Computer Organization and Architecture

William Stallings "*Computer Organization and Architecture*" 10 th edition,
2016 Pearson

***Assoc. Prof.* Dr. Abeer A. Al-mohdar**

Introduction:

- Computer Organization:

- How hardware interacts with software.
- How various circuits and components fit together to create working computer systems.

Computer architecture:

- The structured behavior of the computer as seen by the user.

Computer organization:

- Refers to the operational units and their interconnections that realize the architectural specifications.
- Organizational attributes include hardware details transparent to the programmer such as control signals; interfaces between the computer and peripherals.

The organizational decision may be based on the anticipated frequency of use of the multiply instruction, the relative speed of the two approaches, and the cost and physical size of a special multiply unit.

Computer Architectural

- For example, it is an architectural design issue whether a computer will have a multiply instruction.
- It is an organizational issue whether that instruction will be implemented by a special multiply unit or by a mechanism that makes repeated use of the add unit of the system.
- Many computer manufacturers offer a family of computer models, all with the same **architecture but with differences in organization.**

- In a class of computers called microcomputers, the relationship between architecture and organization is very close. Changes in technology not only influence organization but also result in the introduction of more powerful and more complex architectures.
- Generally, there is less of a requirement for generation-to-generation

- compatibility for these smaller machines. Thus, there is more interplay between organizational and architectural design decisions. An intriguing example of this is

- A computer is a complex system; contemporary computers contain millions of elementary electronic components.
- How, then, can one clearly describe them?

The key is to recognize the hierarchical nature of most complex systems.

Ahierarchical system is a set of interrelated subsystems, each of the latter, in turn, hierarchical in structure until we reach some lowest level of elementary subsystem.

- The hierarchical nature of complex systems is essential to both their design and their description.
- The designer need only deal with a particular level of the system at a time.
- At each level, the system consists of a set of components and their interrelationships.
- The behavior at each level depends only on a simplified, abstracted characterization of the system at the next lower level.

At each level, the designer is concerned with structure and function:

- Structure: The way in which the components are interrelated
- Function: The operation of each individual component as part of the structure.
- In terms of description, we have two choices: a)starting at the bottom and building up to a complete description, or b) beginning with a top view and decomposing the system into its subparts.
- Evidence from a number of fields suggests that the top down approach is the clearest and most effective.

- The computer system will be described from the top down.
- We begin with the major components of a computer, describing their **structure and function, and proceed to successively**
- lower layers of the hierarchy.
- The remainder of this section provides a very brief overview of this plan of attack.

Function: Both the structure and functioning of a computer are, in essence, simple. Figure 1

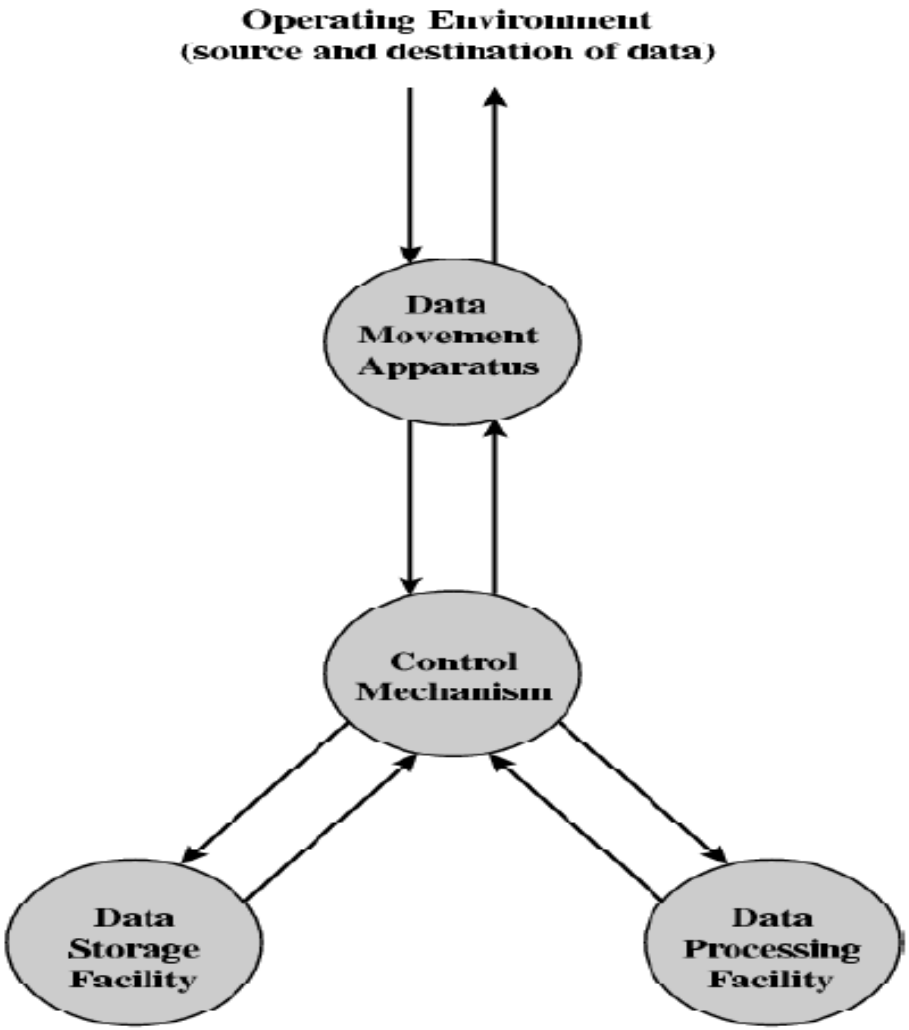


Figure 1: A Functional View of the Computer.

- Presents the basic functions that a computer can perform. In general terms, there are only four:

1- Data processing:

The computer must be able to process wide variety forms of data.

2- Data storage: Also it is essential that computer store data

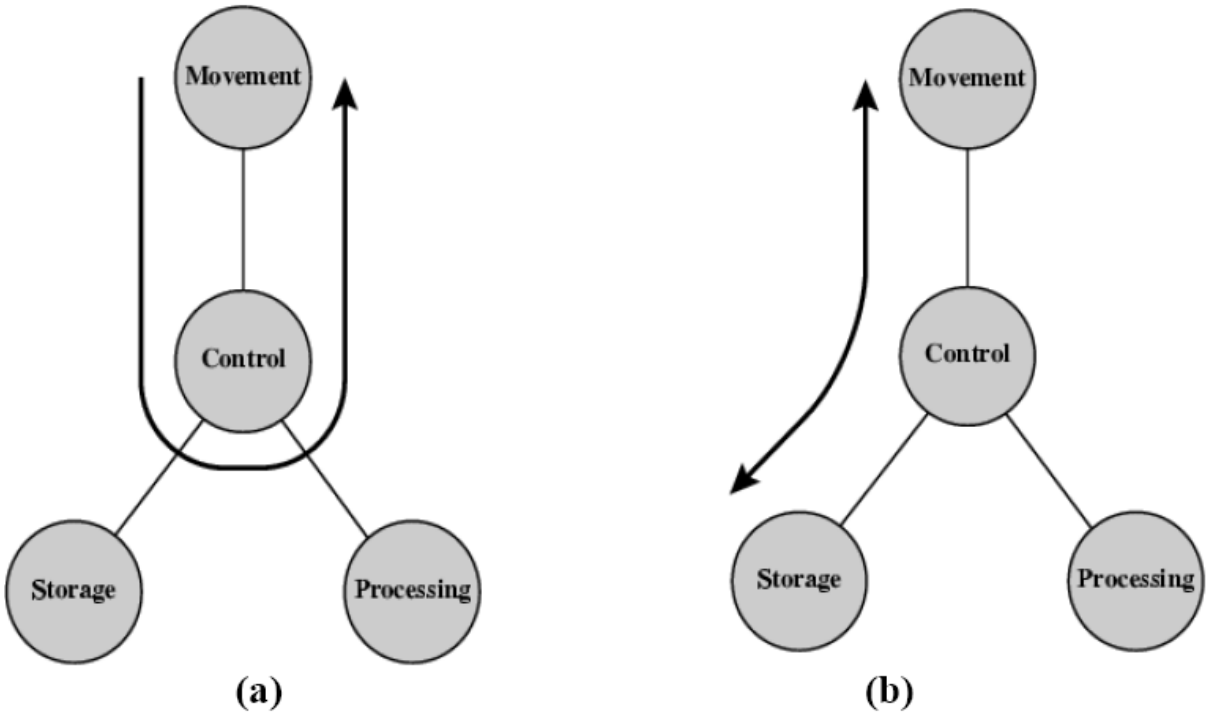
3- Data movement: The computer must be able to move data between itself and the outside world. When data are received from or delivered to a device that is directly connected to the computer, the process is known as ***input-output (I/O)***, and the device is referred to as a peripheral. When data are moved over longer distances, to or

4- Control :

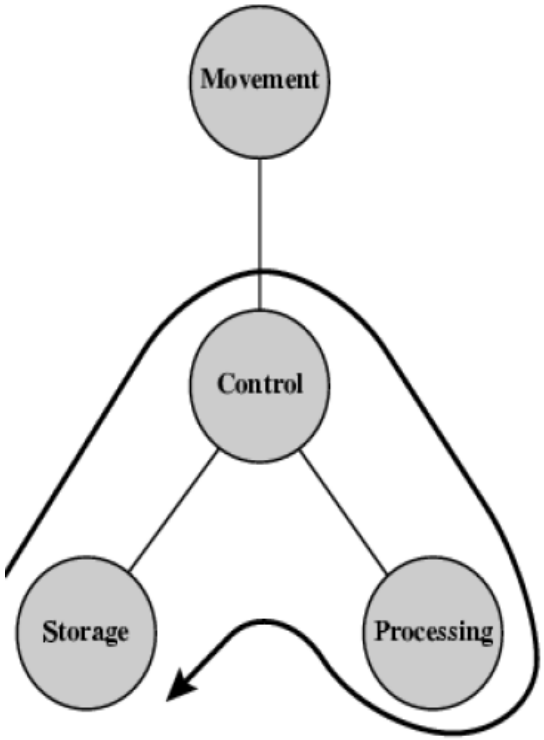
These three functions must be control. This control is executed by the individual who provides the computer with instructions.

- At this general level of discussion, the number of possible operations that can be performed is few.
- Figure 2 depicts the four possible types of operations. The computer can function as a data movement device (Figure 2a), simply transferring data from one peripheral or communications line to another.
- It can also function as a data storage device (Figure 2b), with data transferred from the external environment to computer storage (read) and vice versa (write).

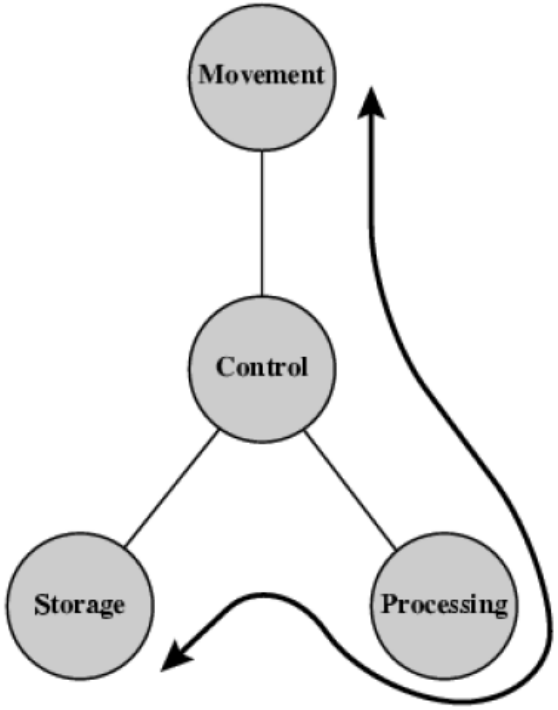
- At this general level of discussion the number of possible operations that can be performed is few. Figure 2 shows the four possible operations.
- Computer can function as a data movement device.
- Data transferred from one peripheral or communication line to another. It can also function as a data storage device.
- Data transferred from storage device (read) and vice versa (write), (data processing operations).
- Data transferred from external environment to computer storage device (read) and vice versa (write(.


Movement
Control
Storage
Processing
(a)
Movement
Control
Storage
Processing
(b)

The final two diagrams show operations involving data processing, on data either in storage (Figure 2c) oren route between storage and the external environment (Figure 2d).



(c)



(d)

Structure

- Figure 3 is the simplest possible depiction(وصف) of a computer.
- The computer interacts in some fashion with its external environment. In general, all of its linkages to the external environment can be classified as peripheral devices or communication lines.
- We will [illegible]oth types of linkag

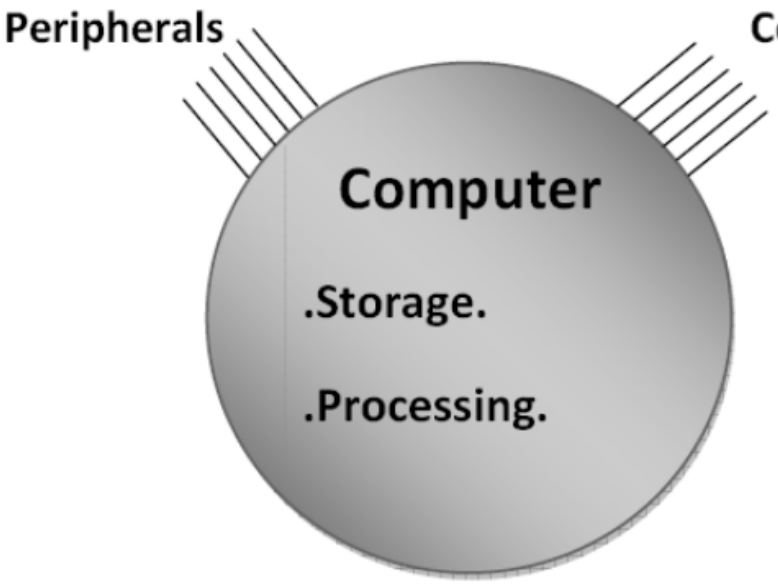


Figure3: The Computer

- The internal structure of the computer itself, which is shown in Figure 4.

There are four main structural components:

- **Central processing unit (CPU):** Controls the operation of the computer and performs its data processing functions; often simply referred to as **processor**.
- **Main memory:** Stores data.
- **I/O:** Moves data between the computer and its external environment.
- **System interconnection:** Some mechanism that provides for communication among CPU, main memory, and I/O.

A common example of system interconnection is by means of a system bus, consisting of a number of conducting wires to which all the other components attach.

There may be one or more of each of the aforementioned components. Traditionally, there has been just a single processor. In recent years, there has been increasing use of multiple processors in a single computer. Some design issues relating

to multiple processors crop up and are

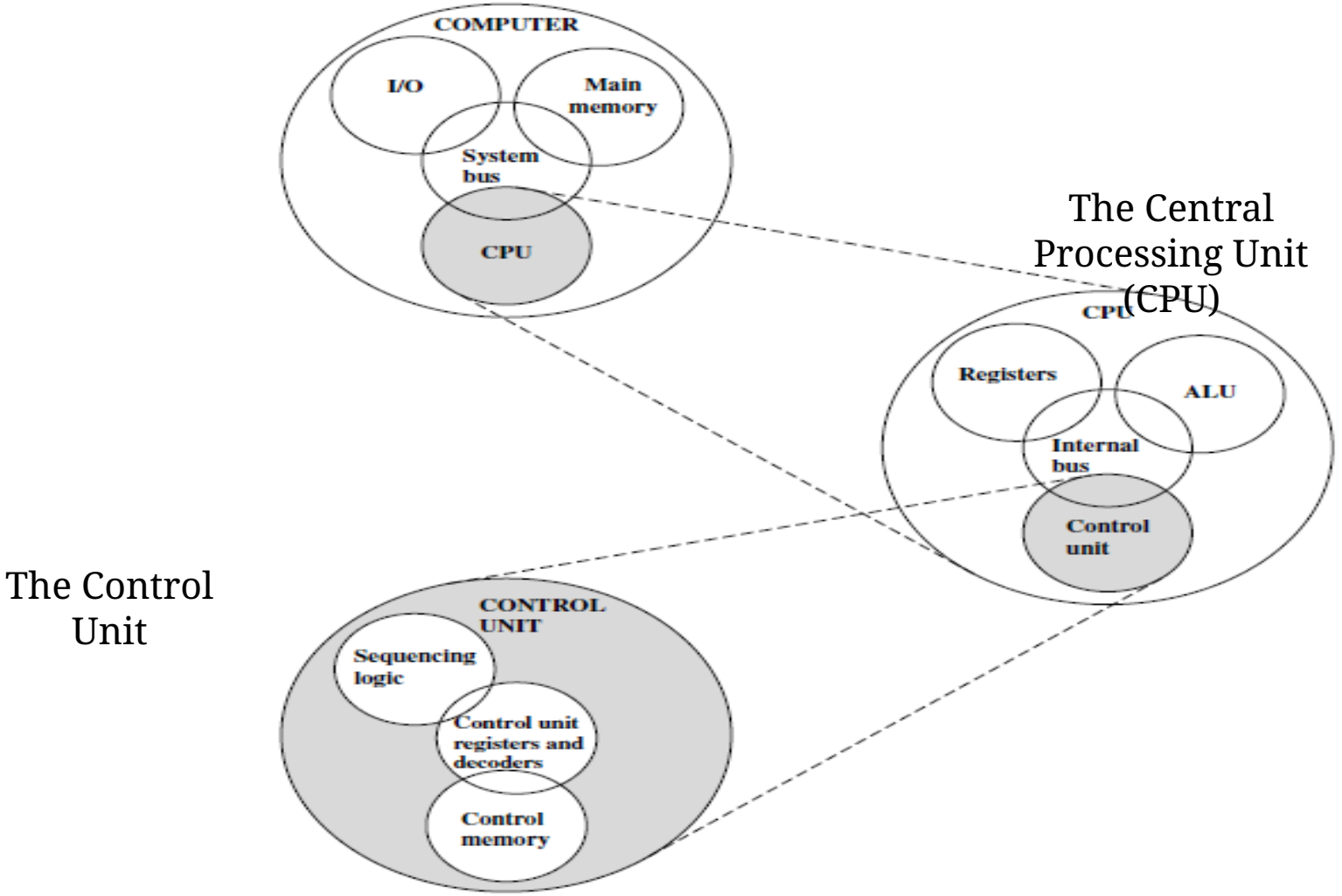


Figure 4: The Compute : Top-Level Structure

Each of these components have its major structural components complex components is the CPU; its structure is depicted in Figure 4.

- The major components as follows:
- Control unit: control the operation of the CPU and hence the computer.
- Arithmetic and logic unit (ALU): Performs the computer's data processing functions.
- Registers: Provides storage internal to the CPU.
- CPU interconnection: Some mechanism that provides for communication among the control unit, ALU and registers.
- A micro programmed control unit operates by executing microinstructions that define the functionally of the control unit. With this approach, the structure of the control unit can be depicted as in figure 4.