

# **COMPUTER ORGANIZATION AND ARCHITECTURE**

## **Lecture 1**

### **Introduction to Computer Organization and Architecture**

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## **INTRODUCTION**

This topic is an introduction to the world of computers. An introduction to computers, their components and the types of computers is explored in this topic. The topic will also review the uses of a computer and introduce the terms computer architecture and organization.

### **Learning objectives**

By the end of this topic, you should be able to:

1. Define the term computer and identify the basic functions
2. Identify and describe the various parts of computers
3. Categorize computers based on size and cost

## **OVERVIEW**

Why computers? Why are you learning Computer Science or Information Technology? Computers are all around us. We use them in our daily tasks, and it is up to us, you and me, to understand how a computer works, why it works the way it does and hopefully innovate and improve computers. Society has made incredible advancements due to computers. The world we currently live in would have been inconceivable fifty years ago.

Computers are found in every aspect of our lives. We use them to communicate, to entertain ourselves, to work, to exercise, to cook, to drive and many other tasks. Major advancements have been made in sectors such as education, manufacturing, banking, publishing, space, and oil exploration. Digital literacy is important. In your case, it goes beyond digital literacy. The aim being the innovator or scientist who ensures digital literacy is in the world over through innovative programs and hardware

## **INTRODUCTION TO COMPUTERS**

A computer is an electronic programmable device that accepts data, processes the data, outputs the information, and stores the information as well. A computer has four basic functions and an optional function. The functions include:

1. Input (accept data)
2. Processes (process data)
3. Output (show information)
4. Storage (store the information)

## 5. Communicate (talk with other computers)

Input is the action where a user inputs something into a computer. These could be instructions, some data or even information. Once a user goes through the action of input then it is up to the processor to process the information based on several instructions. The processed data would then be displayed, and these would be considered as output. The output can then be stored for future use as needed.

The fifth – communicate is considered an optional function as it is dependent on the presence of a network. On the other hand, a computer must be able to accept input, process and output the results and store the information to be regarded as a computer. Based on the basic functions of a computer, we come across a term: information processing cycle.

### Information Processing Cycle

The information processing cycle is defined [1] as the activities of a computer that involve input, process, output, and storage devices. While only the four basic functions used to be considered as the only components of the information cycle, communication has since been considered fundamental for the information processing cycle. Figure 1 shows a graphical representation of the information processing cycle.

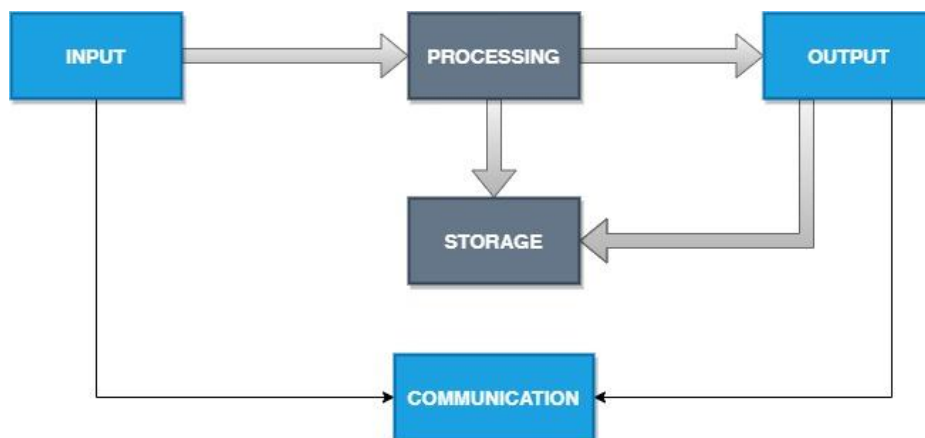


Figure 1: Information Processing Cycle

Two key terms we have just seen from the definition include data and information. We define and give examples in the next section.

### Data and Information

Computers will generally work with data and process it to produce information. Data can be defined as raw facts. Another definition is unprocessed information. Data on its own is meaningless or a better word would be vague and ambiguous. For example, the number 2012 could be many things including a year, number of people, number of shoes or phones in a store, even a movie (Yes! There is a movie called 2012). Basically, without any other information, 2012 could mean anything.

Information on the other hand is meaningful data or processed data. Information has been worked on and you can remove the vagueness. There is no confusing 2012 as being the amount of money one has assuming that the number was consistent with an account balance. For instance, if given the following sets of data:

LPM-12/02/2018

Jan

3.45

Proceed

The data is meaningless. However, if it was arranged in the form below then it becomes information, and we can see it as a students' (Jan) academic progression information based on their student number.

<b>Student Number</b>	<b>Name</b>	<b>GPA</b>	<b>Status</b>
LPM-12/02/2018	Jan	3.45	Proceed

## **COMPONENTS OF A COMPUTER**

A computer is made up of two main components. Hardware and Software. We shall discuss this further throughout the course. We do an overview of the two here.

### **Hardware**

These are the tangible parts of a computer. Hardware is normally categorized according to the five functions of a computer. Input hardware devices are those pieces of hardware that accept commands and data. Examples include the keyboard, mouse, touchscreen, and microphone.

Output hardware devices refer to those components that give out information. Examples include a monitor, printer, speaker, and projector.

Processing hardware is specific as it is used to convert data to information and to execute commands. There is one main processing software: Central Processing Unit (CPU). Some graphics displays have processing capabilities and have a Graphics Processing Unit (GPU).

Storage hardware devices are used to store information or even data for later retrieval. Examples include the USB disk, Hard disk, SD Card and DVD.

Finally, communication hardware refers to hardware that aids in the communication between computers. Examples include a modem, router, switch, and hub.

## **Software**

These refer to the instructions or commands that tell the computer what to do. Software is divided either into system software or application software.

System software is categorized into operating systems and utilities. The operating system is the main software that controls all the operations of the computer and acts as a link between the hardware, the user, and the rest of the software. Examples include Windows, Linux, Mac, Unix, Android, Blackberry and Symbian. Utilities on the other hand oversee ensuring that the machine runs at optimal levels. They act as the maintenance tools of the computer. Examples include the file manager, program manager and firewall.

Application software is designed with a specific function in mind. Application software or Apps will be installed using the program manager. Examples include Chrome, Word, VLC, Facebook App, WhatsApp, among others.

## **COMPUTER USES**

Computers have various uses from homes to offices to government offices. There are various uses of computers. Computers at home are used for various reasons. With the internet available on homes, users can research various topics, can watch movies online, can listen to online radio, play games among other activities. Users are also able to communicate with others using email or messages on applications like WhatsApp.

Computers in the office assist various organizations and businesses to run each of their operations. These organizations invest in computers and ensure that employees have the necessary skills to work on the systems and computers. Examples of users in the workforce include engineers, scientists, bankers, architects, civil servants, among others. The sectors that use computers include finance, government, healthcare, education, among others.

## **CATEGORIES OF COMPUTERS**

Computer types vary and are normally categorized based on their different functionality, size, and cost to an extent. There are six main categories which include embedded computers, mobile devices, personal computers, servers, mainframe computers and supercomputers [1].

### **Embedded Computers**

These are devices that are implanted (embedded) with a computer chip. Normally, these devices have a different function but when embedded with a computer chip the device gets improved functionality. A good example to demonstrate the embedded term is a television set. The main function of television is broadcasting programs and entertainment content. When a television gets a computer chip then it moves to become a smart tv. Some functions of a smart tv are the ability to go online, a user can visit different social media sites, stream movies online. Other examples of embedded computers include Smart Cars, Microwaves, Washing Machines, Smart Houses etc.

### **Mobile Computers**

These are small computers that typically fit in a hand. They are about 3 to 5 inches and have internet capability. Generally, most mobile phones that have internet capabilities are called smartphones and fall under this category. Additional devices that could be considered as mobile devices include smartwatches, portable game devices, media players and e-readers. Most of these devices can go online, streaming content, editing documents, taking pictures and many more activities. With wearable devices such as smartwatches, they can connect to the smartphone and alert one of incoming calls and messages, can track various body vitals etc.

### **Personal Computers**

Personal computers are generally created to be used by one person at a time. There are several categories of computers that are considered as personal computers (PCs) and these include desktop PCs, portable computers which include laptops and netbooks, tablets and finally thin clients.

### **Desktop**

A desktop is a machine that is designed to fit on a desk. A desktop comes with a separate display unit, keyboard, mouse, and system unit. Desktops are found in many organizations, schools, government offices etc. The desktops need to be connected to an external power supply continuously. They do not have any backup power supplies. Depending on the type of desktop, the system unit could either be placed horizontally or vertically (also called a tower). Some desktop computers (as shown in the image below) are what is termed as all-in-one which means that the system unit and the monitor are in one.

### **Laptop And Netbook**

A laptop is a computer that is designed to fit on a person's lap. A laptop has a backup power supply. Its main feature is that the system unit, keyboard, monitor and touchpad (mouse) is all found within one unit. Typically, the sizes range from 13 to 17 inches. A netbook is a smaller size laptop that has lower functionality than the laptop. A netbook will have lower specifications and will not be able to perform complex operations like video editing. Both devices are portable.

### **Tablet**

This is a touchscreen device that can be used for a variety of tasks. Tablets range from 7 to 10 inches. A tablet can either be used in horizontal or vertical mode. They are meant to be operated on with the use of a stylus however a finger works as well.

### **Thin Client**

A thin client is a device that needs to be connected to a network for it to access software, programs, and other resources. The device itself has minimal resources to allow its connection to a server. A thin client is ideal for applications where cost is an issue, and many users require the machines. One of the greatest benefits of thin clients after cost is the low maintenance and better security as the information is stored

online. An example of a thin client as shown is much smaller than the system unit next to it.

## **Servers**

A server is a computer that allows the sharing of resources. In the previous section, we discussed a type of computer called a thin client. It was indicated that the thin client accesses different resources from a central device. This device is a server. A server will allow for files to be retrieved from a central depository, will allow for users to share printing resources, and even access various software. A server is used in organizations and universities to ensure that employees can access various central stores of data and to share printers. Normally a server is larger than a desktop pc, however, the size will be determined by the number of resources that need to be accessed and the number of users accessing it.

## **Mainframe Computers**

A mainframe computer is larger than a server and allows more simultaneous connections than a server. Mainframes are found in large institutions like banks, government offices, corporations, and hospitals. A mainframe is larger and more expensive than a server. It also has higher specifications than a server making it more powerful. IBM is a leader in some of the most popular and fastest mainframes globally. Mainframes have been capable of processing 30,000 transactions per second without any performance issues or downtime. Other mainframes have been capable of transacting over 2 billion transactions in a day.

## **Super Computers**

A super-computer is a huge, powerful, and very expensive machine. Supercomputers are mainly used by institutions that require high processing capabilities such as space and oil exploration, meteorology, and mining. One super-computer will cost anywhere from a million dollars and upwards [1].

## **COMPUTER ARCHITECTURE AND ORGANIZATION**

According to [2], Computer architecture refers to any characteristics that can be seen by a programmer. Architecture is also considered as any that have a direct impact on the logical execution of a program [2]. On the other hand, computer organization refers to the units and connections that enable architectural plans. Throughout the unit, we will review both the organization and architecture of a computer.

## **SUMMARY**

This topic has covered a general overview of computers including the components that make up the computer, the categories of a computer and various uses of a computer. A brief introduction of computer architecture and organization was also introduced. The next chapter will be a focus on the history of computers, the evolution of the Intel processor and a glimpse at the future of computers.

## **DISCUSSION TOPIC**

With the rapid growth and changes brought about by technology, do you think the electronic calculator found in phones and computers, has destroyed the ability for people to perform simple arithmetic functions? Why or why not?

## **REFERENCES**

[1] G. Shelly and M. Vermaat, *Discovering Computers — Fundamentals: Your Interactive Guide to the Digital World*. Boston, MA: Course Technology, 2012.

[2] W. Stallings, *Computer Organization and Architecture Designing for Performance*. Hoboken, NJ: Pearson Education, Inc, 2016.