TOPIC 1 – OVERVIEW

LEARNING OUTCOMES

By the end of this topics, you will be able to:

1. define some different types of computer systems and basic components of a digital computer.
2. describe CPU operation.
3. explain evolution of CPU.
4. explain pipelining and super scaling.

INTRODUCTION

This topic explains about the computer architecture and computer organisation which has major contributions to the computer system. Computer architecture deals with the functional behavior of a computer system as viewed by a programmer. It is like the size of a data type for example 32 bits to an integer). There are many levels in computer architecture which can be classified into the highest level to the lowest level. User runs the program at the highest level while the transistors and wires are available at the lowest level. Computer organization deals with structural relationships that are not visible to the programmer which like clock frequency or the size of the physical memory.

1.1 SOME DIFFERENT TYPES OF COMPUTER SYSTEMS

Let start with the identification of the computer systems. It can be classified into personal computer, workstation, minicomputer, mainframe and supercomputer. The performance of computers are measured by their speed and computing power.

1.1.1 PERSONAL COMPUTER

A personal computer is a small, relatively inexpensive computer. It is designed for an individual user for personal or office use. The architecture of the personal computer is based on the microprocessor technology that enables manufacturers to put an entire central processing unit on one chip. The systems are also linked together to form a network. The personal computer can be categorised into the high-end and low-end based on its power. The high-end models of the personal computer are manufactured by Macintosh while the low-end workstations are manufactured by Sun Microsystems, Hewlett-Packard, and Dell.

Figure 1.1: Personal Computer
(Source: https://www.tutorialspoint.com)

1.1.2 WORKSTATION

The workstation is a computer that mainly used for engineering applications (CAD/CAM), desktop publishing, software development, and other such types of applications. It is suitable to the applications that require a moderate amount of computing power and relatively high-quality graphics capabilities.

The workstations commonly come with a large, high-resolution graphics screen, large amount of Random-Access Memory (RAM), inbuilt network support, and a graphical user interface. Most workstations also have mass storage device such as a disk drive, but a special type of workstation, called diskless workstation, comes without a disk drive.

The common operating systems for workstations are UNIX and Windows NT. Workstations are single-user computers like Personal Computer (PC) but are typically linked together to form a local-area network, although they can also be used as stand-alone systems.

Figure 1.2: Workstation
(Source: https://www.tutorialspoint.com)

1.1.3 MINICOMPUTER

It is a midsize multi-processing system capable of supporting up to 250 users simultaneously.

Figure 1.3: Minicomputer
(Source: https://www.tutorialspoint.com)

1.1.4 MAINFRAME

Mainframe is very large in size and is an expensive computer capable of supporting hundreds or even thousands of users simultaneously. Mainframe executes many programs concurrently and supports many simultaneous executions of programs.

Figure 1.4: Mainframe
(Source: https://www.tutorialspoint.com)

1.1.5 SUPERCOMPUTER

Supercomputers are one of the fastest computers currently available. Supercomputers are very expensive and are employed for specialized applications that require immense amount of mathematical calculations (number crunching).

For example, weather forecasting, scientific simulations, (animated) graphics, fluid dynamic calculations, nuclear energy research, electronic design, and analysis of geological data (e.g. in petrochemical prospecting).

Figure 1.5: Supercomputer
(Source: https://www.tutorialspoint.com)

SELF CHECK 1.1

1. Define FIVE (5) types of computer systems.
2. Explain the differences between mainframe and supercomputer.
3. Discuss how these computer systems can be implemented in the education field.

1.2 BASIC COMPONENTS OF A DIGITAL COMPUTER

1.2.1 CENTRAL PROCESSING UNIT (CPU) OPERATION

Next, lets identify the operation of CPU. The architecture is based on the Von Neumann Model which consists of input unit, central processing unit and output unit.

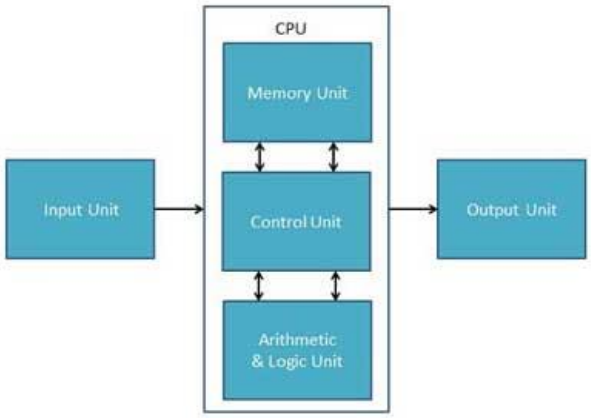

Figure 1.6: Component of Digital Computer System

1.2.2 INPUT UNIT

The input unit will accept the data into the computer from user through the input devices. This unit creates a link for interaction between the user and the computer. When the user enters the data, the input devices translate it into an understandable form by the computer. Then it will be sent to the central processing unit (CPU) for processing.

1.2.3 CENTRAL PROCESSING UNIT (CPU)

In computer system, CPU is considered as the brain of the computer. This is due to the CPU performs all types of data processing operations. The tasks that perform by CPU including data storage, intermediate results, and instructions (program). It also controls the operation of all components of the computer.

The CPU has three components:

- Arithmetic Logic Unit (ALU) – this unit performs the arithmetic and logic operations.
- Memory Unit – this unit stores the most frequently use instructions.
- Control Unit – this unit translates the instructions sent from the memory and control the operation of CPU and the computer.

1.2.4 OUTPUT UNIT

The output unit consists of devices with the help of which we get the information from the computer. This unit is a link between the computer and the users. Output devices translate the computer's output into a form understandable by the users.

SELF CHECK 1.2

1. List THREE (3) components of CPU.
2. Explain the function of ALU, memory unit and control unit.

1.3 EVOLUTION OF CENTRAL PROCESSING UNIT (CPU)

The system bus model is a refinement of the von Neumann model. It has a CPU (ALU and control unit), memory, and an input/output unit.

The system bus is a shared pathway that handled communication among components. It consists of the data bus, the address bus, and the control bus. There is also a power bus, and some architectures may also have a separate I/O bus. Figure 1.7 has shown the system bus model.

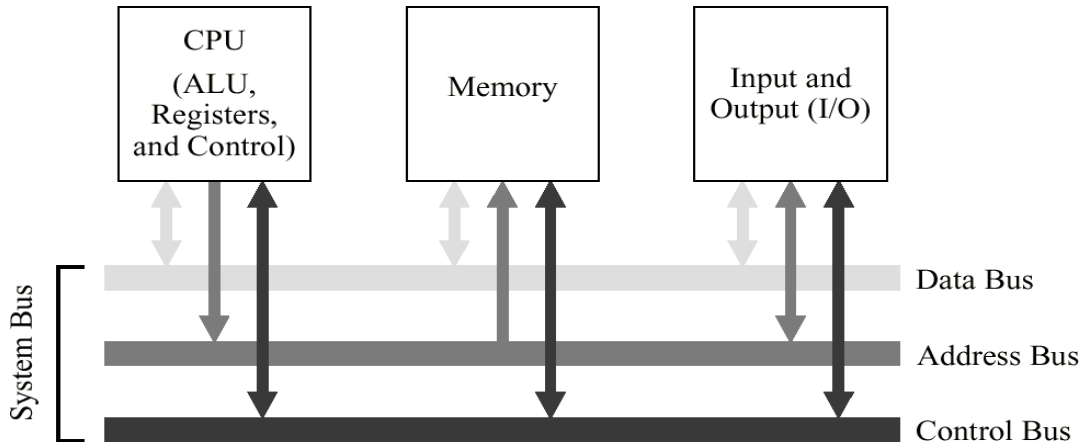

Figure 1.7: System Bus Model

SELF CHECK 1.3

1. What is system bus?
2. List THREE (2) types of system bus.

1.4 CENTRAL PROCESSING UNIT (CPU) OPERATION

Memory or Storage Unit

This unit can store instructions, data, and intermediate results. This unit supplies information to other units of the computer when needed. It is also known as internal storage unit or the main memory or the primary storage or Random-Access Memory (RAM).

Its size affects speed, power, and capability. Primary memory and secondary memory are two types of memories in the computer. Functions of the memory unit are −

- It stores all the data and the instructions required for processing.
- It stores intermediate results of processing.
- It stores the final results of processing before these results are released to an output device.
- All inputs and outputs are transmitted through the main memory.

Control Unit

This unit controls the operations of all parts of the computer but does not carry out any actual data processing operations.

Functions of this unit are −

- It is responsible for controlling the transfer of data and instructions among other units of a computer.
- It manages and coordinates all the units of the computer.
- It obtains the instructions from the memory, interprets them, and directs the operation of the computer.
- It communicates with Input/Output devices for transfer of data or results from storage.
- It does not process or store data.

ALU (Arithmetic Logic Unit)

This unit consists of two subsections namely,

- Arithmetic Section
- Logic Section

Arithmetic Section

Function of arithmetic section is to perform arithmetic operations like addition, subtraction, multiplication, and division. All complex operations are done by making repetitive use of the above operations.

Logic Section

Function of logic section is to perform logic operations such as comparing, selecting, matching, and merging of data.

1.5 PIPELINING

Pipelining is the process that use a pipeline to accumulate the instruction from the processor. It allows the instructions to be stored and executed in an order.

A pipeline is the continuous and somewhat overlapped movement of instruction to the processor or in the arithmetic steps taken by the processor to perform an instruction.

Without a pipeline, a computer processor gets the first instruction from memory, performs the operation it calls for, and then goes to get the next instruction from memory, and so forth. While fetching (getting) the instruction, the arithmetic part of the processor is idle.

SELF CHECK 1.5

1. What is pipelining?

1.6 SUPERSCALING

Superscaling is a process of implementation parallelism using superscalar processor. This process also known as instruction-level parallelism within a single processor. It allows more throughput at a given clock rate.

A superscalar processor can execute more than one instruction during a clock cycle by simultaneously dispatching multiple instructions to different execution units on the processor.

Each execution unit is not a separate processor (or a core if the processor is a multi-core processor), but an execution resource within a single CPU such as an arithmetic logic unit.

SELF CHECK 1.6

1. Describe TWO (2) functions of superscalar.

SUMMARY

In this topic you have learnt that:

Some different types of computer systems, basic components, basic components of a digital computer, Central Processing Unit (CPU) operation, evolution of Central Processing Unit (CPU), pipelining and super scaling.

KEY TERMS

Computer System	Set of integrated devices that input, output, process, and store data and information.
Digital Computer	Any of a class of devices capable of solving problems by processing information in discrete form. It operates on data, including magnitudes, letters, and symbols, that are expressed in binary code—i.e., using only the two digits 0 and 1.
Throughput	The number of instructions that can be executed in a unit of time

REFERENCES

Stallings, W., (2019). *Computer Organization and Architecture Designing for Performance*. 11th ed. New York: Pearson.