COMPUTER ORGANIZATION

Lecture 3

Basic Design of a Computer

INTRODUCTION

In this lecture we will provide you with an overview of the ***basic design of a computer.*** You will know how different parts of a computer are organized and how various operations are performed between different parts to do a specific task.

- The *internal architecture of computer may differ* from system to system, but the *basic organization* remains the same for all computer systems.

OBJECTIVES

At the end of the lecture you will be able to:

- ✓ Understand basic organization of computer system
- ✓ Understand the meaning of Arithmetic Logical Unit, Control Unit and Central Processing Unit
- ✓ Differentiate between bit , byte and a word define computer memory

- ✓ Differentiate between primary memory and secondary memory
- ✓ Differentiate between input devices and output devices

BASIC COMPUTER OPERATIONS

A diagram as shown in Fig. 2.1 performs basically five major operations or functions irrespective of their size and make. These are :

1) it accepts data or instructions by way of input
2) it stores data
3) it can process data as required by the user
4) it gives results in the form of output, and
5) it controls all operations inside a computer.

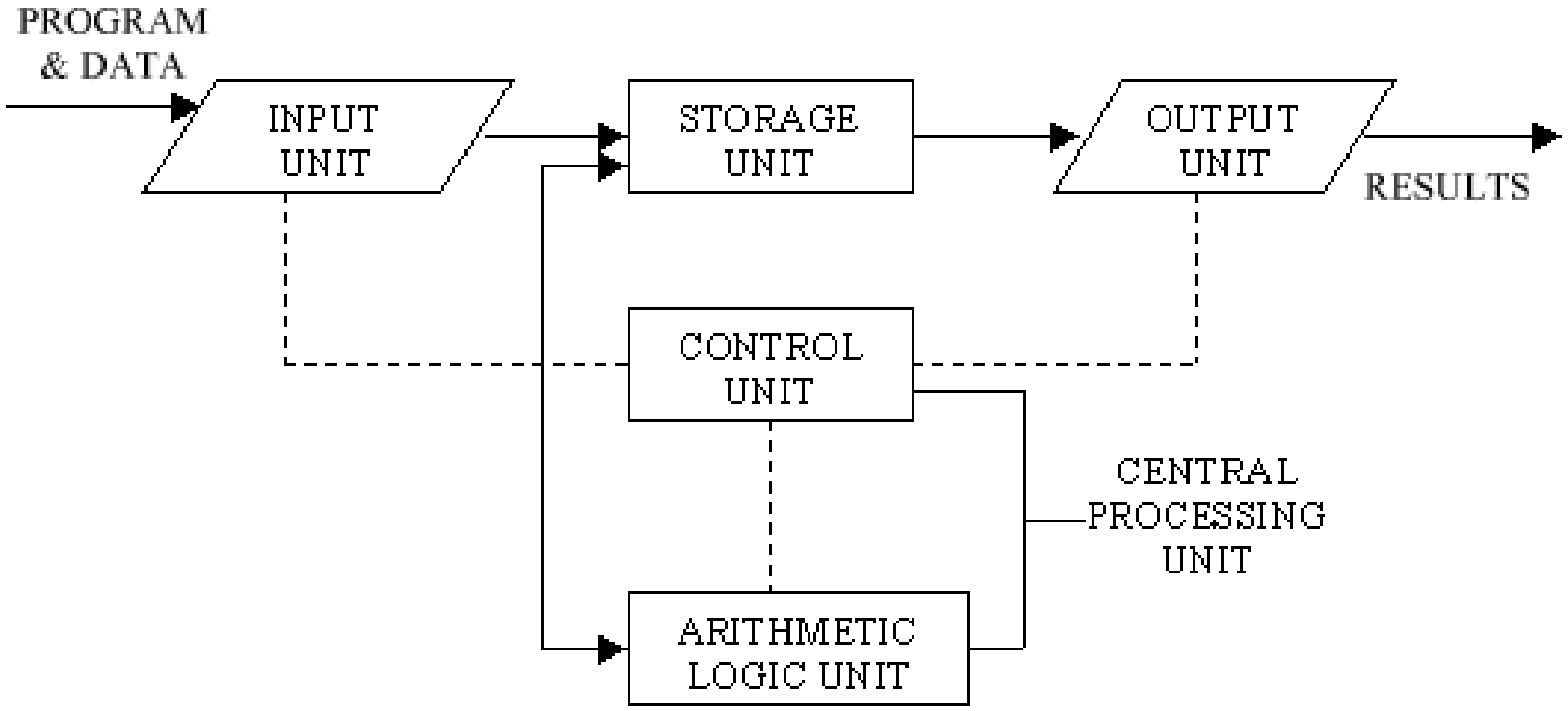

PROGRAM
& DATA
INPUT
UNIT
STORAGE
UNIT
OUTPUT
UNIT
RESULTS
CONTROL
UNIT
CENTRAL
PROCESSING
UNIT
ARITHMETIC
LOGIC UNIT

Fig. 2.1

1. Input:

This is the process of entering data and programs in to the computer system.

Therefore, the input unit ***takes data from us to the computer in an organized manner for processing.***

2. Storage:

The ***process of saving data and instructions permanently is known as storage***. Data has to be fed into the system before the actual processing starts.

- Therefore the data is first stored in the storage unit for faster access and processing. This storage unit or the primary storage of the computer system is designed to do the above functionality. It provides space for storing data and instructions.

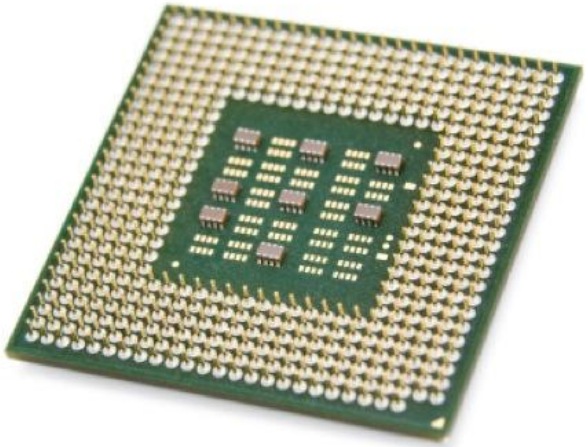
The storage unit performs the following major functions:

- ***All data and instructions are stored here before and after processing.***
- ***Intermediate results of processing are also stored here.***

3. Processing:

The ***task of performing operations*** like arithmetic and logical operations is called ***processing***.

- The Central Processing Unit (CPU) takes *data* and *instructions* from the storage unit and makes all sorts of calculations based on the instructions given and the type of data provided. It is then sent back to the storage unit.



4. Output:

This is the process of producing results from the data for getting useful information.

5. Control:

The manner how instructions are executed and the above operations are performed. Controlling of all operations like input, processing and output are performed by control unit. It takes care of step by step processing of all operations inside the computer.

FUNCTIONAL UNITS

In order to carry out the operations mentioned in the previous section the computer allocates the task between its various functional units. The computer system is divided into three separate units for its operation. They are:

1) arithmetic logical unit,
2) control unit,
3) central processing unit.

Arithmetic Logical Unit (ALU)

After you enter data through the input device it is stored in the primary storage unit. *The actual processing of the data and instruction are performed by Arithmetic Logical Unit.* The major operations performed by the ALU are addition, subtraction, multiplication, division, logic and comparison.

Control Unit (CU)

The next component of computer is the Control Unit, which acts like the supervisor seeing that things are done in proper fashion. *The control unit determines the sequence in which computer programs and instructions are executed.*

Things like processing of programs stored in the main memory, interpretation of the instructions and issuing of signals for other units of the computer to execute them.

Therefore it is the manager of all operations mentioned in the previous section

Central Processing Unit (CPU)

The **ALU and the CU** of a computer system are jointly known as the central processing unit. You may call CPU as the *brain* of any computer system. It is just like brain that takes all major decisions, makes all sorts of calculations and directs different parts of the computer functions by activating and controlling the operations.

Personal Computer Configuration

Now let us identify the physical components that make the computer work. These are

1. Central Processing Unit (CPU)
2. Computer Memory (RAM and ROM)
3. buses
4. Ports

5. Motherboard
6. Hard disk
7. Output Devices
8. Input Devices

All these components are ***interconnected*** for the personal computer to work

Memory System in a Computer

There are two kinds of computer memory: ***primary*** and ***secondary***. Primary memory is accessible directly by the processing unit.

RAM is an example of primary memory.

As soon as the computer is ***switched off*** the contents of the primary memory ***is lost***. You can store and retrieve data **much faster** with primary memory compared to secondary memory

- Secondary memory such as floppy disks, magnetic disk, etc., is located outside the computer. Primary memory is more expensive than secondary memory. Because of this the size of primary memory is less than that of secondary memory. We will discuss about secondary memory later on.

Computer memory is used to **store two things**:

i) instructions to execute a program and

ii) data.

When the computer is doing any job, the data that have to be processed are stored in the primary memory. This data may come from an input device like keyboard or from a secondary storage device like a floppy disk.

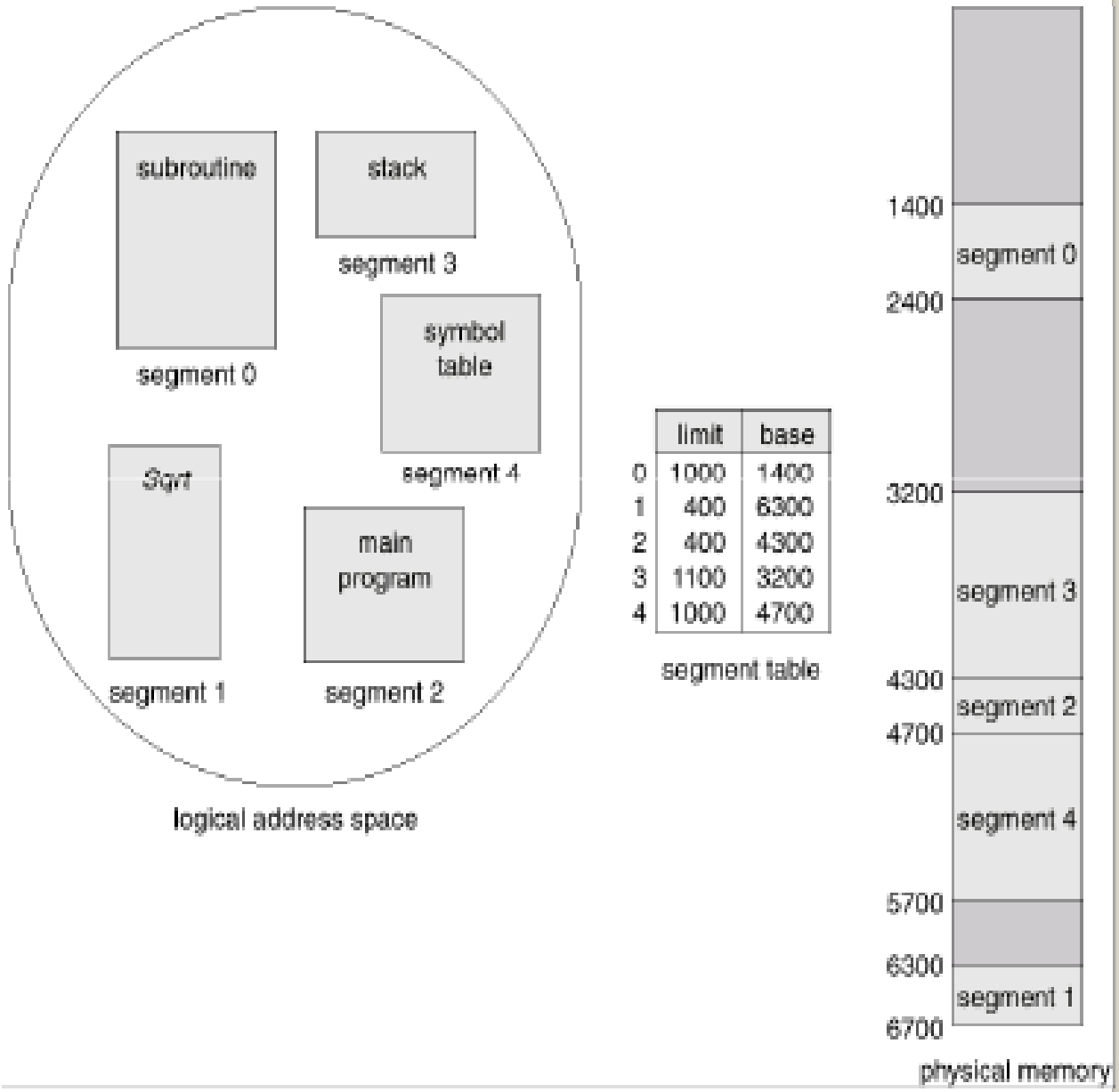
- As program or the set of instructions is kept in primary memory, the computer is able to follow instantly the set of instructions. For example, when you book ticket from railway reservation counter, the computer has to follow the same steps:

1. *take the request,*
2. *Check the availability of seats,*
3. *calculate fare,*
4. *wait for money to be paid,*
5. *store the reservation*
6. *and get the ticket printed out.*

The program containing these steps is kept in memory of the computer and is followed for each request

But inside the computer, the steps followed are quite different from what we see on the monitor or screen. In computer's memory both programs and data are stored in the binary form**.** You have already been introduced with decimal number system, which is the numbers 0 to 9. But the binary system has only two values 0 and 1.

❖These are called ***bits***. As human beings we all understand decimal system but the computer can only understand binary system

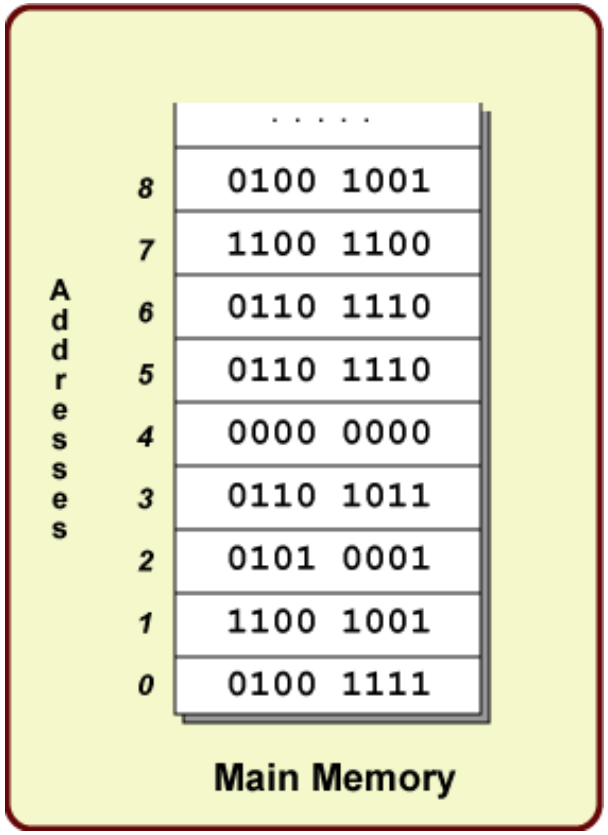


It is because a large number of integrated circuits inside the computer can be considered as **switches**, which can be made ON, or OFF. If a switch is ON it considered 1 and if it is OFF it is 0. A number of switches in different states will give you a message like this: 110101....10. So the computer takes input in the form of 0 and 1 and gives output in the form 0 and 1 only.

Therefore it is the computer that takes information or data in decimal form from you, convert it in to binary form, process it producing output in binary form and again convert the output to decimal form.

- The primary memory as you know in the computer is in the form of IC's (Integrated Circuits). These circuits are called Random Access Memory (RAM). Each of RAM's locations stores one *byte* of information. (1*byte* is equal to 8 *bits*). A bit is an acronym for *binary digit*, which stands for one binary piece of information.

- This can be either 0 or 1. The Primary or internal storage section is made up of several small storage locations called cells. Each of these cells can store a fixed number of bits called *word length*.



- Each cell has a ***unique number*** assigned to it called the ***address*** of the cell and it is used to identify the cells. The address starts at 0 and goes up to (N-1).

Capacity of Primary Memory

You know that each cell of memory contains *one* character or 1 byte of data. So the capacity is defined in terms of byte or words. Thus 64 kilobyte (KB) memory is capable of storing 64 × 1024 = 32,768 bytes. (***1 kilobyte is 1024 bytes***).