

Tishk International University
Computer Engineering Department
Computer Organization CMPE 352/A
Lecture 1: 04/02/2021



Computer Organization: Introduction Chapter - 1

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Syllabus

1. Introduction to computer organization
2. The computer systems
3. The computer function and interconnection
4. Cache Memory, Internal Memory, and External Memory.
5. Operating System
6. Central Processing Unit (CPU)

Reference

William Stallings, 2013. Computer Organization and Architecture, 9th Edition, Publisher: Pearson.



Computer
Organization
and Architecture
Designing for Performance
Ninth Edition

William Stallings

Lecture 1 Outline:

- Organization and Architecture
- Function
- Structure

Organization and Architecture

Computer organization and architecture is the study of the computer internal working.

The Architecture of the computer likes a catalog of the available tools for the operating system, while the Organization is the way of how the system is structured, in order to use all these tools.

- **Computer Architecture:** refers to the attributes of a system those visible to the programmer such as:
 - Instruction set, number of bits used to represent data (number, characters), I/O mechanisms, and the technique for addressing memory.

Organization and Architecture

- **Computer Organization:** refers to the operational units and their interconnections, such as: the hardware details those are transparent to the programmer such as control signal, interfaces between the computer and peripherals, and the memory technology used.
- As an example: the architecture issue whether the computer has a multiply instruction. While the organization issue whether the instruction will be implemented by a special multiply unit or by a mechanism that makes repeated use of add unit of the system.
- Historically, and still today, the connection between the architecture and the organization is very important. Many computer manufacturers offer a family of computer models with the same architecture, and differences in the organization. Which leads to have different models in the same family, with different performance and price.

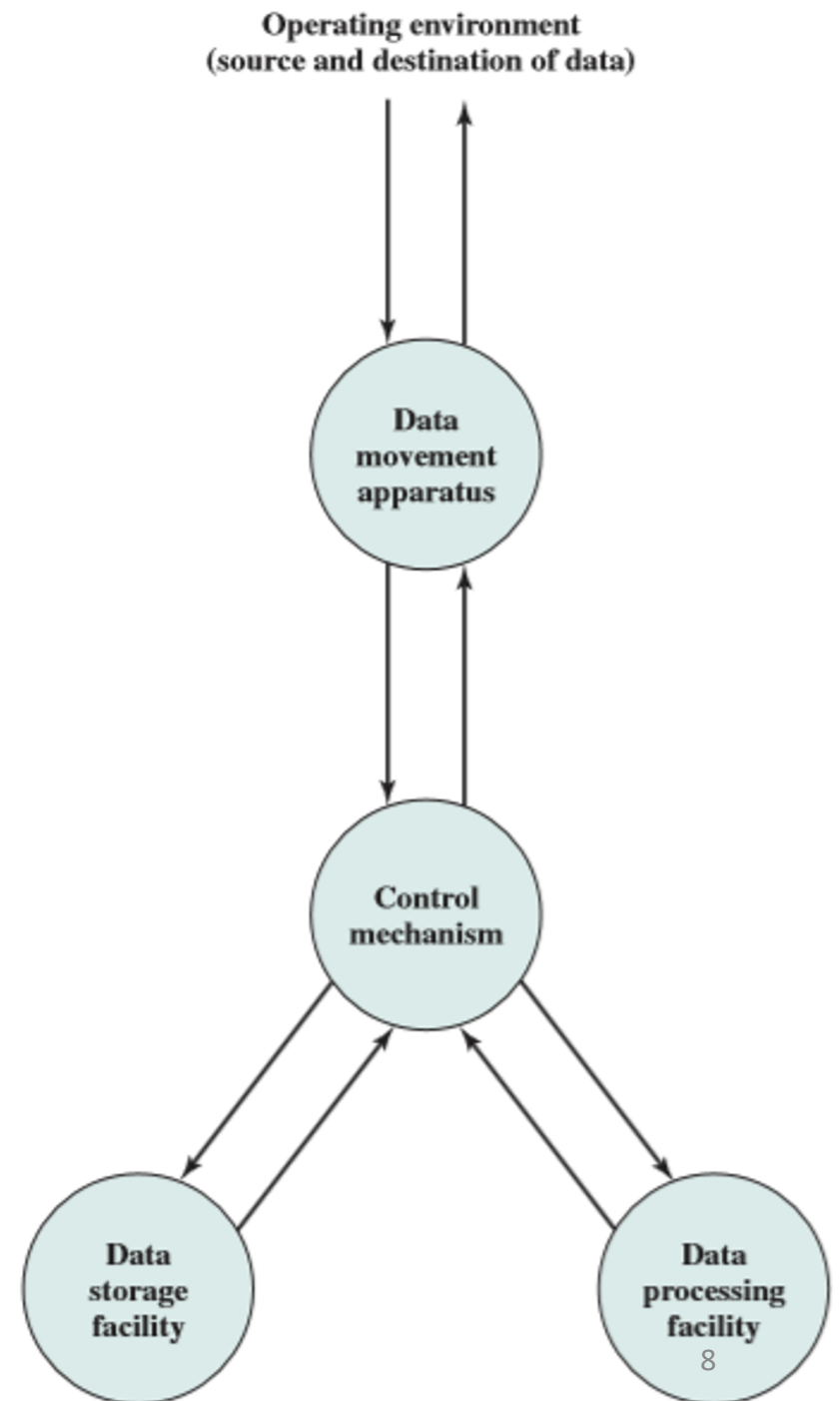
Structure and Function

- A computer is a complex system that contains millions of elementary electronic components. The hierarchical nature of complex systems is essential to both their design and their description. A hierarchical system is a set of interrelated subsystems.
- At a time, the designer needs to deal with a particular level from the hierarchical structure. The behaviors of each level depends on the characteristics of the next lower level. At each level, the designer is concerned with *structure* and *function*.
 - **Structure:** means the way in which the components are interrelated.
 - **Function:** means the operation of each individual components as a part of the structure.

1. Function

The basic functions those can be performed by the computer are:

- Data processing
- Data storage
- Data movement
- Control



1. Function

- The computer must be able to *process data*. The data may take a wide variety of forms, and the range of processing requirements is broad. However, there are only a few fundamental methods or types of data processing.
- It is also essential that a computer *store data*. Even if the computer is processing data on the fly (i.e., data come in and get processed, and the results go out immediately), the computer must temporarily store at least those pieces of data that are being worked on at any given moment. Thus, there is at least a **short-term data storage** function. Equally important, the computer performs a **long-term data storage** function.
- The computer must be able to *move data* between itself and the outside world. The computer's operating environment consists of devices that serve as either sources or destinations of data.
 - 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 from a remote device, the process is known as data communications.
- Finally, there must be *control* of these three functions. Ultimately, this control is exercised by the individual(s) who provides the computer with instructions. Within the computer, a control unit manages the computer's resources and orchestrates the performance of its functional parts in response to those instructions.

1.1 Data Movement

The number of possible operations that can be performed is few, figure(2) shows four possible types of operations:

1. The computer can function as a data movement device as shown in Fig. (2 a) by simply transferring data from one peripheral or communication line to another.

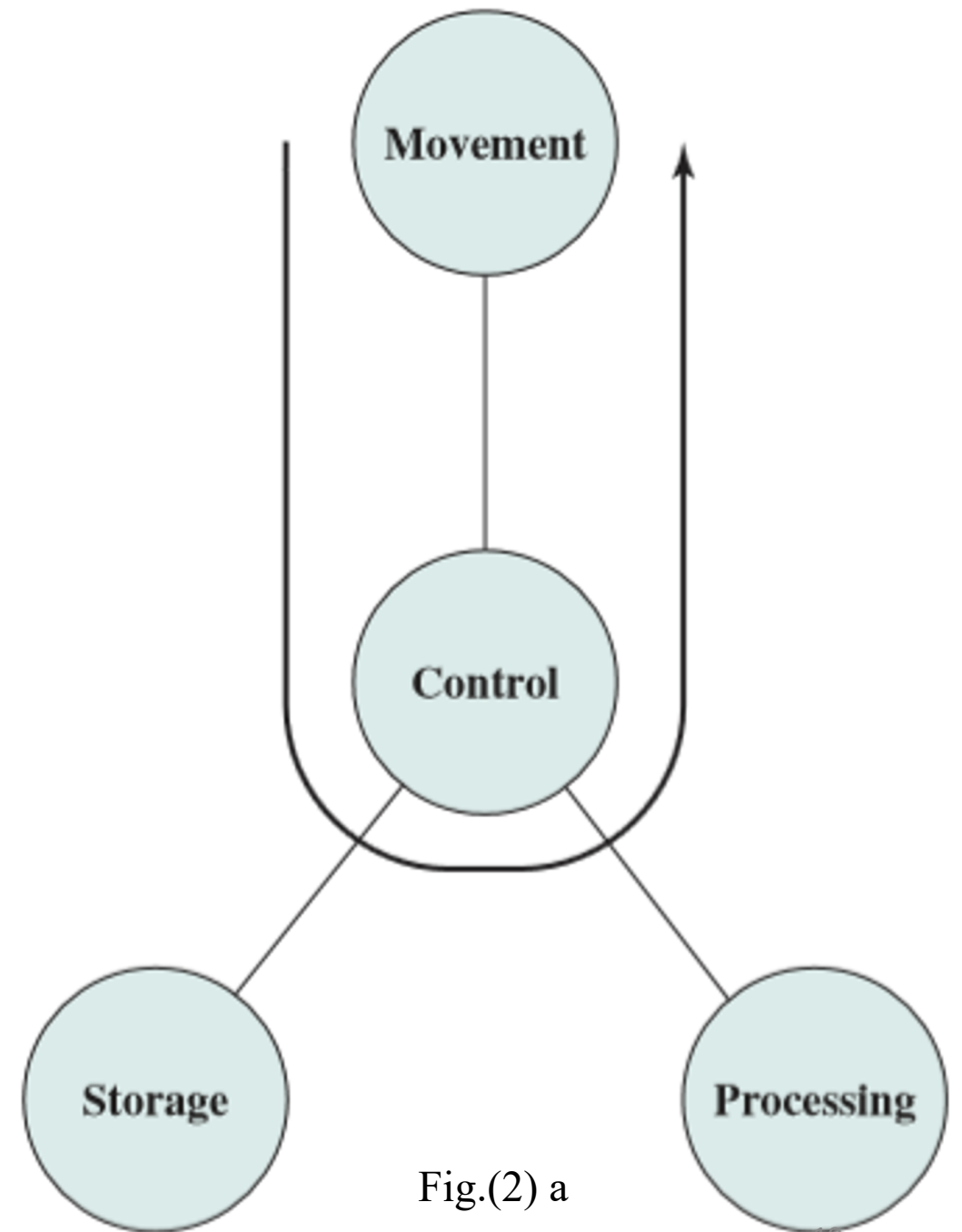


Fig.(2) a

1.2 Data Storage

- 2. It can also function as a data storage device, as shown in Fig.(2 b), with data transferred from the external environment to computer storage (read) and vice versa (write).

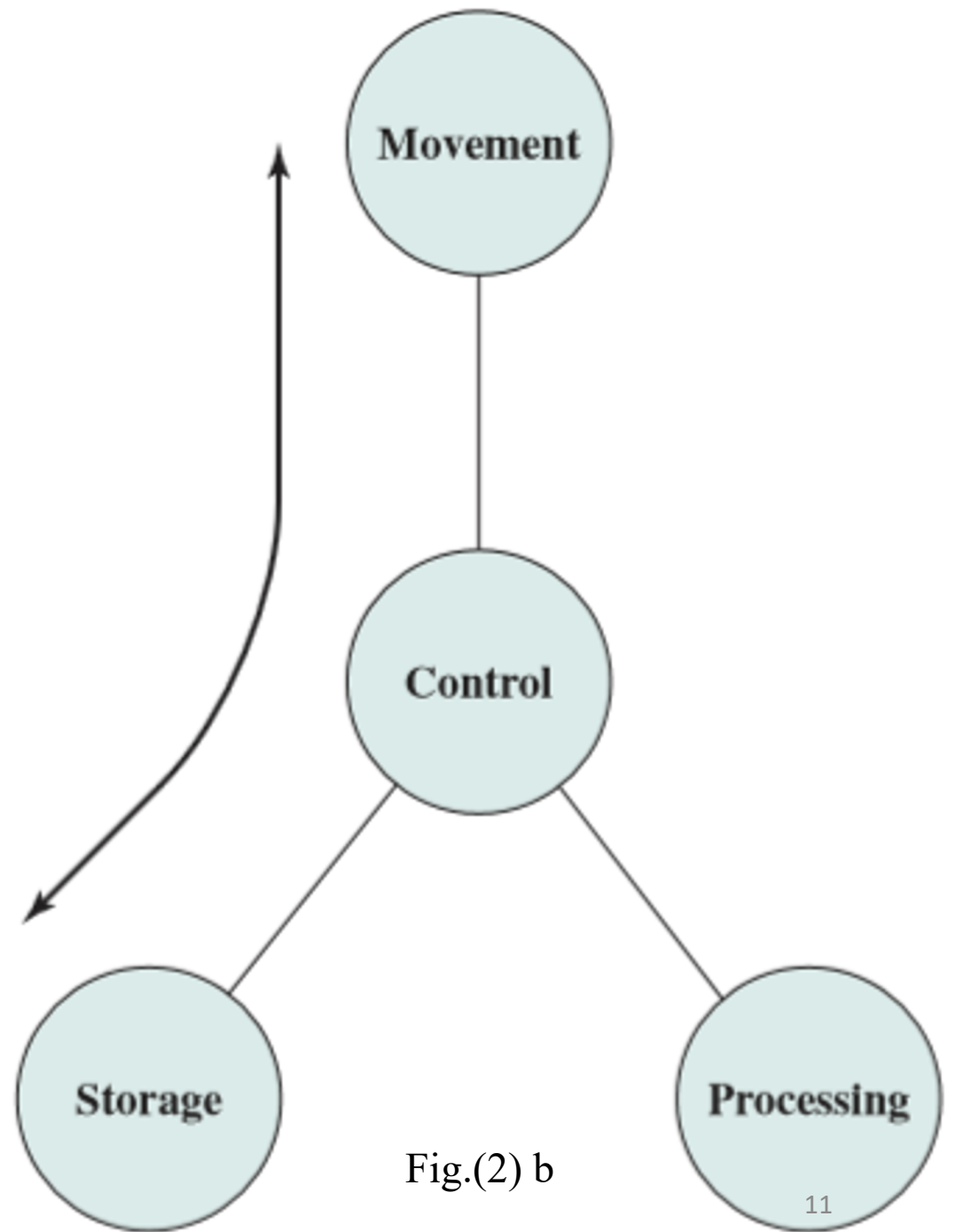
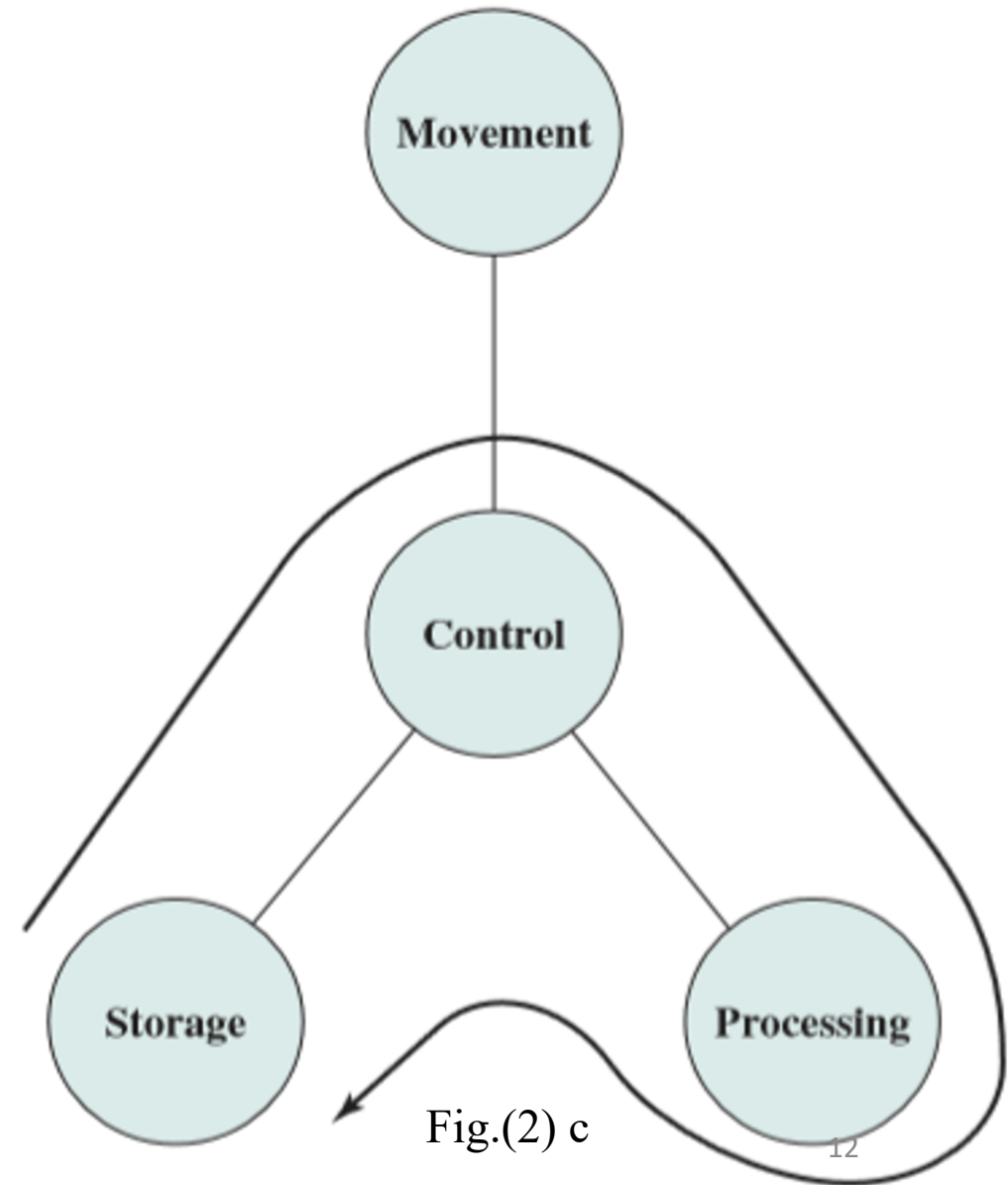


Fig.(2) b

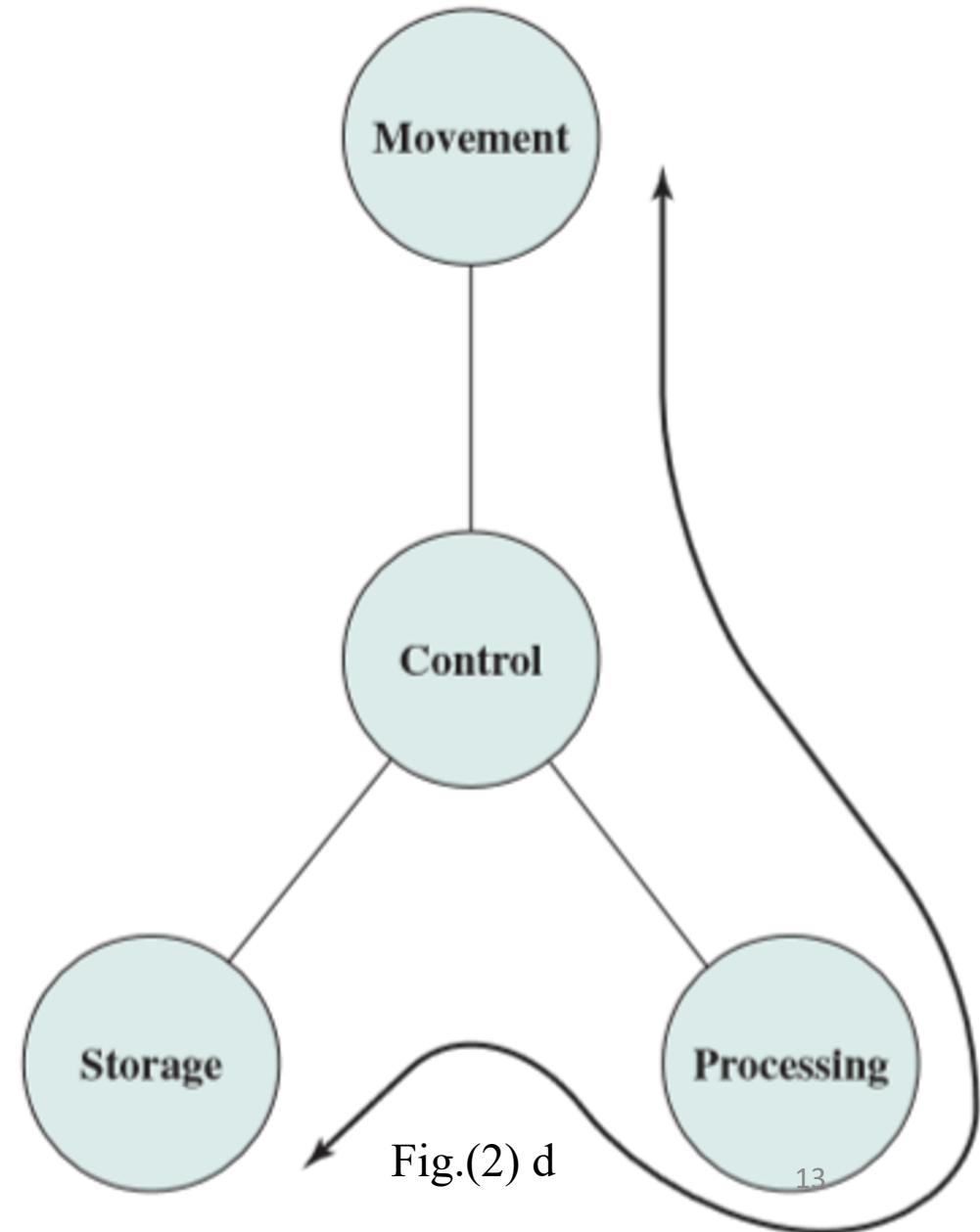
1.3 Data Processing from/to storage

3. Data processing from/to storage as shown in Figure (2c).



1.4 Data processing to the external environment (I/O)

- 4. Data processing from the storage to the external environment (I/O) as shown in Figure (2d).



2. Structure

Figure 3 is the simplest possible depiction 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.

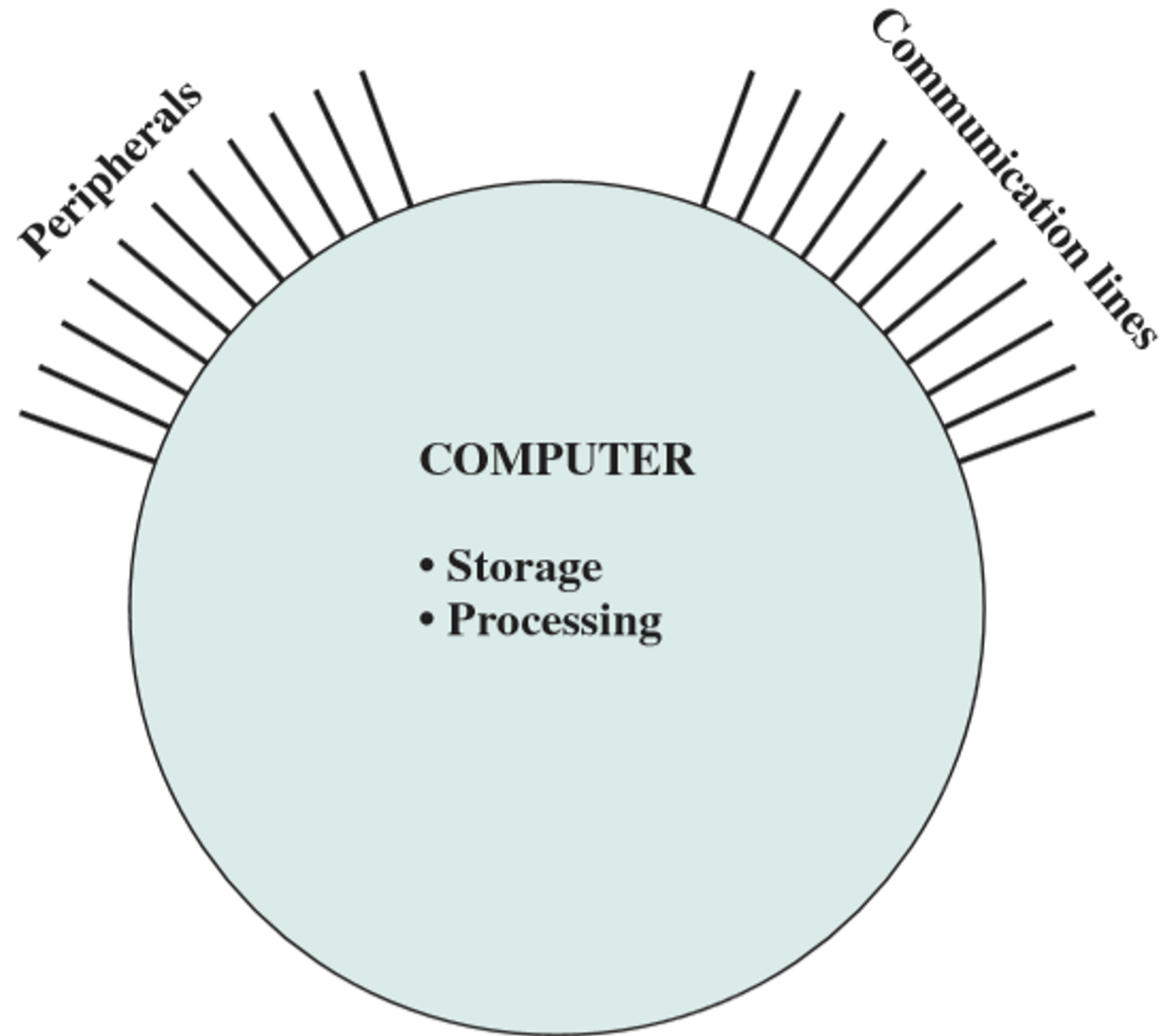


Fig.(3)

2.1 Structure-Top Level

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.

2.1 Structure-Top Level

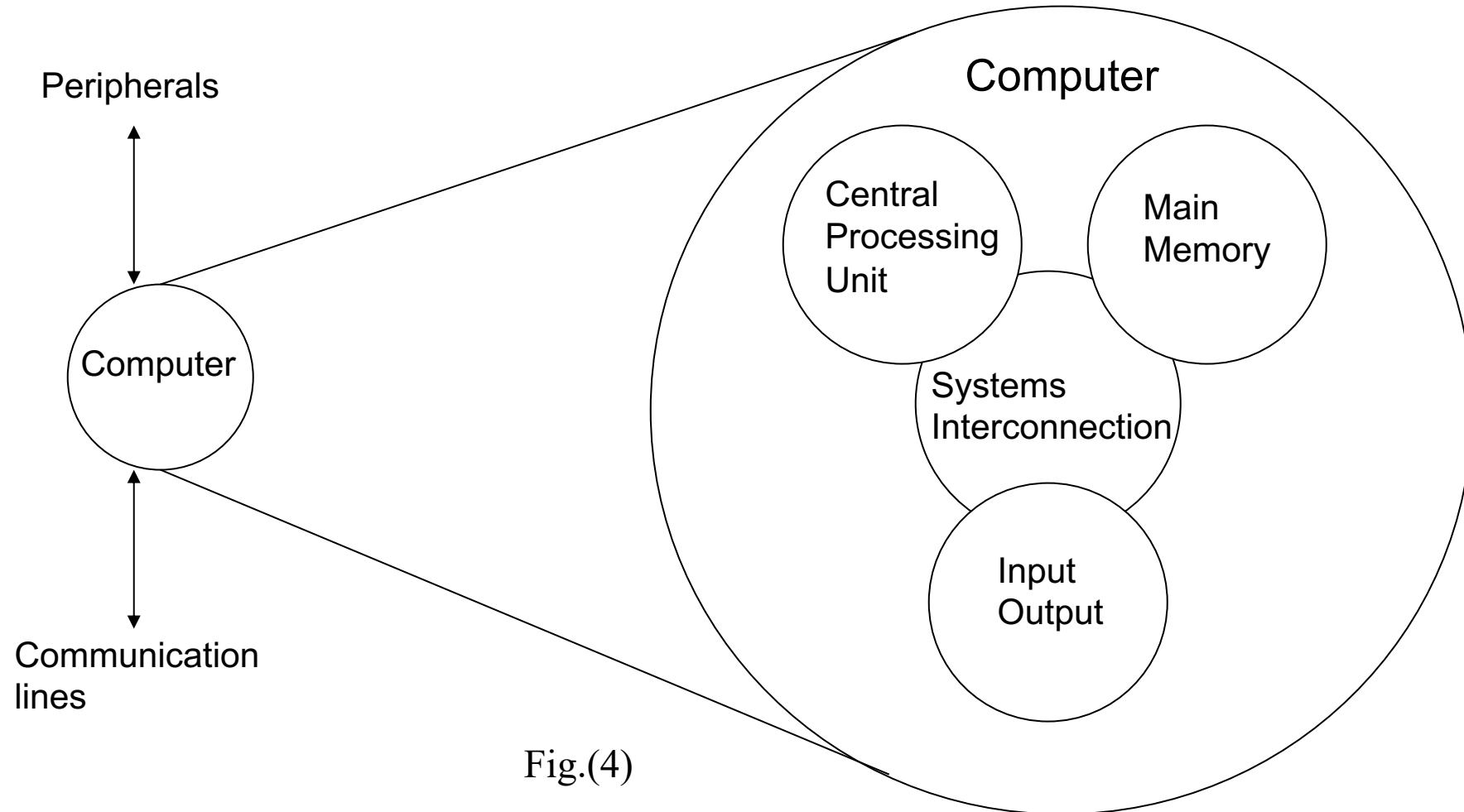


Fig.(4)

2.2 Structure – The CPU

The major structural components in the CPU, as shown in Fig.(5), are as follows:

- Control unit: Controls 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.

2.2 Structure – The CPU

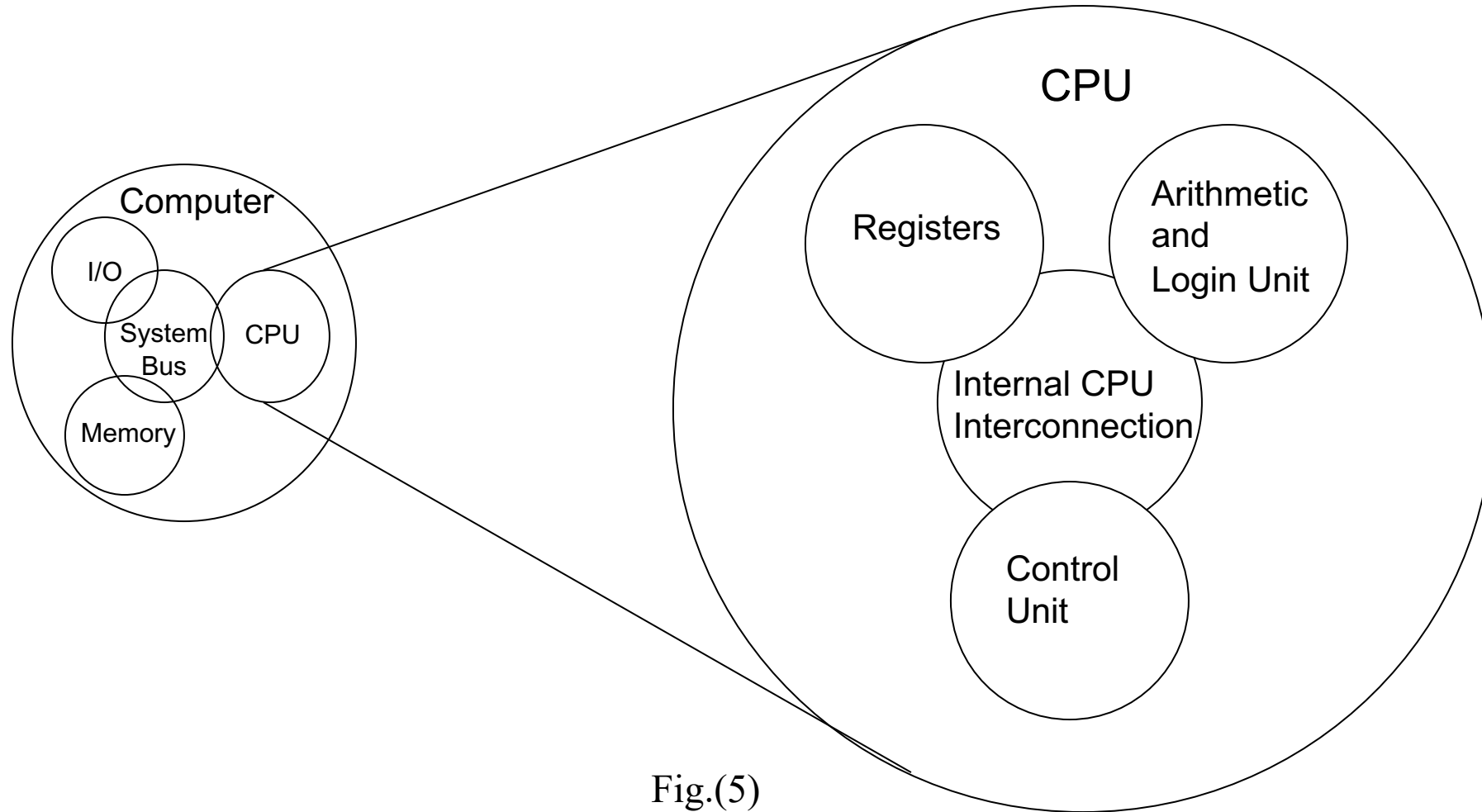


Fig.(5)

2.3 Structure – The Control Unit

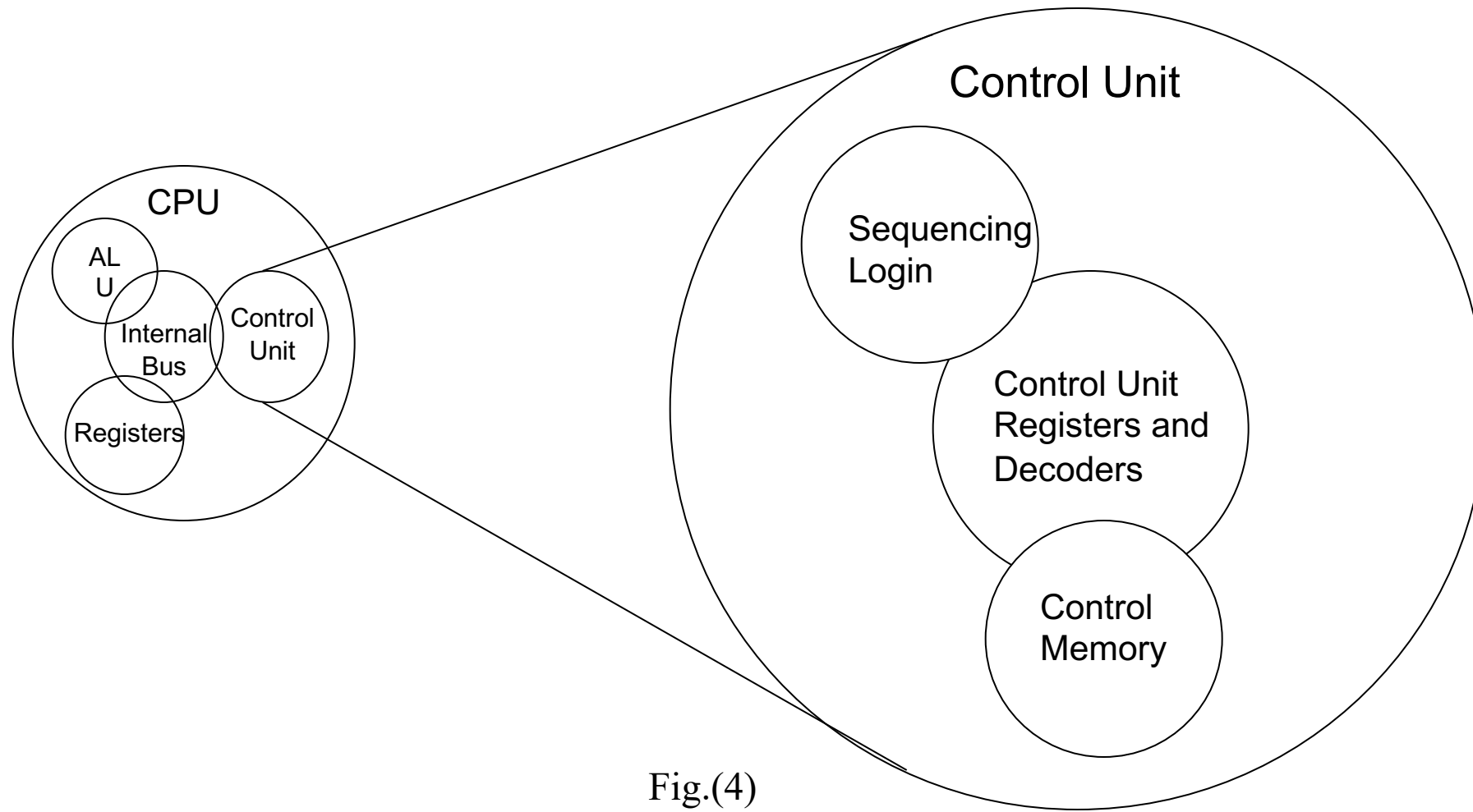


Fig.(4)

Exercises

- What is, in general terms, the distinction between computer organization and computer architecture?
- What is the meaning of computer structure and computer function?
- What are the four main components of any general-purpose computer?
- List and briefly define the main structural components of a processor.
- Briefly describe the Arithmetic and Logic Unit.
- What are the main functions of a computer?

Next Lecture

- Computer Evaluation and Performances