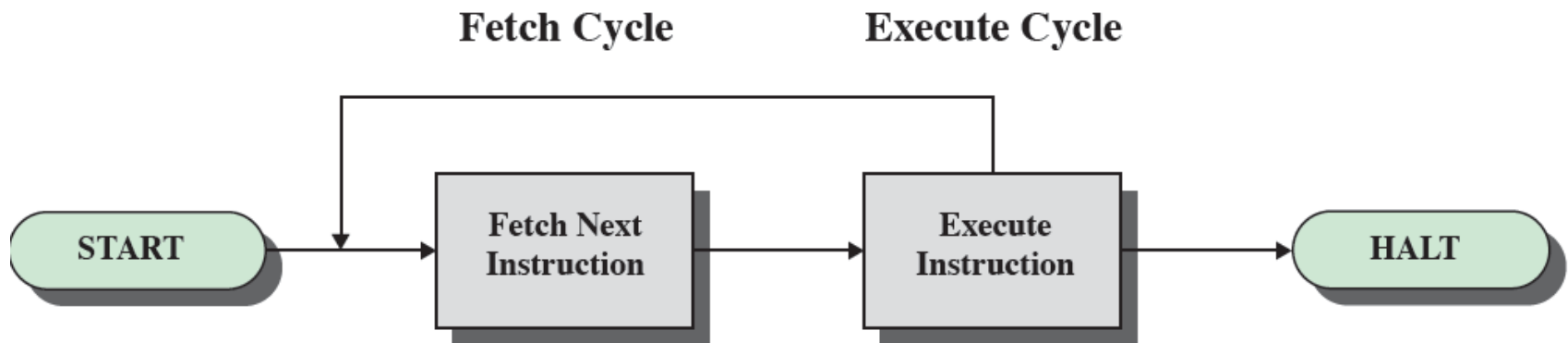


Figure 3.2 Computer Components: Top-Level View



COMPUTER FUNCTION

Basic Instruction Cycle



INSTRUCTION FETCH AND EXECUTE

Program Counter (PC)

- At the start of each instruction cycle
 - Processor fetches an instruction from memory
 - Program Counter (PC) holds the address of the instruction to be fetched next
 - Unless told otherwise, the processor always increments the PC after each instruction fetch

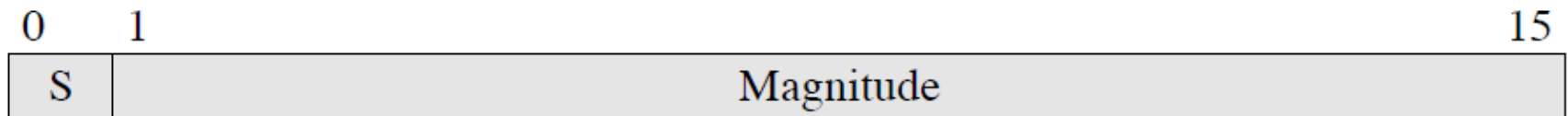
Instruction Register (IR)

- Fetched instruction is loaded into the IR
- Processor interprets the instruction:
 - Processor-memory
 - Processor-I/O
 - Data processing
 - Control

Example: Hypothetical Computer



(a) Instruction format



(b) Integer format

Example: Hypothetical Computer

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

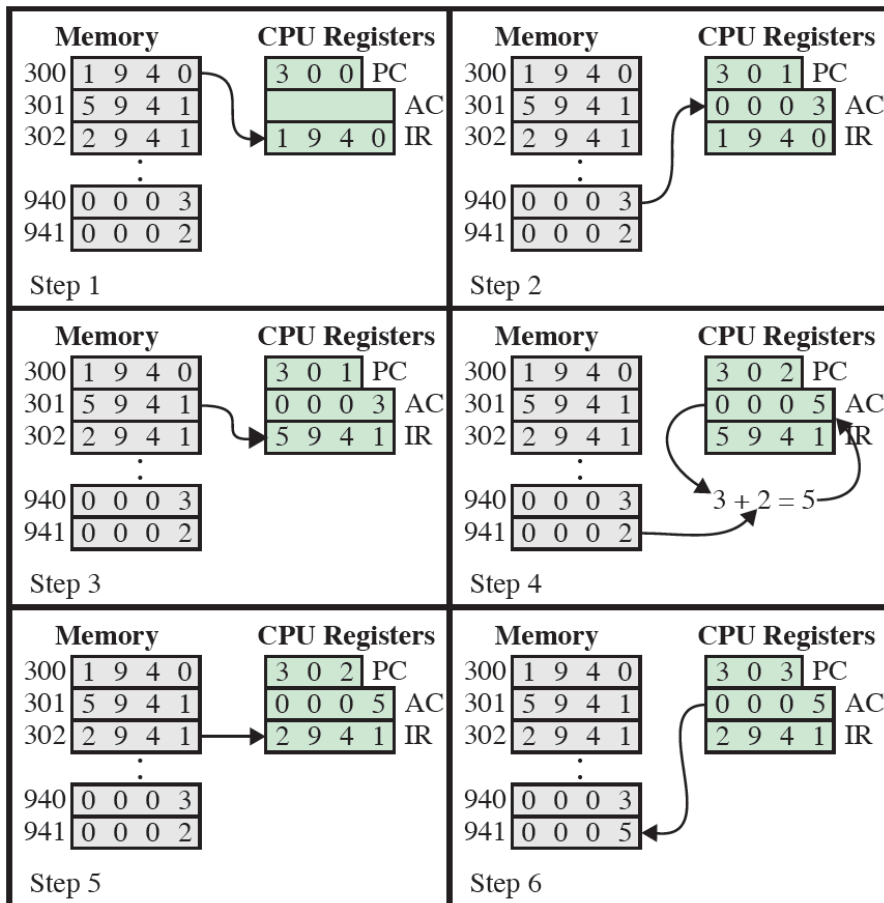
0101 = Add to AC from Memory

(d) Partial list of opcodes

Instructions

- How many possible instructions can this hypothetical computer have? Why?

Example of Program Execution

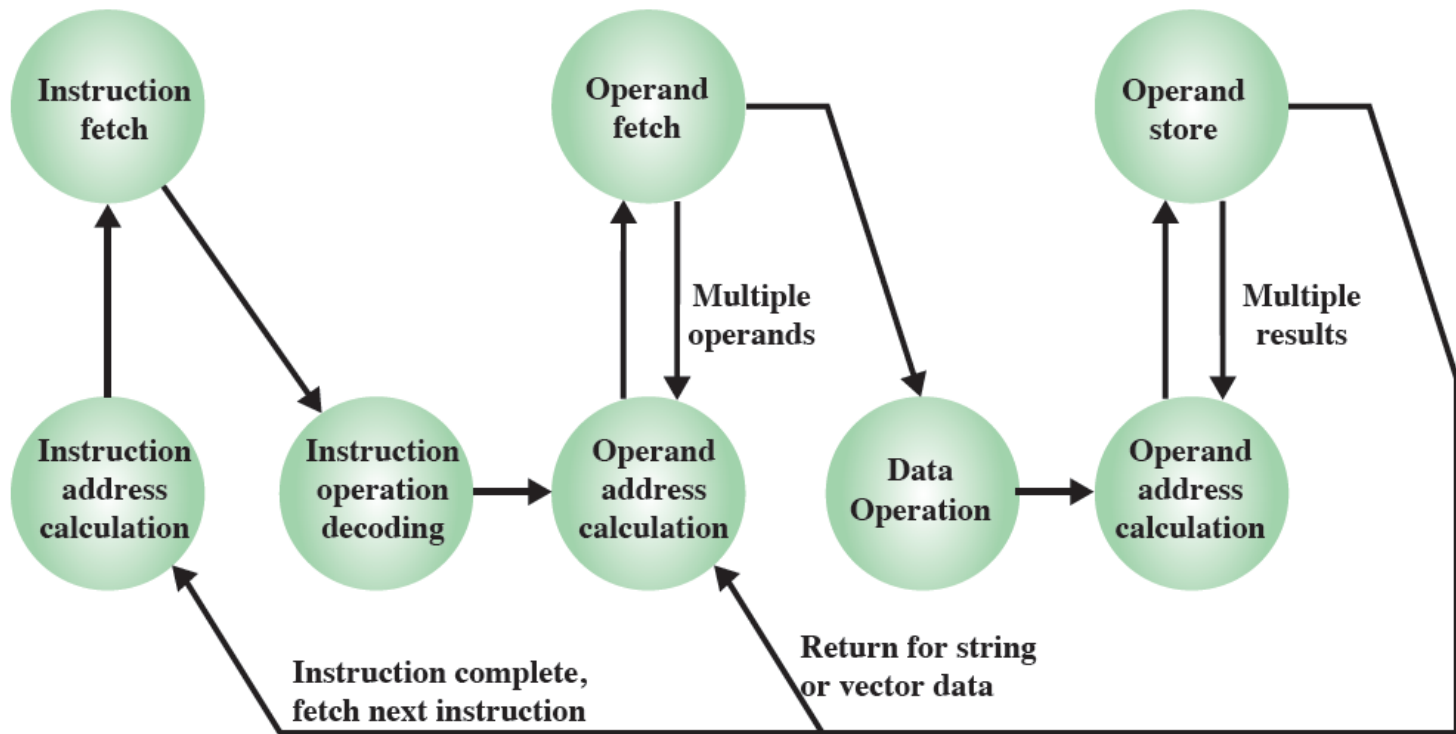


- What does the program do?
- How many instruction cycles are executed?

More Complex Instructions

- Instruction sets with more complex instructions would require fewer instruction cycles
- Example: PDP-11 had the instruction ADD B,A
- The execution cycle for a particular instruction may involve more than one reference to memory

Instruction Cycle



Question

- What sequence of states would result from the PDP-11 ADD A,B instruction?