

# Study Unit 1

# Introduction to Digital Technology

## Introduction to Digital Technology Outline

- Overview of Computers
- Operating Systems
- Hardware & Software
- Digital Technologies
- The Internet
- Browsers, Search Engines, Emails
- Social Media
- Cloud Computing
- Cyber Security

## Study Session Duration

This Study Session requires a minimum of four (4) hours formal study time.

You may spend an additional 2-3 hours on revision.

## Preamble

Even though it is probably true that most literate people have at one time or the other used or encountered a computer in their everyday tasks, a lot of these users still misconstrue what exactly a computer is. Most times, people do imply or perceive that a computer is just a laptop or desktop, but a computer is much more than this. In this Study Session, you will get to know what exactly a computer is and what it entails.

With the increasing use of computers and new technologies emerging every day. Computers come with a bunch of digital tools and applications and it is expected that every user should be able to use these tools proficiently. This study unit covers the basic knowledge and skills expected of a beginner that is just starting to use computers for their everyday tasks.

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## Learning Outcomes of Study Unit 1

Upon completion of this study unit, you should be able to:

- 1.1 Describe and Classify Computers
- 1.2 Explain Operating System (OS) and what it does
- 1.3 Differentiate between Hardware and Software
- 1.4 Explain Digital Literacy and technologies involved
- 1.5 Use Basic Digital Tools like the Internet, Emails and Social Media
- 1.6 Mitigate and Prevent Cyber Threats using preventive measures.



## Terminologies, Acronyms and their Meaning

CPU	Central Processing Unit
CU	Control Unit
RAM	Random Access Memory
OS	Operating System
MB	Mega Byte
ML	Machine Learning

ALU	Arithmetic Logical Unit
AI	Artificial Intelligence
DT	Digital Technology
GB	Giga Byte
GDU	Graphics Display Unit

## 1.1 Overview of Computers

The word "*computer*" was first used in 1613 in the book "*The Yong Mans Gleanings*" by Richard Braithwaite and originally described a human who performed calculations or computations. The definition of a computer remained the same until the end of the 19th century, when the industrial revolution gave rise to machines whose primary purpose was calculating. Now, the term almost universally refers to automated electronic machinery.

### 1.1.1 Definitions of Computer

There are several definitions of computers. Let us look at three (3) of these definitions:

#### Box 1.1: Definitions of a Computer

*Definition 1: A Computer is an electronic device that can accept data as input, process data in order to generate the desired output using instructions (program).*

*Definition 2: A Computer is a device that accepts information (in the form of digitalized data) and manipulates it for some result based on a program, software, or sequence of instructions on how the data is to be processed.*

*Definition 3: A Computer is an electronic machine that processes information—in other words, an information processor: it takes in raw information (or data) at one end, stores it until it's ready to work on it, chews and crunches it for a bit, then spits out the results at the other end.*

In definitions 1, 2, 3 as well as any other definition you may find on Computers, there are 3 peculiar attributes that are included in all these definitions, these are:

- i. A Computer takes an input
- ii. A Computer process the data or information it receives as inputs
- iii. A Computer produces an output

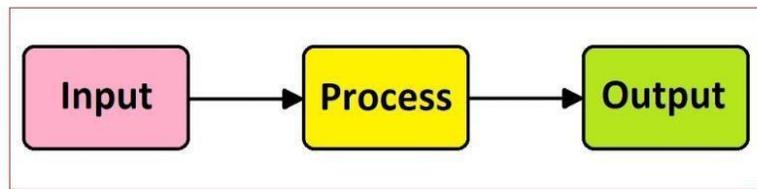


Figure 2.1: Peculiar Attributes of a Computer

### 1.1.2 Classifications of Computer

Computers have become a vital part of everyday life. It is almost inconceivable that you could spend a whole day without involving in at least one event that has not been influenced by a computer.

To a novice or an illiterate, perhaps the word ‘computer’ automatically conjures up the image of a personal computer sitting on a desk, but the truth is, there are many devices and appliances that we use every day unaware that they are actually computers. It is these types of computers that influence our lives the most.

Classification of computers can be based on:

- i. Size
- ii. Purpose
- iii. Data Handling or Applications
- iv. Age or Generation of Technology

#### (A) Classification based on Size

A computer can be categorized into 4 types based on size.

- a) Micro or Personal Computer (PC)
- b) Mini Computer
- c) Mainframe Computer
- d) Supercomputer

##### I. Micro or Personal Computer (PC)

A microcomputer is a small, relatively inexpensive computer with a microprocessor as its CPU. A Micro or Personal Computer contains a microprocessor, memory, and minimal I/O circuitry mounted on a single printed circuit board. In addition to the microprocessor, a PC also has a

keyboard for entering data, a monitor for displaying information, and a storage device for saving data. Examples include: Desktops, Laptops, Palmtop, Digital Diary, Notebook, PDAs, Tablets, Smartphones etc.

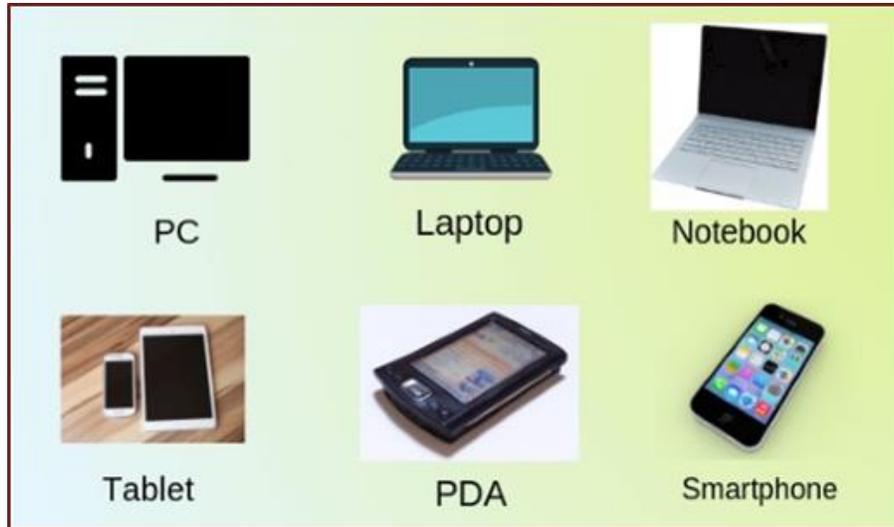


Figure 2.2: Examples of Micro Computers

## II. Mini Computer (MC)

Minicomputer is a multi-user computer capable of supporting from 10 to hundreds of users simultaneously. MC are outfitted with more than one CPU, making it faster than PC, but slower than mainframes and supercomputers. In size, MCs are smaller than mainframe and supercomputers but they cost considerably more than microcomputers and PCs

The major difference between Mini and Micro-computer is the numbers of users. With Mini computers, ten to hundreds of users can access the same resources and platform via terminals BUT microcomputer is a single user computer.

Mini Computers are also known as mid-range computers. Some of the Minicomputer intended activities includes:

- Switchboard control.
- Dedicated applications for graphics and computer design.
- Time-sharing, to allow multiple users to interact concurrently on a single system.
- Control and monitoring of manufacturing activities.
- Monitoring and control of laboratory equipment

### **III. Mainframes**

A mainframe is a large, expensive and powerful multi-user computer capable of supporting many hundreds or thousands of users simultaneously. Mainframes store huge amounts of data, instructions, and information. They execute many programs concurrently and supports much simultaneous execution of programs.

Most major corporations, government, banks use mainframes for business activities. With mainframes, enterprises are able to bill millions of customers, prepare payroll for thousands of employees, and manage thousands of items in inventory.

They are used in large organizations where thousands of clients have to access data simultaneously.

For examples:

- Performing ATM cash withdrawals and deposits.
- Business transactions that use credit cards or pre-paid cards.
- Online electronic transactions.
- Cloud storage.
- Handling of patient records in major hospitals.
- Making reservations and travel schedules for airline companies.
- Manipulation and tallying of data for census and electoral purposes.



Figure 2.3: Mainframes

#### **IV. Super Computers**

Supercomputers are extremely fast computers, which can execute hundreds of millions of instructions per second. They are the largest in size contrasted with every other classification of computers. These computers run various CPUs in parallel and work all the while. This procedure is called Parallel Processing.

Supercomputers are very expensive and are employed for specialized applications that require an 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 etc.



Figure 2.4: Supercomputers

#### **(B) Classification by Purpose**

There are two types of computers according to their purpose.

- i. General-Purpose Computers
- ii. Special-Purpose Computers

##### **General Purpose Computers**

Most computers in use today are General-Purpose computers. They are designed to perform a wide variety of functions and operations based on the programs running on them. Simply by using a general purpose computer and different software, various tasks can be accomplished, including

but not limited to writing and editing (word processing), manipulating facts in a database, tracking manufacturing inventory, making scientific calculations, controlling an organization's security system etc.

### **Special Purpose Computers**

A Special Purpose Computer is the type of computer designed to perform only one special task i.e. they are designed to solve one particular problem.

They are also known as dedicated computers, because they are dedicated to perform a single task over and over again. The program or instructions set is permanently stored in such a machine. It does its single task very quickly and it cannot be used for any other purpose

Examples include computers used in traffic lights control system, navigational system in an aircraft, weather forecasting, satellite launch / tracking, oil exploration etc.

## **(C) Classification by Data Handling or Signal Type**

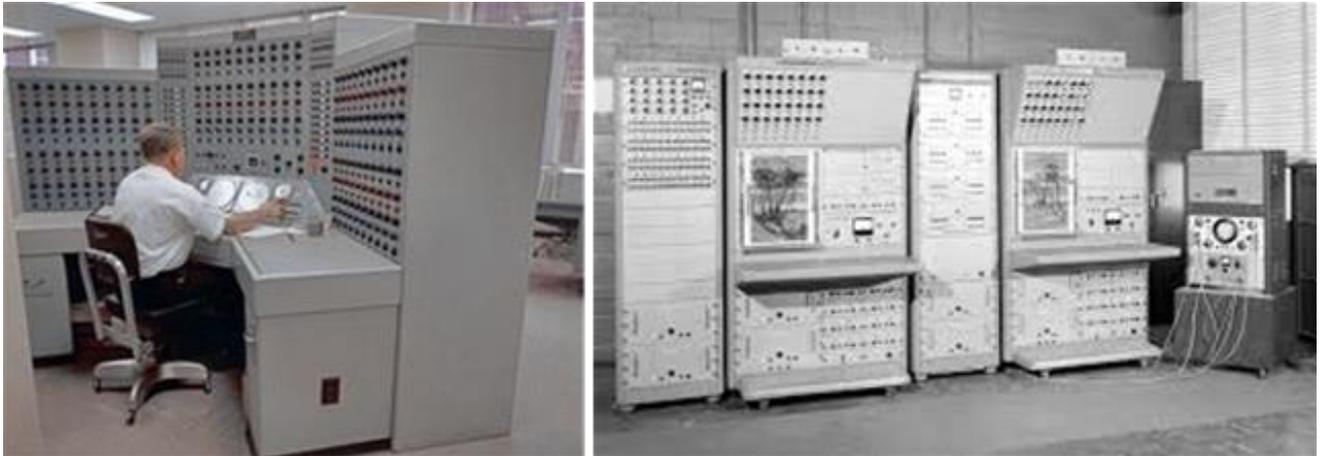
Based on type of data handled, a computer can be categorized into 3 types:

- i. Analog Computer
- ii. Digital Computer
- iii. Hybrid Computer

### **a) Analog Computer**

Analog Computers are the computers that are utilized to gauge physical units, for example, length, weight, temperature, voltage, speed, and so on and convert them into digits. These computers just do estimations, not computations.

Analog computers are now obsolete, however, during their time, they are used to process continuously varying data. This is because they provide a precise answer and not the ones that has been approximated to the nearest digit.



**Figure 2.5: Analog Computers**

### **b) Digital Computers**

Digital computers are computers that count digits. They are the computers you see around you today. These computers perform calculations and logical operations with quantities represented as digits, usually in the binary number system of “0” and “1”.

These category of computers are used to perform mathematical calculations, organize and analyze data, control industrial and other processes, simulate dynamic systems such as global weather patterns etc. Most computers of nowadays are Digital computers.



**Figure 2.6: Digital Computers**

### **Analog Vs. Digital Computers**

Let's take a look at the differences between Analog and Digital Computers

Analog Computers	Digital Computers
Are relatively old computers	Are of new age
Cannot be used for multipurpose and cannot multitask	Can be used for multipurpose work and can be multitasked
Analog computers use capacitors and resistors to perform an action/execute a command.	Digital computers use the microprocessors and other different computing chips like the Ram memory



Figure 2.7: Analog vs Digital Computer

### c) Hybrid Computer

A hybrid computer has the features of both analog computers and digital computers. It can accept analog signals, converts them to digital form and processes them. They are mainly found in specialized applications that need to process analog and digital information hybrid computers can process discrete and continuous data.

An example of a hybrid computer is the Intensive Care Unit (ICU) computers in hospitals. These devices use analog technology to measure temperature and blood pressure, and the data is then converted and shown in digital form on a small screen.



Figure 2.8: Hybrid Computers

### **(D) Classification by Age of Technology or Generation**

Based on age or generation, we have 5 generations of computers:

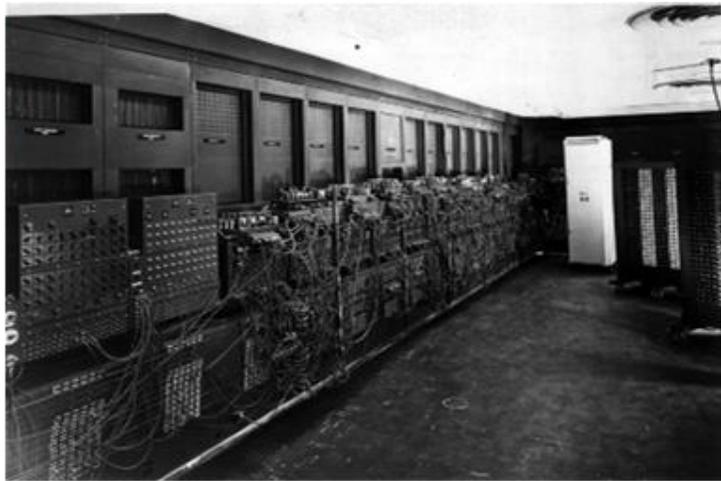
- i. First Generation (1940-1956) Vacuum Tubes and Plugboards
- ii. Second Generation (1956-1963) Transistors
- iii. Third Generation (1964-1971) Integrated Circuits
- iv. Fourth Generation (1971-Present) Microprocessors
- v. Fifth Generation – Artificial Intelligence based

#### **FIRST GENERATION COMPUTERS (1940-1956)**

First Generation Computers used Vacuum Tubes as Switching Device and Magnetic Drum for Memory. Because of the vacuum tubes, these computers consume a lot of electricity and thus, produce excessive heat. Also, because of the excessive heat produced by the tubes, the tubes get burned out a lot and need to be replaced more frequent. Thus, the operation cost is too expensive. The operating instructions or programs used in these types of computers were specifically built for the task for which computer was manufactured.



**Vacuum tubes used in the 1st generation computers**



**The popular first generation computers are - EDSAC (1949); EDVAC (1950) & UNIVAC I (1951)**

**Figure 2.9: First Generation Computers**

### **Features of 1st Generation Computers**

- Used vacuum tubes for circuitry
- Electron emitting metal in vacuum tubes burned out easily
- Used magnetic drums for memory
- Were huge, slow, expensive, and many times undependable
- Were expensive to operate
- Were power hungry
- Solved one problem at a time
- Generated a lot of heat which would make them malfunction
- Used input based on punched cards
- Had their outputs displayed in print outs
- Used magnetic tapes
- Used machine language
- Had limited primary memory
- Can be programmed only in machine language

## **2ND GENERATION COMPUTERS (1956-1963)**

Transistors replaced vacuum tubes in the second generation of computers. This generation of computers were better than their predecessors in terms of apparent small size, speed and cheaper cost. Transistors are more or less the building blocks of any microchip out there, and also, they are more reliable, energy efficient and capable of conducting electricity faster and better

### **Features of 2nd Generation Computers**

- Used transistors
- Faster and more reliable than first generation systems
- Slightly smaller, cheaper, faster
- Consumed less heat & consumed less electricity
- Still relied on punch cards and printouts for input/output
- Stored data in magnetic media (tapes & discs)
- Were still costly and needed air conditioning
- First Operating System was developed
- Programming done in Machine Language & Assembly Language

Some of the popular 2nd gen computers are: The UNIVAC LARC mainframe from Sperry Rand (1960) and IBM-7030 Stretch supercomputer (1961), and CDC 6600 mainframe (1963)



**UNIVAC I operator 's console**



**Univac I at Census Bureau with two operators ca. 1960**

**Figure 2.10: 2<sup>nd</sup> Generation Computer – UNIVAC I**

### **3<sup>RD</sup> GENERATION COMPUTERS (1964-1971)**

3rd generation computers used Integrated Circuit (IC) microchip instead of transistors. One IC is packed with a huge number of transistors, capacitors, diodes and rectifiers onto a single germanium or silicon. The manual interconnection of capacitors, diodes, and rectifiers in transistors was time-consuming & not completely reliable. IC solved the cumbersome procedures of designing a transistor circuitry. Invention of IC Chips (placing of multiple transistors on a single chip) made it possible to greatly reduce the size of computers with increased operation speed (nanoseconds), performance and reliability.

#### **Features of 3rd Generation Computers**

- Used ICs
- Used parallel processing
- Were slightly smaller, cheaper, faster
- Used motherboards
- Data was input using keyboards
- Simplified programming languages i.e. BASIC
- Reduce computational time from microseconds to nanoseconds
- Consumed less power & generated less heat. In some cases, air conditioning was still required.
- Output was visualized on the monitors
- Used Operating Systems, thus permitting multitasking



Figure 2.11: Third Generation Computers

## 4<sup>TH</sup> GENERATION COMPUTERS (1971-PRESENT)

The Microprocessor brought the fourth generation of computers, as thousands of integrated circuits were built on a single silicon chip. The birth of the microprocessor was at the same time the birth of the microcomputer. Computers of fourth generation used Very Large Scale Integrated (VLSI) circuits. VLSI circuits have about 5000 transistors or more and other circuit elements with their associated circuits on a single chip. Fourth generation computers are more powerful, compact, reliable, and affordable. As a result, it gave rise to Personal Computer (PC) revolution.

### Features of 4th Generation Computers

- VLSI technology used (MP), Heat reduced, No AC required
- Very cheap, thus computers became easily available and affordable
- Portable and reliable
- Concept of internet was introduced
- Pipeline processing and Fast processing power with less power consumption.
- Programmed with High-level languages like C, C++, DBASE etc.
- Graphical User Interface (GUI) Operating Systems
- Introduction of Mouse and GUI make computers more enjoyable.
- More powerful and reliable than all previous generations.



Figure 2.12: Fourth Generation Computer

### **1.1.3 Architecture of a Computer**

Computer Architecture is a specification describing how several unit including the hardware and software technologies interact to create a computer platform or system. When we think of the word architecture, we think of building a house or a building. Keeping that same principle in mind, computer architecture involves building a computer and all that goes into a computer system.

The Architecture of a Computer is composed of five basic units that help the computer to perform its operations, these are:

- i. Input Unit
- ii. Output Unit
- iii. Memory or Storage Unit
- iv. Arithmetic Logic Unit
- v. Control Unit

#### **Input Unit**

Input unit connects the external environment with internal computer system. It provides data and instructions to the computer system. Commonly used input devices are keyboard, mouse, magnetic tape etc.

Input unit performs following tasks:

- Accept the data and instructions from the outside environment.
- Convert it into machine language.
- Supply the converted data to computer system.

#### **Output Unit**

It connects the internal system of a computer to the external environment. It provides the results of any computation, or instructions to the outside world. Some output devices are printers, monitor etc.

## **Memory or Storage Unit**

This unit holds the data and instructions. It also stores the intermediate results before these are sent to the output devices. It also stores the data for later use.

The storage unit of a computer system can be divided into two categories:

**Primary Memory or Storage:** This memory is used to store the data which is being currently executed. It is used for temporary storage of data. The data is lost, when the computer is switched off. RAM is used as primary storage memory.

**Secondary Memory or Storage:** The secondary memory is slower and cheaper than primary memory. It is used for permanent storage of data. Commonly used secondary memory devices are hard disk, CD etc.

## **Arithmetic Logical Unit**

All the calculations are performed in ALU of the computer system. The ALU can perform basic operations such as addition, subtraction, division, multiplication etc. Whenever calculations are required, the control unit transfers the data from storage unit to ALU. When the operations are done, the result is transferred back to the storage unit.

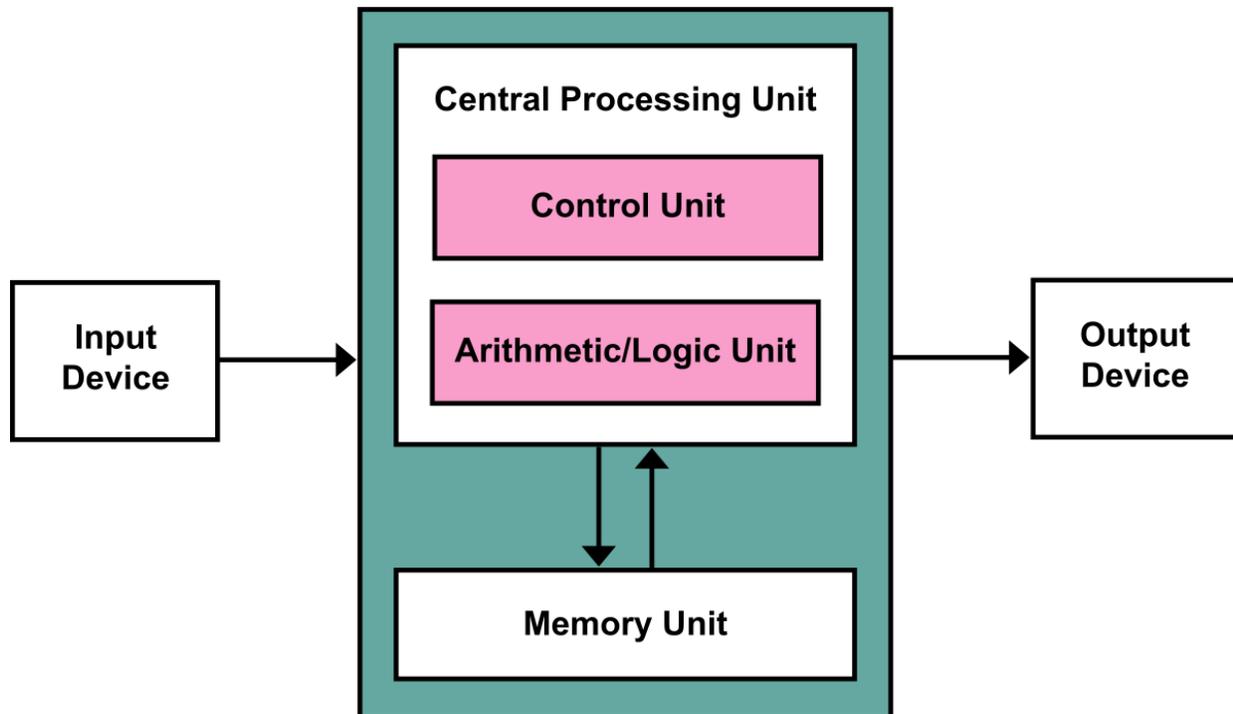
## **Control Unit**

It controls all other units of the computer. It controls the flow of data and instructions to and from the storage unit to ALU. Thus it is also known as central nervous system of the computer.

## **CPU**

It is Central Processing Unit of the computer. The control unit and ALU are together known as CPU. CPU is the brain of computer system. It performs following tasks:

- It performs all operations.
- It takes all decisions.
- It controls all the units of computer.



**Figure 2.13: Architecture of a Computer**

Computer architecture can be termed to be the organization of the components making up a computer system and the semantics or meaning of the operations that guide its function.



### **Peer to Peer Interaction**

**Have you have encountered an old computer before, probably 1<sup>st</sup> to 3<sup>rd</sup> generation?**

**If Yes, Describe the computer to your peers**

**Which peculiar old technology did you notice about that computer?**

### 1.1.4 Computer Programming Language and Numbering System

A computer can be programmed to do any function i.e. we can instruct a computer to do whatever we want it to do. However, a Computer **cannot** do anything without a **Program**.

#### Definition of a Computer Program

A Computer Program is a collection of instructions that can be executed by a computer to perform a specific task.

#### Low level languages

A low level language is a type of programming languages that contain basic instruction recognized by a computer. A low-level language may also be called a computer's native language. Example machine language, assembly language.

- **Machine language** - machine language is a low level language. It consists of entirely 1s and 0s. It is the only programming language that the computer understands directly without any translation.
- **Assembly language** - It is also a low level language. In assembly languages, programs are written in combination of mnemonic codes and binary codes. Assembly languages is easier to understand than machine languages.

#### High level languages

A high level language is a programming languages that enables a programmer to write program that are more or less independent of a particular type of computer. such languages are considering high level because they are closer to human languages and further from machine languages.

High-level languages are intended to be used by a human operator or the programmer. They are designed to be closer to humans than to computers. Their programming technique and framework is easier to grasp and execute than low-level languages, and the code as a whole generally concentrates on whichever specific program is being developed.

Most popular programming languages are regarded as high-level languages. Examples include:

C++	Java	Perl
C#	JavaScript	PHP
Cobol	Objective C	Python
Fortran	Pascal	Swift

### 1.1.5 Computer Number Systems

Number systems are the technique to represent numbers in the computer system architecture, every value that you are saving or getting into/from computer memory has a defined number system.

Computer architecture supports following number systems.

- i. Binary number system
- ii. Octal number system
- iii. Decimal number system
- iv. Hexadecimal (hex) number system

**Decimal Numbering Systems:** The decimal numbering system is a base 10 numbering system (this means there are 10 digits we can use - these digits are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9). When we talk about a number, we understand what the number is because of its face value and its positional value. Thus, the digit 5 has a different meaning when it is in the tens position than when it is in the ones position (i.e. when it is in the tens position, we express it as 50 and when it is in the ones position, we express it as 5). In this case, the face value of the digit is 5 and the positional value of a number is based on the position it occupies. In decimal, the positional value of a number is based on the powers of 10 (remember, we are in base 10):

5	7	2	4	Face value
$10^3$	$10^2$	$10^1$	$10^0$	Positional Value (powers of 10)
1000	100	10	1	Resolved positional value

To figure out the value of 5724, we do the following

$$\begin{aligned}
 5 \times 10^3 &= 5 \times 1000 = 5000 \\
 7 \times 10^2 &= 7 \times 100 = 700 \\
 2 \times 10^1 &= 2 \times 10 = 20
 \end{aligned}$$

$$4 \times 10^0 = 4 \times 1 = \frac{4}{5724}$$

Decimal number system is the number system we use in our day to day life

**Binary number system:** The binary numbering system works much the same way as the decimal numbering system except that now we are in base 2 so we only have 2 digits (0, 1). The value of the number is still determined by the face value times the positional value, but since we are in base 2, the positional values are the powers of 2. Since the face values can only be 0 or 1, this means that the 0 or 1 is multiplied by the positional place in which it is found.

*Example:* binary number  $1011011_2$

1	0	1	1	0	1	1	Face value
26	25	24	23	22	21	20	Positional value
64	32	16	8	4	2	1	Resolved positional value

The positional values are first shown in the powers of 2 and then as the resolved number - in other words, 2 to the 6th is equal to 64.

**Octal number system:** This number system contains eight digits (0-8) i.e. 0 1 2 3 4 5 6 7. Therefore, it has base 8, which means each position in octal number system represents the power of base 8 instead of 2 as in binary.

**Hexadecimal number system:** This number system consists of 16 digits (0-15). The first ten digits 0 1 2 3 4 5 6 7 8 9 are digits of decimal number system and rest six digits 10 11 12 13 14 15 are denoted by the characters A B C D E and F respectively.

## PRACTICE EXERCISES

### A. Converting binary to decimal:

In the previous example, to find the decimal equivalent for the number  $1011011_2$ , we do the following:

$$1 \times 2^6 = 1 \times 64 = 64$$

$$0 \times 2^5 = 0 \times 32 = 0$$

$$1 \times 2^4 = 1 \times 16 = 16$$

$$1 \times 2^3 = 1 \times 8 = 8$$

$$0 \times 2^2 = 0 \times 4 = 0$$

$$1 \times 2^1 = 1 \times 2 = 2$$

$$1 \times 2^0 = 1 \times 1 = \underline{1}$$

**91 or 91<sub>10</sub>**

### B. Converting decimal to binary:

Before doing this it is important that we review the decimal equivalent for the frequently used powers of 2:

$$2^0 = 1 \quad 2^1 = 2 \quad 2^2 = 4 \quad 2^3 = 8 \quad 2^4 = 16 \quad 2^5 = 32$$

$$2^6 = 64 \quad 2^7 = 128 \quad 2^8 = 256 \quad 2^9 = 512 \quad 2^{10} = 1024 \quad \text{etc.}$$

### 1.1.6 Applications and Use Cases of Computers

There are several functions and use cases of computers. Some of these are in:

Business	Marketing	Banking and Finance
Education	Science	Transport
Healthcare	Publishing	Navigation
Retail and Trade	Arts and Entertainment	Working from Home
Government	Communication	Military
Social	Security and Surveillance	Robotics
Booking Vacations	Weather Forecasting	

#### 1. Business

Almost every business uses computers nowadays. They are used to store and maintain accounts, manage projects, personnel records, track inventory, create presentations, reports, etc. They enable communication with individuals within and outside the business, using various technologies, including e-mail, social media and other resourceful tools. They can be used to promote the business and enable direct interaction with users or clients.

## **2. Education**

Computers can be used to give learners learning resources such as audio-visual packages, interactive exercises and activities, in the form of remote learning, including tutoring over the internet. Educational information can also be accessed from intranet and internet sources, or via e-books. Learners performance can also be maintained and monitored, including through the use of online proctored examinations, as well as to create capstone projects and assignments.

## **3. Healthcare**

For centuries, manual and paper based mode has been the most popular means of conducting activities in health institutions. However, hospitals and clinics are now employing the use of computers in their everyday tasks. Example of use cases is the use of digitized medical information, making it easier to store and access patient data, data analytics and experts systems to aid discovery of diagnoses, as well as search for risks of diseases. Computers used in healthcare include control lab equipment, blood pressure monitors, heart rate monitors, and other forms of automated ICU equipment. Likewise, with computers, doctors have greater access to information on the latest drugs, as well as the ability to share information on diseases with other medical specialists.

## **4. Retail and Trade**

Computers can be used to buy and sell products online - this enables sellers to reach a wider market with low overheads, and buyers to compare prices, read reviews, and choose delivery preferences. They can be used for direct trading and advertising too, using sites such as eBay, Craigslist, or local listings on social media or independent websites.

## **5. Marketing**

Computers enable marketing campaigns to be more precise through the analysis and manipulation of data. They facilitate the creation of websites and promotional materials. They can be used to generate social media campaigns. They enable direct communication with customers through email and online chat.

## **6. Communication**

Computers have made real-time communication over the internet easy, thanks to software and videoconferencing services such as Skype, Zoom etc. Families can connect with audio and video,

businesses can hold meetings between remote participants, and news organizations can interview people without the need for a film crew.

## 7. Security and Surveillance

Computers are increasingly being combined with other technologies to monitor people and goods. Computers combined with biometric passports make it harder for people to fraudulently enter a country or gain access to a passenger airplane. Face-recognition technology makes it easier to identify terrorists or criminals in public places.

## 8. Robotics

Robotics is an expanding area of technology which combines computers with science and engineering to produce machines that can either replace humans, or do specific jobs that humans are unable to do. One of the first uses of robotics was in manufacturing to build cars. Since then, robots have been developed to explore areas where conditions are too harsh for humans, to help law enforcement, to help the military, and to assist healthcare professionals.

### Tutor Marked Assignment I



- i. In your own words, what is a computer?*
- ii. CPU vs. Microprocessor. Are they the same?*  
*If Yes, Justify your response with facts.*  
*If No, what are the differences?*
- iii. What is the difference between a 32 bit Windows PC and a 64 bit Windows PC?*

## 1.2 Operating Systems

The Operating System (OS) can be considered as the most important program that runs on a computer. Every general-purpose computer must have an Operating System to provide a software platform on top of which other programs (the application software) can run. It is also the main control program of a computer that schedules tasks, manages storage, and handles communication with peripherals.

### Definition of Operating System

An Operating System (OS) can be defined as the application that serves as an interface between hardware and software while managing all system activities and resources.

#### 1.2.2 Parts of OS

An Operating System has four (4) main parts. These are:

- i. The Kernel
- ii. The Device Drivers
- iii. The User Interface
- iv. The System Utilities

#### The Kernel

The Kernel has the task of loading the applications into memory, making sure they do not interfere with one another and allowing them to share use of the CPU efficiently. The Kernel also handles file storage to and from secondary storage devices such as hard disks and optical drives.

In other words, the kernel handles:

- loading / unloading applications from memory
- scheduling tasks to run on the CPU
- memory management, file management
- data security

## **Device Drivers**

Every piece of hardware that makes up the computer or connected to it, will have a device driver that allows the operating system to control and communicate with it. there could be hundreds of device drivers pre-installed with the operating system, and the right ones for that particular computer set-up is loaded on boot-up.

The exact detail of which device driver is needed by the operating system is kept in a file - in Windows, the file is called the 'registry' and in Linux the details will be stored as a number of 'configuration files'.

Makers of printers, graphics tablets, scanners, digital cameras and so on, will normally provide device drivers for each make of operating system. a device driver for windows is different from the device driver for Linux.

This is why if you remove an Operating System such as windows from a hard disk, and install Linux instead, you will need to make sure you have all the correct device drivers available for each piece of hardware.

## **User Interface**

This part of the operating system is directing what you see on the screen (via the device driver) and reacting to your key presses and other inputs. the user interface could be a basic command line interface, as you might find on a server, or it might be a full blown Graphical User Interface (GUI) such as the MAC OS X, Windows or perhaps Gnome on Linux.

## **System Utilities**

This part of the operating system provides all the basic facilities that run in the background without user interaction. for example, print spool services, cryptographic password management, file management services, etc.

### **1.2.1 Examples of Operating Systems**

Operating systems usually come pre-loaded on any computer you buy. Laptops, tablets, and desktop computers all run operating systems that you've probably heard of. Most people use the operating system that comes with their computer, but it's possible to upgrade or even change

operating systems. The five most common operating systems for personal computers are *Microsoft Windows, MacOS (formerly OS X), Linux, Android OS and iPhone Operating System (IOS)*.

In addition to these popular OS, there are many other examples of OS. Others include, UNIX, Blackberry OS, Chrome OS etc.

Modern operating systems use a graphical user interface, or GUI which lets you use your mouse to click icons, buttons, and menus, and everything is clearly displayed on the screen using a combination of graphics and text.

Servers, like those that host the websites you visit or serve the videos you watch, typically run specialized operating systems, designed and optimized to run the special software required to make them do what they do. Some examples include Windows Server, Linux, and FreeBSD.

### **1.2.3 Functions of OS**

A Computer has many resources (hardware and software), which may be require to complete a task. The commonly required resources are input/output devices, memory, file storage space, CPU etc. The operating system acts as a manager of the above resources and allocates them to specific programs and users as necessary for their task. Therefore, operating system is the resource manager i.e. it can manage the resource of a computer system internally. the resources are processor, memory, files, and i/o devices.

Some of the major functions of an O.S are:

#### **Program Execution**

The Operating System is responsible for execution of all types of programs whether it be user programs or system programs. The Operating System utilises various resources available for the efficient running of all types of functionalities

#### **Security**

The operating system uses password protection to protect user data and similar other techniques. it also prevents unauthorized access to programs and user data.

### **Control over system performance**

Monitors overall system health to help improve performance. records the response time between service requests and system response to have a complete view of the system health. This can help improve performance by providing important information needed to troubleshoot problems.

### **Job accounting**

Operating system Keeps track of time and resources used by various tasks and users, this information can be used to track resource usage for a particular user or group of user.

### **Error handling and detection**

Operating system constantly monitors the system to detect errors and avoid the malfunctioning of computer system.

### **Coordination between other software and users**

Operating systems also coordinate and assign interpreters, compilers, assemblers and other software to the various users of the computer systems.

### **Memory Management**

The operating system manages the Primary Memory or Main Memory. Main memory is made up of a large array of bytes or words where each byte or word is assigned a certain address.

### **Process Management**

In a multi programming environment, the OS decides the order in which processes have access to the processor, and how much processing time each process has. This function of OS is called process scheduling. An Operating System performs the following activities for processor management.

- Keeps tracks of the status of processes. The program which perform this task is known as traffic controller.
- Allocates the CPU that is processor to a process.
- De-allocates processor when a process is no more required.

## Device Management

An OS manages device communication via their respective drivers. It performs the following activities for device management. Keeps tracks of all devices connected to system. designates a program responsible for every device known as the Input/output controller. Decides which process gets access to a certain device and for how long. Allocates devices in an effective and efficient way. Deallocates devices when they are no longer required.

## File Management

A file system is organized into directories for efficient or easy navigation and usage. These directories may contain other directories and other files. An Operating System carries out the following file management activities. It keeps track of where information is stored, user access settings and status of every file and more... These facilities are collectively known as the file system.



## Recommended Further Reading

For additional reading material on O.S, you can obtain more details via this link.

<https://edu.gcfglobal.org/en/computerbasics/understanding-operating-systems/1/>



## Peer to Peer Interaction

*Visit the LMS, locate forum activity and participate in the discussion*

**Beyond the above listed applications and use cases of Computers, from your own perspective, what are the other areas or sectors that you think computers are useful or might be useful in the future?**

## 1.3 Hardware and Software

### 1.3.1 Hardware

Hardware refers to the physical components of a computer that a human can see and touch. Computer hardware devices are classified into four different categories such as:

- a) Input Devices
- b) Processing Devices
- c) Output Devices
- d) Memory/Storage Devices

#### A. Input Devices

These are devices or components mostly used to input or obtain data that are given by users for solving their problems. Data may enter an information system in a variety of ways, and the input device that is most appropriate will usually depend on the type of data being entered into the system, how frequently this is done, and who is responsible for the activity.

Examples of Input Devices are:

- **The Keyboard:** A lot of input happens by means of a keyboard. Usually, the information that is entered by means of a keyboard is displayed on the monitor.



ComputerHope.com

- **Pointing devices (e.g. computer mouse):** The now ubiquitous electronic mouse is an essential input device for use with any graphical user interface. It consists of a plastic molded housing, designed to fit snugly in the palm of the hand, with a small ball at its bottom. Moving the mouse across a flat surface will translate the movements into a rolling

action of the ball. This is translated into electronic signals that direct the corresponding movement of a cursor on the computer monitor. Buttons on the mouse can then be used to select icons or menu items, or the cursor can be used to trace drawings on the screen.

There are several devices that falls under the category of pointing devices such as Mouse, Trackball, Joystick, Pointing stick, Wii Remote, Finger tracking, Graphics tablet, Stylus etc.

In addition to Keyboard, Mouse and other pointing devices, there are so many other forms of input devices. These include but not limited to:

- Camera
- Microphones
- Scanners
- Touchscreens
- Optical Character Recognition (OCR) etc.



## B. Processing Devices

Processing is the most important function of a computer. The main function of processing devices is to get meaningful information from converted data with the help of various processing devices.

Processing device examples are:

- **Microprocessors:** Microprocessor is logically integrated chip that process all logical instructions, and produce the output.

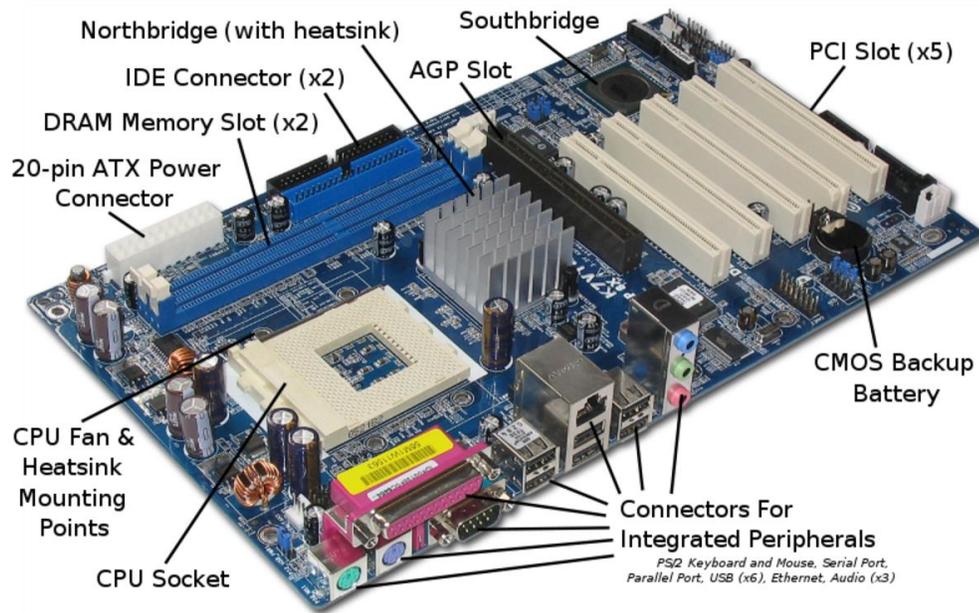


- **GPU:** Graphics processing unit is also a processor that is designed for rendering the videos and images with good quality.

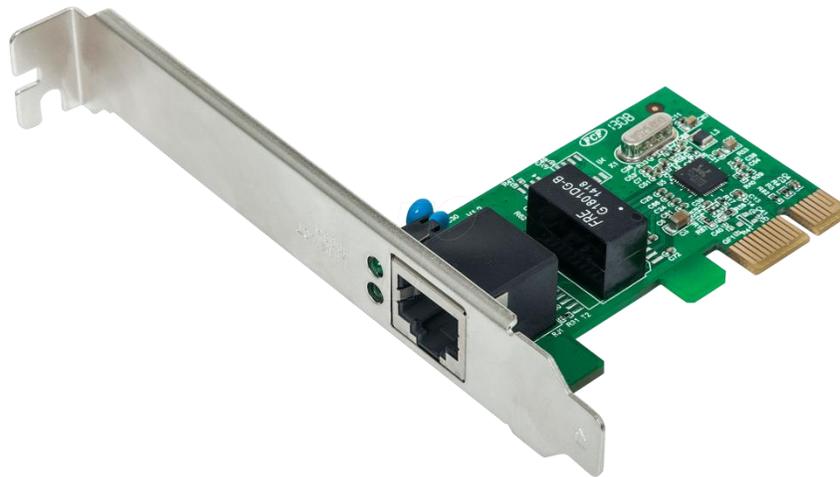


- **CPU:** With the help of the central processing unit, a computer can execute all instruction such as logically, arithmetically, and I/O operation which are given by users.

- **Mother board:** This is the heart of a computer, because all processor and other components are connected to the motherboard. Thus, there are several other components of a computer that is attached to the motherboard.



- **Network Card:** Network card help to connect multiple computer and other devices of computer.



- **Sound Card:** Execute the voice instructions and arise the output in the sound form.



- **Video Card:** Used to process the all video instructions, and yield the good quality video.



### **C. Storage Devices**

Storage Devices are alternatively referred to as digital storage, storage, storage media, or storage medium/ These are the hardware capable of holding information either temporarily or permanently. There are two types of storage devices used with computers: a primary storage device, such as RAM, and a secondary storage device, such as a hard drive. Secondary storage can be removable, internal, or external.

## **Magnetic storage devices**

Today, magnetic storage is one of the most common types of storage used with computers. This technology is found mostly on extremely large HDDs or hybrid hard drives.



Some of the Magnetic Storage Devices we have are:

- Floppy diskette
- Hard drive
- Magnetic strip
- SuperDisk
- Tape cassette
- Zip diskette

### **Hard Disk Drive**

A hard disk drive (also known as a hard drive, HD, or HDD) can be found installed in almost every desktop computer and laptop. Hard disk drives are non-volatile magnetic storage devices capable of remembering vast amounts of data. It stores files for the operating system and software programs, as well as user documents, such as photographs, text files, videos, and audio.

<https://www.computerscience.gcse.guru/theory/storage-devices#hard-disk-drive>



### Optical storage devices

Another common type of storage is optical storage, which uses lasers and lights as its method of reading and writing data.

- Blu-ray disc
- CD-ROM disc
- CD-R and CD-RW disc.
- DVD-R, DVD+R, DVD-RW, and DVD+RW disc.



### Flash memory devices

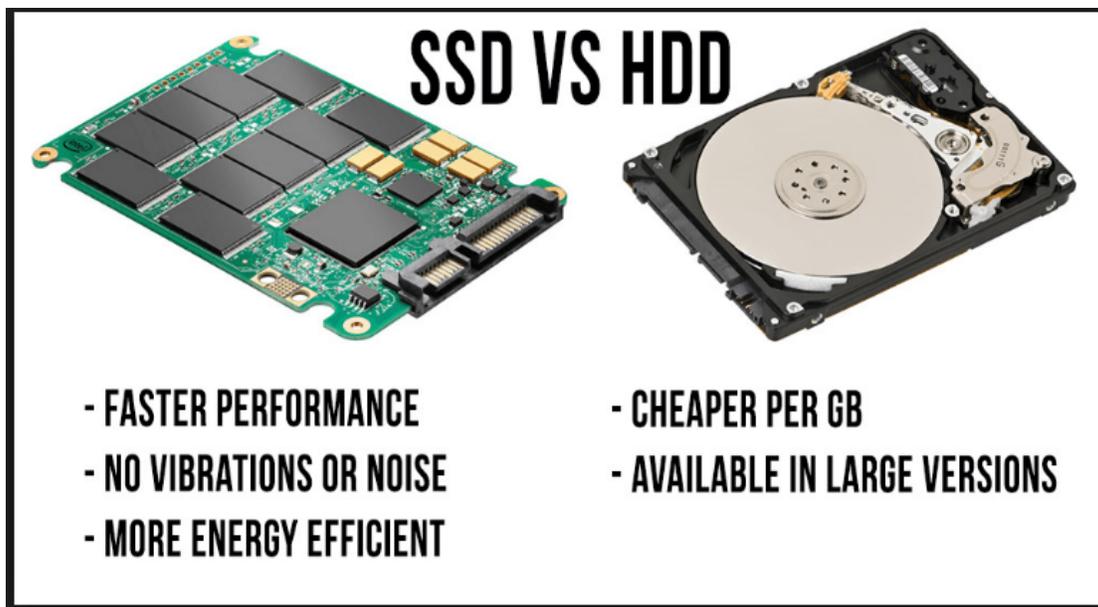
Flash memory has replaced most magnetic and optical media as it becomes cheaper because it is the more efficient and reliable solution.

- USB flash drive, jump drive, or thumb drive.
- CF (CompactFlash)
- M.2, Memory card
- MMC
- SDHC Card
- SmartMedia Card
- Sony Memory Stick
- SD card
- SSD



## Various Types of Memory Cards

 <p>SM Card</p>	 <p>SD Card</p>	 <p>CF Card</p>
 <p>xD card</p>	 <p>Memory Stick</p>	 <p>Microdrive</p>



For more details on Memory or storage devices visit this url

<https://www.computerscience.gcse.guru/theory/storage-devices>

#### D. Output Devices

Output devices are peripherals that receive or display output from a computer. They are used to communicate the results of data that has processed by the computer to the user.

Examples of Output Device

- Monitor
- Printer

- Speakers
- Headphones/Headsets etc.
- Projector

## Monitor

They are the device which displays computer output. It is capable of displaying video and graphics information generated by the computer through the video card. Monitors are very similar to televisions but usually display information at a much higher resolution.

### *Types of Monitor*

- *Cathode Ray Tube (CRT)*
- *Liquid Crystal Display (LCD)*
- *Light-emitting Diode (LED)*



**LCD**



**CRT**



**LED**

## Printer

Printer is an external hardware device responsible for taking computer data and generating a hard copy of that data. Printers are one of the most used peripherals on computers and are commonly used to print text, images, and photos.



### Speakers

A hardware device connected to a computer's sound card that outputs sounds generated by the computer. Speakers can be used for various sounds meant to alert the user, as well as music and spoken text. Speakers are of different purposes, the choice of which type to be used is dependent on purpose, budget and specification requirements.



### Plotter

The plotter is a computer printer for printing vector graphics. Plotters are used in applications such as computer aided design such as diagrams, layouts, specification sheets and banners. The plotter is capable of producing color drawings in a matter of minutes.



## Projectors

A projector is an output device that takes images generated by a computer and reproduces them by projecting it onto a screen, wall, or another surface. In most cases, the surface projected onto is large, flat, and lightly colored. For example, you could use a projector to show a presentation on a large screen so that everyone in the room can see it. Projectors can produce either still (slides) or moving images (videos). A projector is often about the size of a toaster and weighs only a few pounds.



### 1.3.2 Recognizing the Specification of a Computer

Imagine you are tasked with purchasing or recommending a laptop or desktop for your company to purchase. Will you just pick any laptop that you see in a store? Will just any laptop work just fine? Why will you pick a brand over another brand? Or a specification over the other? All of these questions can be answered considering the purpose or what the user intends using the PC for. What if the PC is already available, you also need to be able to check the specifications of the PC and decide if it is adequate or not.

Sometimes checking the hardware specification of a computer is necessary, especially when the process to be performed on the PC is hardware dependent or when you need to purchase a new computer for a specific purpose. To view the specification of the hardware of a computer, you need to have administrative access to such computer.

Hardware Specifications you can check include

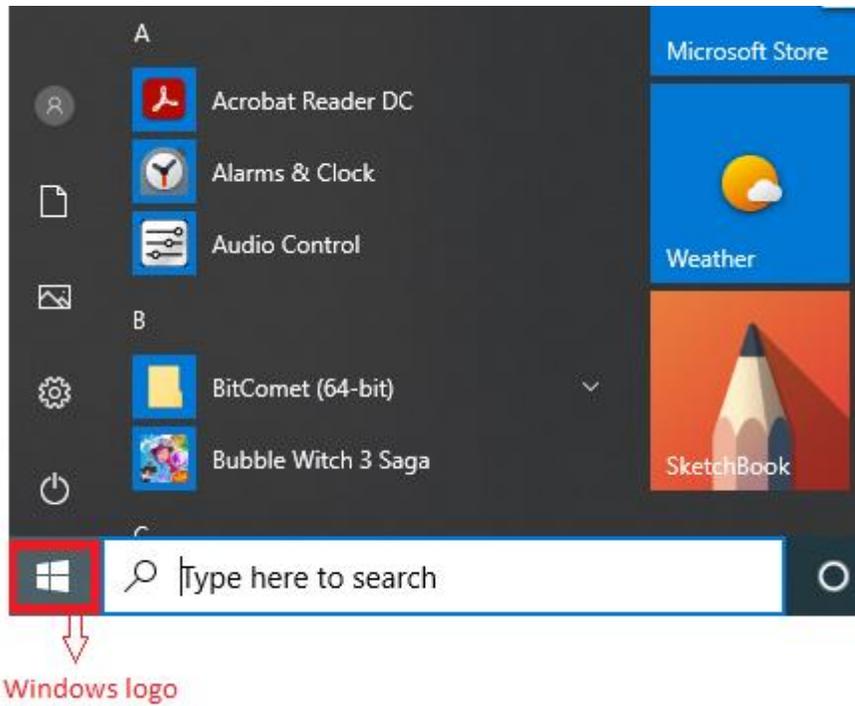
- Primary Memory (RAM)
- Secondary Memory or Storage Drive (HDD or SSD)
- Processor
- Graphics Card
- Network Card
- Screen Resolution

You can also check the brand, Operating System and other details of a PC.

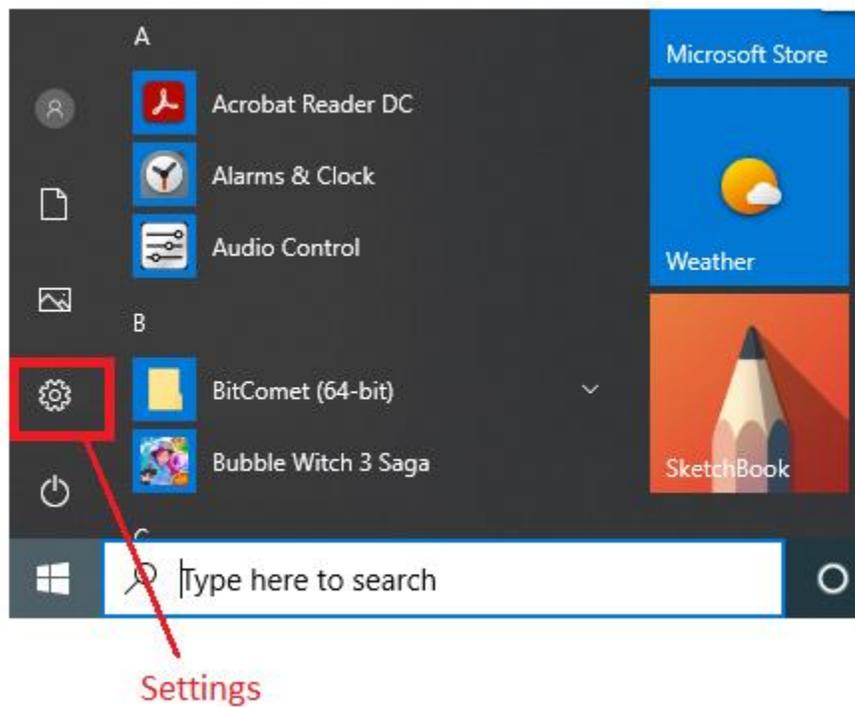
#### Method 1:

The Simplest way to do all these is to follow the steps as listed thus:

**Step 1:** Click the Start or Windows logo in the bottom-left corner of the screen. It can also be found on the keyboard. Once clicked, the Start menu will pop up.



**Step 2:** Open Settings Image by clicking the gear-shaped icon in the bottom-left corner of the Start menu. This will open the Settings window.



**Step 3:** Click System

**Step 4:** Click About: It's in the lower-left corner of the window, though you may have to place your cursor on the left-hand sidebar and scroll down to see it.

## Device specifications

Device name	DESKTOP-STUDIO2
Processor	Intel(R) Core(TM) i3-8130U CPU @ 2.20GHz 2.21 GHz
Installed RAM	8.00 GB (7.86 GB usable)
Device ID	C39DCAEF-3CEE-4A3E-821C-13D6DB28C52C
Product ID	00330-80000-00000-AA333
System type	64-bit operating system, x64-based processor
Pen and touch	No pen or touch input is available for this display

Rename this PC

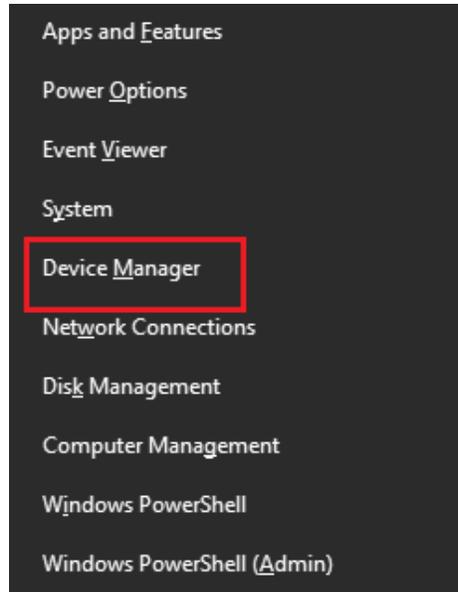
**Step 5:** View all Specifications of hardware and the Operating System to under the Windows Specification

## Windows specifications

Edition	Windows 10 Pro
Version	1909
Installed on	12/2/2019
OS build	18363.1256

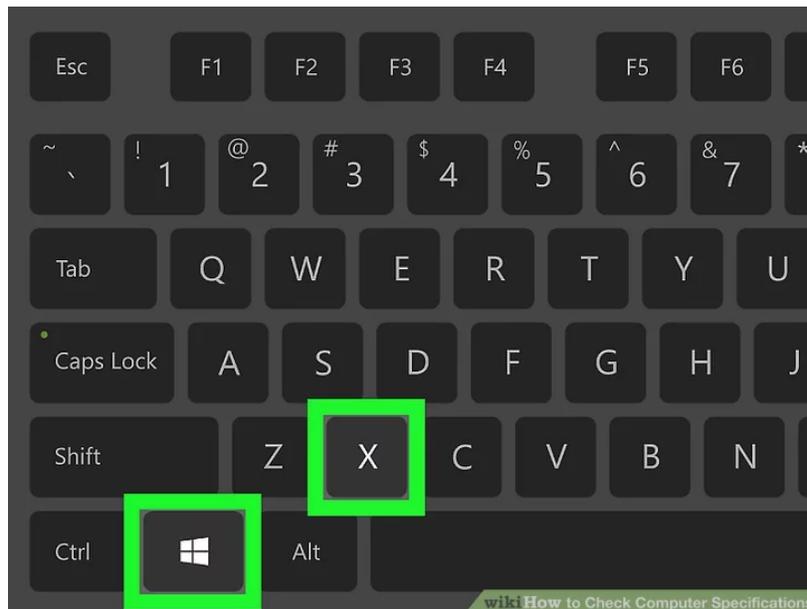
**Method 2:** Using Device Manager to check hardware and System properties for the OS. If you want an advanced, in-depth list of all of the hardware that your computer uses, you can use Device Manager. This is useful when attempting to find out what type of proprietary hardware your computer uses.

- a. To Launch Device Manager, Open the advanced Start menu. Either right-click the Start with Windows logo in the bottom-left corner of the screen, type windows manager and Press Enter.



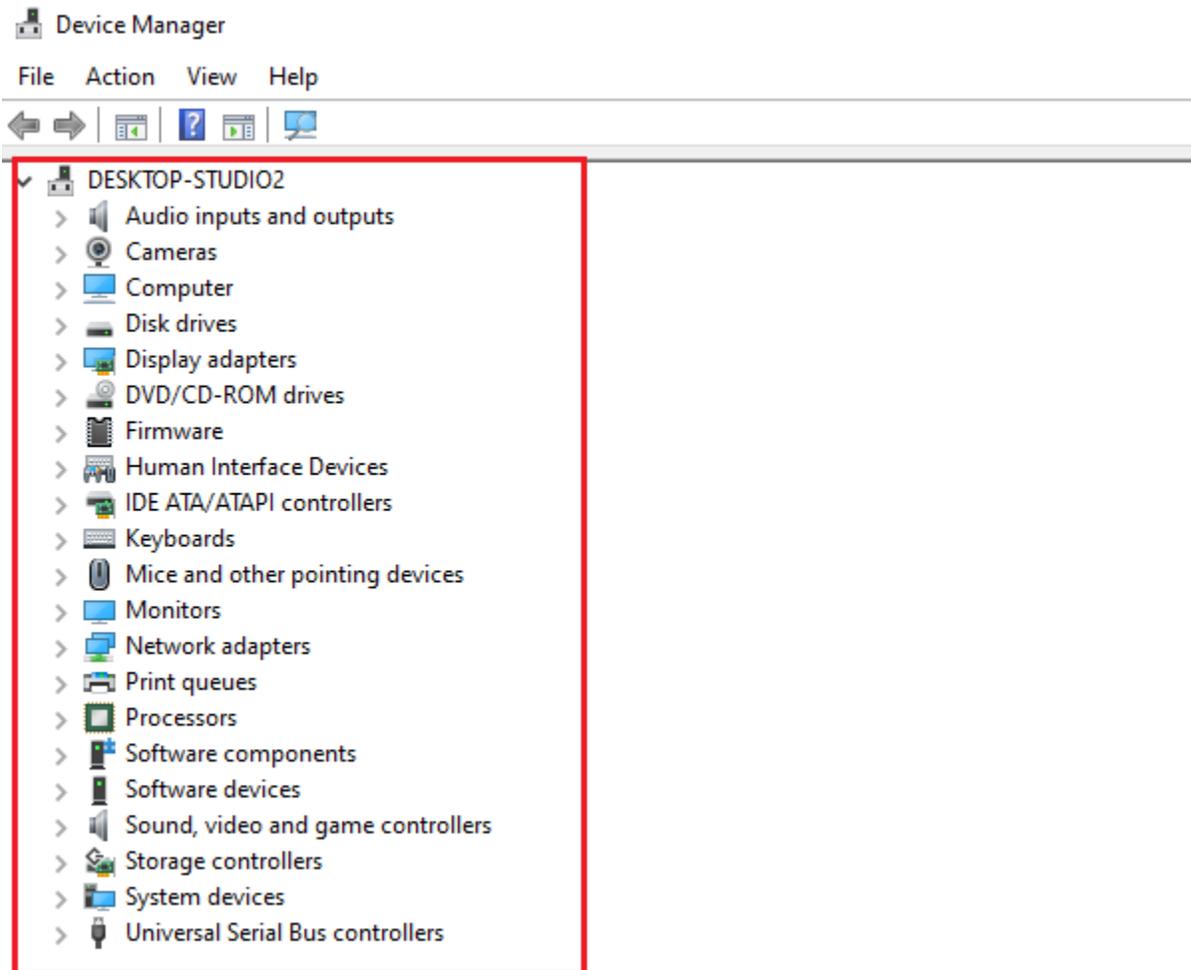
OR

Press Windows key + X simultaneously, you should see a pop-up menu appear on the left side of the screen.



Source” (<https://www.wikihow.com/Check-Computer-Specifications>)

Once launched, device manager looks like the image below.

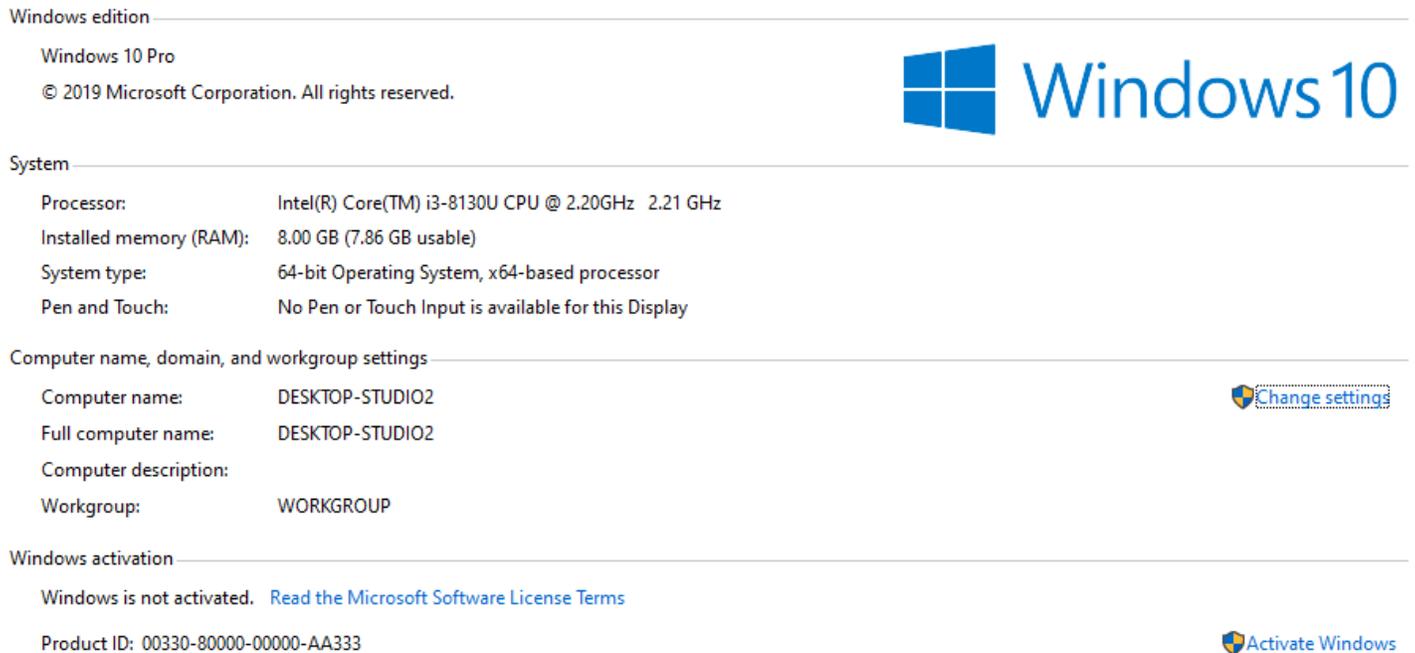


Find a hardware category to review. Scroll through the different categories of hardware until you find one that you want to open. For example, if you wanted to find out more about your computer's processor, you would double-click the Processors heading. Depending on who built your computer (brand), what you see in Device Manager may vary slightly.

- b. To check the Operating system, open the System Properties window. Either of the following two methods will allow you to access it:
  - Press the [Windows] + [R] keys simultaneously to open the Run prompt. Type control system in the box and then press [Enter].

- Open “My Computer”, locate System Properties at the top left corner, and click on it. The System Properties window will look something like the image below.

### View basic information about your computer



The screenshot shows the Windows System Information window. It is divided into several sections: Windows edition, System, Computer name, domain, and workgroup settings, and Windows activation. The Windows edition section shows Windows 10 Pro. The System section lists the processor as Intel(R) Core(TM) i3-8130U CPU @ 2.20GHz 2.21 GHz, installed memory (RAM) as 8.00 GB (7.86 GB usable), system type as 64-bit Operating System, x64-based processor, and pen and touch as No Pen or Touch Input is available for this Display. The Computer name, domain, and workgroup settings section shows the computer name as DESKTOP-STUDIO2, full computer name as DESKTOP-STUDIO2, computer description as empty, and workgroup as WORKGROUP. The Windows activation section shows that Windows is not activated and provides a link to read the Microsoft Software License Terms. The product ID is 00330-80000-00000-AA333. There are also links to change settings and activate Windows.

Windows edition

Windows 10 Pro  
© 2019 Microsoft Corporation. All rights reserved.

System

Processor: Intel(R) Core(TM) i3-8130U CPU @ 2.20GHz 2.21 GHz  
Installed memory (RAM): 8.00 GB (7.86 GB usable)  
System type: 64-bit Operating System, x64-based processor  
Pen and Touch: No Pen or Touch Input is available for this Display

Computer name, domain, and workgroup settings

Computer name: DESKTOP-STUDIO2 [Change settings](#)  
Full computer name: DESKTOP-STUDIO2  
Computer description:  
Workgroup: WORKGROUP

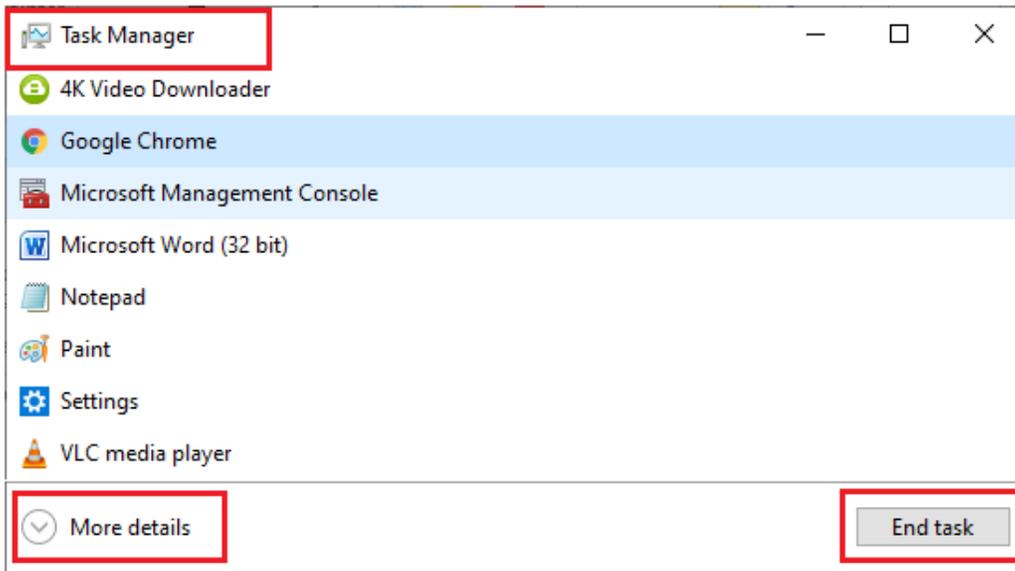
Windows activation

Windows is not activated. [Read the Microsoft Software License Terms](#)  
Product ID: 00330-80000-00000-AA333 [Activate Windows](#)

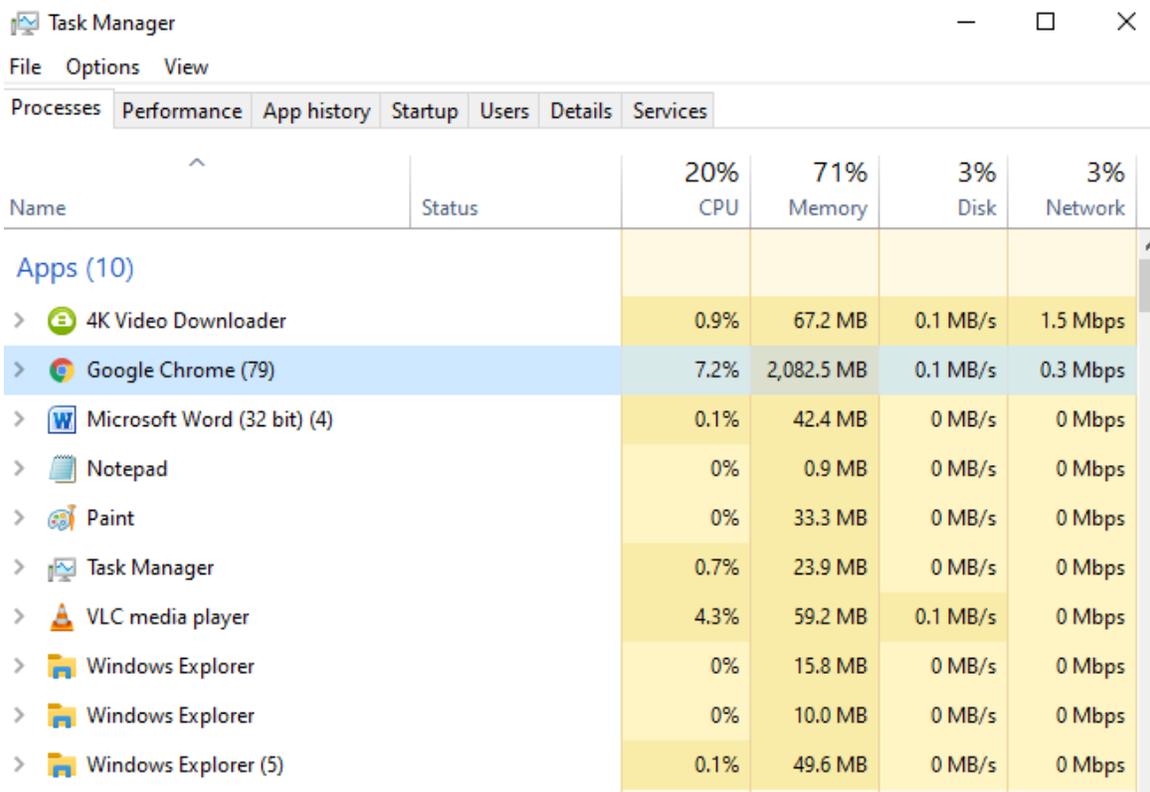
### Using Task Manager

Sometimes your PC might be misbehaving, screen freeze or have some minor issues, and you can resolve these issues by using the task manager. This feature allows user to be able to end processes, check processor activities and so many more.

To launch task manager, press **Ctrl + Alt + Delete**



- To stop any responding application, locate such app by click on it and then click **end Task**
- To view further details, click on **further details** to see performance, app history, startup and others



Name	Status	20% CPU	71% Memory	3% Disk	3% Network
<b>Apps (10)</b>					
> 4K Video Downloader		0.9%	67.2 MB	0.1 MB/s	1.5 Mbps
> Google Chrome (79)		7.2%	2,082.5 MB	0.1 MB/s	0.3 Mbps
> Microsoft Word (32 bit) (4)		0.1%	42.4 MB	0 MB/s	0 Mbps
> Notepad		0%	0.9 MB	0 MB/s	0 Mbps
> Paint		0%	33.3 MB	0 MB/s	0 Mbps
> Task Manager		0.7%	23.9 MB	0 MB/s	0 Mbps
> VLC media player		4.3%	59.2 MB	0.1 MB/s	0 Mbps
> Windows Explorer		0%	15.8 MB	0 MB/s	0 Mbps
> Windows Explorer		0%	10.0 MB	0 MB/s	0 Mbps
> Windows Explorer (5)		0.1%	49.6 MB	0 MB/s	0 Mbps

- To view the performance of the CPU, Memory, Network and other, click on the performance tab further details, click on **further details** to see performance, app history, startup and others

The screenshot shows the Windows Task Manager Performance tab. The 'Performance' tab is highlighted with a red box. The left sidebar shows various system components: CPU (6% utilization, 1.11 GHz), Memory (5.4/7.9 GB, 68%), Disk 0 (C:) (0%), Wi-Fi Direct (0 Kbps), Wi-Fi (0.1 Mbps Send, 1.3 Mbps Receive), and GPU 0 (0%). The main area displays the CPU performance for an Intel(R) Core(TM) i3-8130U CPU @ 2.20GHz. A line graph shows % Utilization over 60 seconds, with a peak at 100% and a current value of 6%. Below the graph, a table lists system specifications:

Utilization	Speed	Base speed:	2.21 GHz
6%	1.11 GHz	Sockets:	1
Processes	Threads	Cores:	2
243	2684	Logical processors:	4
Handles	100421	Virtualization:	Disabled
Up time	2:05:20:19	Hyper-V support:	Yes
		L1 cache:	128 KB
		L2 cache:	512 KB
		L3 cache:	4.0 MB

### **1.3.3 Software**

Software is a set of programs, which is designed to perform a well-defined function. A program is a sequence of instructions written to solve a particular problem.

There are two types of software:

- System Software
- Application Software

#### **System Software**

The system software is a collection of programs designed to operate, control, and extend the processing capabilities of the computer itself. System software is generally prepared by the computer manufacturers. These software products comprise programs written in low-level languages, which interact with the hardware at a very basic level. System software serves as the interface between the hardware and the end users.

Some examples of system software are:

- Operating System
- Compilers,
- Interpreter,
- Assemblers, etc.

#### **Application Software**

Application software products are designed to satisfy a particular need of a particular environment. All software applications prepared in the computer lab can come under the category of Application software.

Application software may consist of a single program, such as Microsoft's notepad for writing and editing a simple text. It may also consist of a collection of programs, often called a software package, which work together to accomplish a task, such as a spreadsheet package.

Examples of Application software are the following –

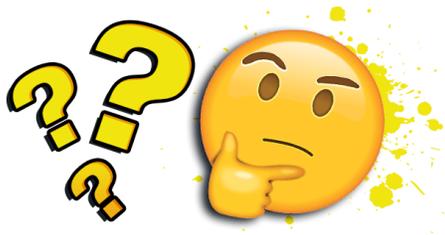
- Payroll Software
- Inventory Management Software

- Railways Reservation Software
- Microsoft Office Suite Software
- Microsoft Word
- Microsoft Excel
- Microsoft PowerPoint etc.

### **Open Source Software**

Open source software is a type of program that has been designed, developed, tested and improved through the collaboration of many program developers and community members. The software has open “source code” (the code that creates the program), allowing anyone to inspect, modify or enhance it in a way they see fit. Some of the software created, is comparable with premium paid versions. Open Source Software are free to use by anyone for any purpose.

For more details on the features, advantages and disadvantages of open source software, read the article on it via <https://www.thewahman.com/free-open-source-software/>



### **Study Unit 1 Quiz 1**

Attempt this Quiz before the deadline. It forms part of your Continuous Assessment

## **1.4 Digital Technology**

The word “*digital*” originates from the Latin word — “*digitus*” which means “*finger*” or “*toe*” in English. While the word started in the mid-17th century, being one of the oldest tools for counting, it has evolved from referring to digits, i.e., fingers, to numerical digits, entering the 20th century through the radio and recording technologies, then to the 1950s as the world of computers. It is probably true that most literate people, regardless of their level of qualification, have heard of or probably uttered the word “computer” at one time or the other.

The term “Digital technology” is a broad term, it serves as an umbrella term for computer-based products and solutions. Considering that nearly everything area of our lives and every sector of the world workforce relies on computers in one way or another it covers a lot of things.

Summarily, Digital Technology entails the use of digital devices that enable access to cyberspace, the use of digital audio/video and information communications technology (ICT) and

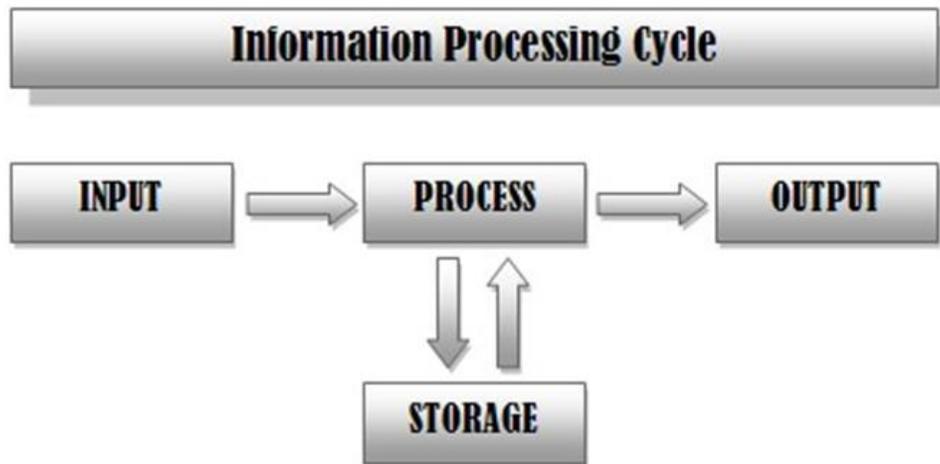
### **1.4.1 Digital Devices**

A digital device is an advanced electronic device that takes raw data as input from the user and processes these data under the control of a set of instructions (called program) and gives the result (output) and saves output for future use.

For a device to be a digital device or a digital computer, there are four (4) basic processes or features it must possess:

- i. accepts data - Input
- ii. processes data - Processing
- iii. produces output - Output
- iv. stores results – Stores results

These features or processes are sequential i.e. process 1 leads to process 2 which leads to process 3 and then process 4



### 1.4.2 The Impact of Digital Technologies - Why Digital Technology is Important for All

Technologies can help make our world fairer, more peaceful, and more just. Digital advances can support and accelerate achievement of each of the 17 Sustainable Development Goals (as proposed by United Nations & SDG) – from ending extreme poverty to reducing maternal and infant mortality, promoting sustainable farming and decent work, and achieving universal literacy. But technologies can also threaten privacy, erode security and fuel inequality. They have implications for human rights and human agency. Like generations before, we – governments, businesses and individuals – have a choice to make in how we harness and manage new technologies.

Some of the areas of human lives that digital technology will impact the most are:

#### 1. A Digital Future for All

Digital technologies have advanced more rapidly than any innovation in our history – reaching around 50 per cent of the developing world’s population in only two decades and transforming societies. By enhancing connectivity, financial inclusion, access to trade and public services, technology can be a great equalizer.

In the health sector, for instance, AI-enabled frontier technologies are helping to save lives, diagnose diseases and extend life expectancy. In education, virtual learning environments and distance learning (like this DISH project) have opened up programmes to students who would otherwise be excluded. However, those yet to be connected remain cut off from the benefits of this new era and remain further behind. Many of the people left behind are women, the elderly, and

persons with disabilities or from ethnic or linguistic minorities, indigenous groups and residents of poor or remote areas.

## **2. The Future of Work**

Throughout history, technological revolutions have changed the labour force: creating new forms and patterns of work, making others obsolete, and leading to wider societal changes. This current wave of change is likely to have profound impacts. For example, the International Labour Organization estimates that the shift to a greener economy could create 24 million new jobs globally by 2030 through the adoption of sustainable practices in the energy sector, the use of electric vehicles and increasing energy efficiency in existing and future buildings.

## **3. The Future of Data**

Today, digital technologies such as data pooling and AI are used to track and diagnose issues in agriculture, health, and the environment, or to perform daily tasks such as navigating traffic or paying a bill. They can be used to defend and exercise human rights – but they can also be used to violate them, for example, by monitoring our movements, purchases, conversations and behaviours. Governments and businesses increasingly have the tools to mine and exploit data for financial and other purposes.

## **4. The Future of Social Interactions and Entertainment**

Social media connects almost half of the entire global population. It enables people to make their voices heard and to talk to people across the world in real time. However, it can also reinforce prejudices and sow discord, by giving hate speech and misinformation a platform, or by amplifying echo chambers. In this way, social media algorithms can fuel the fragmentation of societies around the world. And yet they also have the potential to do the opposite.

As technology advances, new virtual fun entertainment will be developed, ranging from the use of Augmented Reality, Virtual Reality, Robotics, and many other technologies we might not even have conceived yet.

## 5. The Future of Cyberspace

How to manage these developments is the subject of much discussion – nationally and internationally – at a time when geopolitical tensions are on the rise. The UN Secretary-General has warned of a ‘great fracture’ between world powers, each with their own internet and AI strategy, as well as dominant currency, trade and financial rules and contradictory geopolitical and military views. Such a divide could establish a digital Berlin Wall. Increasingly, digital cooperation between states – and a universal cyberspace that reflects global standards for peace and security, human rights and sustainable development – is seen as crucial to ensuring a united world. A ‘global commitment for digital cooperation’ is a key recommendation by the Secretary-General’s High-level Panel on Digital Cooperation.

### 1.4.3 Trending Technologies

Technology is constantly changing and evolving at such a rapid pace that it seems like by time users catch up to one, a new one is already out. A technology or a programming language that is making the rounds this week may be obsolete by the next few days! As more and more funds are invested in research and development, computer scientists and professionals are constantly tweaking and improving existing technologies to get the most out of them.

The Major Trending Technologies that are innovative and revolutionizing nowadays include:

1. **Artificial Intelligence (AI), Data Science & Machine Learning.** The increasing ability of machines to learn and act intelligently will absolutely transform our world. It is also the driving force behind many of the other trends on this list.
2. **The Internet of Things (IoT).** This refers to the ever-growing number of “smart” devices and objects that are connected to the internet. Such devices are constantly gathering and transmitting data, further fueling the growth in Big Data and AI.
3. **Wearables and Augmented humans.** What started with fitness trackers has now exploded into a whole industry of wearable technology designed to improve human performance and help us live healthier, safer, more efficient lives. In the future, we may even see humans merge with technology to create “augmented humans” or “transhumans.”

4. **Big Data and augmented analytics.** Big Data refers to the exponential growth in the amount of data being created in our world. Thanks to augmented analytics (highly advanced data analytics, often fueled by AI techniques), we can now make sense of and work with enormously complex and varied streams of data.
5. **Intelligent spaces and smart places.** Closely linked to the IoT, this trend is seeing physical spaces – like homes, offices, and even whole cities – becoming increasingly connected and smart.
6. **Blockchains and distributed ledgers.** This super-secure method of storing, authenticating, and protecting data could revolutionize many aspects of business – particularly when it comes to facilitating trusted transactions.
7. **Cloud and edge computing.** Cloud computing – where data is stored on other computers and accessed via the internet – has helped to open up data and analytics to the masses. Edge computing – where data is processed on smart devices (like phones) – will take this to the next level.
8. **Digitally extended realities.** Encompassing virtual reality, augmented reality, and mixed reality, this trend highlights the move towards creating more immersive digital experiences.
9. **Digital twins.** A digital twin is a digital copy of an actual physical object, product, process, or ecosystem. This innovative technology allows us to try out alterations and adjustments that would be too expensive or risky to try out on the real physical object.
10. **Voice interfaces and chatbots.** Alexa, Siri, chatbots – many of us are now quite used to communicate with machines by simply speaking or typing our request. In the future, more and more businesses will choose to interact with their customers via voice interfaces and chatbots.
11. **Computer vision and facial recognition.** Machines can talk, so why shouldn't they "see" as well? This technology allows machines to visually interpret the world around them, with facial recognition being a prime example. Although we will no doubt see greater regulatory control over the use of facial recognition, this technology isn't going anywhere.
12. **Robots and cobots.** Today's robots are more intelligent than ever, learning to respond to their environment and perform tasks without human intervention. In certain industries, the

future of work is likely to involve humans working seamlessly with robot colleagues – hence the term “cobot,” or “collaborative robot.”

13. **Autonomous vehicles.** The 2020s (2021-2030) will be the decade in which autonomous vehicles of all kinds – cars, taxis, trucks, and even ships – become truly autonomous and commercially viable.
14. **5G.** The fifth generation of cellular network technology will give us faster, smarter, more stable wireless networking, thereby driving advances in many other trends (e.g., more connected devices and richer streams of data).
15. **Genomics and gene editing.** Advances in computing and analytics have driven incredible leaps in our understanding of the human genome. Now, we’re progressing to altering the genetic structure of living organisms (for example, “correcting” DNA mutations that can lead to cancer).
16. **3D and 4D printing and additive manufacturing.** Although this may seem low-tech compared to some of the other trends, 3D and 4D printing will have very wide applications – and will be particularly transformative when combined with trends like mass-personalization.
17. **Nanotechnology and materials science.** Our increasing ability to understand materials and control matter on a tiny scale is giving rise to exciting new materials and products, such as bendable displays.

There are so many more technologies that are innovative and upcoming which will change how we work and how we live

## 1.5 The Internet

The Internet, originally the ARPAnet (Advanced Research Projects Agency network), began as a military computer network in 1969. Other government agencies and universities created internal networks based on the ARPAnet model. The catalyst for the Internet today was provided by the National Science Foundation (NSF). Rather than have a physical communications connection from each institution to a supercomputing center, the NSF began a "chain" of connections in which institutions would be connected to their "neighbor" computing centers, which all tied into central supercomputing centers. This beginning expanded to a global network of computer networks, which allows computers all over the world to communicate with one another and share information stored at various computer "servers," either on a local computer or a computer located anywhere in the world.

### 2.5.1 Internet Terminologies and their meaning

**Bandwidth** - It is a measurement of the amount of data that can be transmitted over a network at any given time. The higher the network's bandwidth, the greater the volume of data that can be transmitted. Network bandwidth is usually expressed in bits per second (bps); modern networks typically have speeds measured in the millions of bits per second (megabits per second, or Mbps) or billions of bits per second (gigabits per second, or Gbps).

### Bits and Bytes

Bit stands for binary digit: 0 or 1

A byte is made up of 8 bits.

It takes 1 byte to store one ASCII character ASCII stands for the American Standard Code for Information Interchange. The combination of bits (which makes up one byte) below represents the letters below

A - 0100 0001

B - 0100 0010

C - 0100 0011

**K** stands for **kilo** and = 1024 (2 to the tenth power)

**M** stands for **mega**. Thus, **1 MB**, megabyte is about a million bytes (1024x1024)

**G** stands for **giga**. **1 GB**, gigabyte is about a billion bytes (1024x1024x1024)

**T** stands for **tera**. **1 TB**, terabyte is about a trillion!

**Browser** - A software program that allows users to access the Internet. Examples:

- **Non-graphical:** a user interface for computers which allows you to read plain text, not pictures, sound, or video, on the Internet. It is strictly text based, non-Windows, and does not place high memory demands on your computer. An example is lynx [.\(http://lynx.browser.org/\)](http://lynx.browser.org/)
- **Graphical:** a user interface for computers which enables people to see color, graphics, and hear sound and see video, available on Internet sites. These features are usually designated by underlined text, a change of color, or other distinguishing feature; sometimes the link is not obvious, for example, a picture with no designated characteristic. Examples are Mozilla Firefox, Google Chrome, Opera, Internet Explorer, etc.

**Cache:** A set of files saved on your hard disk that help your browser display pages you have already visited more quickly. It displays the files from your hard disk instead of the web.

**Cookies** - A small piece of information you may be asked to accept when connecting to certain servers via a web browser. It is used throughout your session as a means of identifying you. A cookie is specific to, and sent only to the server that generated it.

**Domain Name** - A method of identifying computer addresses. Your e-mail address has a domain address. If you have an "edu" at the end of your e-mail address that means your account is affiliated with an educational institution. A "com" extension means you have a business account. A government account has a .gov suffix.

**Firewall** - The name "firewall" derives from the term for a barrier that prevents fires from spreading. A computer "firewall" is a barrier between your computer and the outside world. Just like a fire is most likely to spread through open doors in a building, your computer is most vulnerable at its ports (the doors). Without ports you could not go on the Internet or let Internet traffic enter your computer.

An effective software firewall isolates your computer from the Internet using a code that sets up a blockade to inspect each packet of data, from or to your computer — to determine whether it should be allowed to pass or be blocked.

Firewall software operates in various ways: Packet filters block traffic from IP addresses and/or port numbers. Proxy servers can break the connection between two networks. NATs (Network Address Translators) hides the IP addresses of client stations by presenting one IP address to the "outside" world. Stateful inspection verifies inbound and outbound traffic to be sure the destination and the source are correct. Firewall software can allow your computer to operate in stealth mode, so that its IP address is not visible.

**HTML** - A type of text code in Hypertext Markup Language which, when embedded in a document, allows that document to be read and distributed across the Internet.

**HTTP** - The hypertext transfer protocol (http) that enables html documents to be read on the Internet.

**Hypertext** - Text that is non-sequential, produced by writing in HTML (Hypertext Markup Language) language. This HTML coding allows the information (text, graphics, sound, video) to be accessed using HTTP (Hypertext Transfer Protocol).

**Hyperlink** - Text, images, graphics that, when clicked with a mouse (or activated by keystrokes) will connect the user to a new Web site. The link is usually obvious, such as underlined text or a "button" of some type, but not always.

### **2.5.2 World Wide Web (Websites)**

The Internet has been defined as a global network of billions of computers and other electronic devices. With the Internet, it's possible to access almost any information, communicate with anyone else in the world, and do much more. You can do all of this by connecting a computer to the Internet, which is also called going online. When someone says a computer is online, it's just another way of saying it's connected to the Internet.

The *World Wide Web*—usually called the Web for short—is a collection of different websites you can access through the Internet. A website is made up of related text, images, and other resources. Websites can resemble other forms of media—like newspaper articles or television programs—or they can be interactive in a way that's unique to computers.

The purpose of a website can be almost anything: a news platform, an advertisement, an online library, a forum for sharing images, or an educational site like the DISH Project site.

Thus, The Internet can be defined as a global network of thousands of computer networks linked by data lines and wireless systems. The Internet is not governed by any official body, but there are organizations which work to make the Internet more accessible and useful.

Once you are connected to the Internet, you can access and view websites using a type of application called a web browser. Just keep in mind that the web browser itself is not the Internet; it only displays websites that are stored on the Internet.

### **2.5.3 How does the Internet work?**

At this point you may be wondering, how does the Internet work? The exact answer is pretty complicated and would take a while to explain. Instead, let's look at some of the most important things you should know.

It's important to realize that the Internet is a global network of physical cables, which can include copper telephone wires, TV cables, and fiber optic cables. Even wireless connections like Wi-Fi and 3G/4G rely on these physical cables to access the Internet.

When you visit a website, your computer sends a request over these wires to a server. A server is where websites are stored, and it works a lot like your computer's hard drive. Once the request arrives, the server retrieves the website and sends the correct data back to your computer. What's amazing is that this all happens in just a few seconds!

### **2.5.4 Search Engines**

A search engine is a web-based tool that enables users to locate information on the World Wide Web. The engine provides a list of results that best match what the user is trying to find.

Today, there are many different search engines available on the Internet, each with its own abilities and features. Popular examples of search engines are Google, Yahoo!, and MSN Search.

Search engines utilize automated software applications (referred to as robots, bots, or spiders) that travel along the Web, following links from page to page, site to site. The information gathered by the spiders is used to create a searchable index of the Web. Other search engines include AOL, Ask.com, Baidu, Bing, DuckDuckGo, etc.

### **How a search engine works?**

Because large search engines contain millions and sometimes billions of pages, many search engines display the results depending on their importance. This importance is commonly determined by using various algorithms.

Once a page is crawled, the data contained in the page is processed and indexed. Often, this can involve the steps below.

- Strip out stop words.
- Record the remaining words on the page and the frequency they occur.
- Record links to other pages.
- Record information about any images, audio, and embedded media on the page.

The data collected is used to rank each page. These rankings then determine which pages to show in the search results and in what order.

Finally, once the data is processed, it's broken up into files, inserted into a database, or loaded into memory where it's accessed when a search is performed.

### **2.5.5 Electronic Mail (email)**

Electronic Mail popularly called email is a way to send and receive messages across the Internet. It offers an efficient, inexpensive and real time mean of distributing information among people.

#### **E-Mail Address**

Each user of email is assigned a unique name for his email account. This name is known as E-mail address. Different users can send and receive messages according to the e-mail address.

E-mail is generally of the form *username@domainname*.

For example, paulassimwe@gmail.com is an e-mail address where paulassimwe is username and gmail.com is domain name.

An email domain is the web address that comes after the @ symbol in an email address.

In an email, please note the following:

- The username and the domain name are separated by @ (at) symbol.
- E-mail addresses are not case sensitive.
- Spaces are not allowed in e-mail address.

Email is similar to traditional mail, but it also has some key differences. To get a better idea of what email is all about, take a look at the infographic below and consider how you might benefit from its use.

### E-mail Header

The first five lines of an E-mail message is called E-mail header. The header part comprises of following fields:

- |        |           |       |
|--------|-----------|-------|
| ✓ From | ✓ To      | ✓ CC  |
| ✓ Date | ✓ Subject | ✓ BCC |

- **From**

The From field indicates the sender's address i.e. who sent the e-mail.

- **Date**

The Date field indicates the date when the e-mail was sent.

- **To**

The To field indicates the recipient's address i.e. to whom the e-mail is sent.

- **Subject**

The Subject field indicates the purpose of e-mail. It should be precise and to the point.

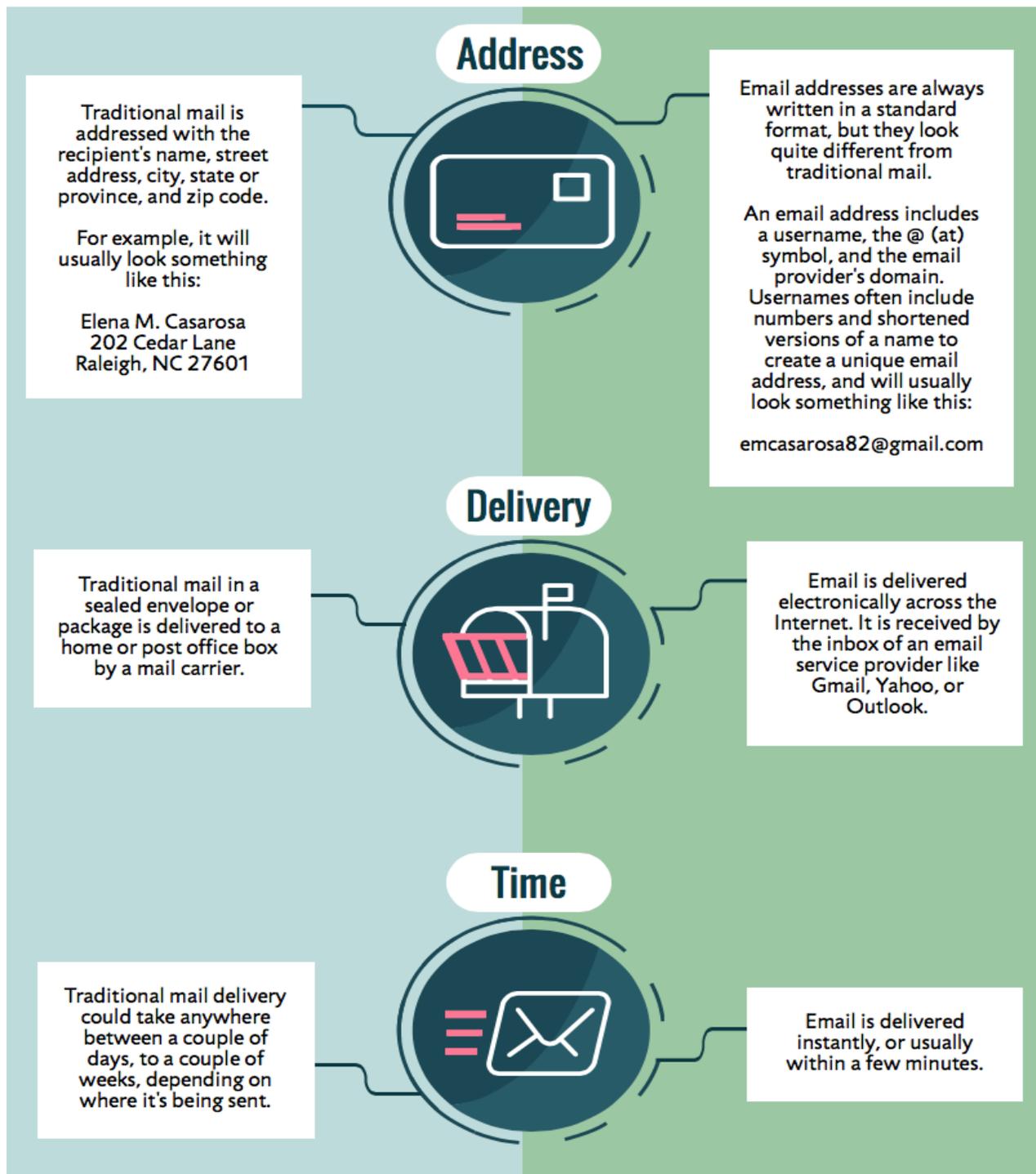
- **CC**

CC stands for Carbon copy. It includes those recipient addresses whom we want to keep informed but not exactly the intended recipient.

- **BCC**

BCC stands for Black Carbon Copy. It is used when we do not want one or more of the recipients to know that someone else was copied on the message.

# Traditional Mail vs Email



## **Guidelines for Writing Effective E-Mail**

As in other forms of communication, start with you--a statement acknowledging the recipient.

- Keep your message short.
- Make heading clear and exact. Always use Subject to denote the purpose of the mail
- If something is urgent, mark it "Urgent."
- Include a short introduction indicating exactly to what you are responding, even if the original message is included.
- Remember that a message can end up anywhere. Read well before sending
- Remember that electronic privacy doesn't exist.
- Avoid using all capital letters.
- Do not forward an e-mail without permission.
- Keep e-mail addresses confidential.
- Know the meaning and purpose of cc, bcc and other related menu icons. Use them appropriately.

### **2.5.6 Social Media**

Social media are interactive real-time digitally-mediated technologies that facilitate the creation or sharing/exchange of information, ideas, career interests, and other forms of expression via virtual communities and networks. Since social media works in real-time, it allows knowledge to be rapidly created and shared through social networks. It is changing the way people communicate and has thus become an important tool in our everyday lives.

With Social Media, businesses can reach their potential clients by publicizing their products and services on these social platforms. In education, social media allows peers to communicate with one another and with the teacher; it also provides a platform for learners and teachers to share resources as texts, photos or even videos. Social Media significant play roles also in religion, law, government, etc.

### **Types or Categories of Social Media**

There are so many social media platform, each serving specific purpose and use cases, though most works in multiple areas. Alas, some of the examples of social media application in these

subtypes might be restricted or barred in certain region due to national policy of such regions. Some of the sub categories of social media include:

- **Social networks** — Used to connect with people
  - Examples: Facebook, Twitter, LinkedIn, WhatsApp, Telegram, Wechat
- **Media sharing networks** — To share photos, videos, and other media
  - Examples: Instagram, Snapchat, YouTube, WhatsApp, Telegram
- **Discussion forums** — Share news and ideas
  - Examples: reddit, Quora, Digg
- **Bookmarking and Content Curation Networks** — Discover, save, and share new contents
  - Examples: Pinterest, Flipboard
- **Consumer Review Networks** — Find and review businesses
  - Examples: Yelp, Zomato, TripAdvisor
- **Blogging and publishing networks** — Publish content online
  - Examples: WordPress, Tumblr, Medium
- **Interest-based networks** — Share interests and hobbies
  - Examples: Goodreads, Houzz, Last.fm
- **Social shopping networks** — Shop online
  - Examples: Polyvore, Etsy, Fancy
- **Sharing economy networks** — Trade goods and services
  - Examples: Airbnb, Uber, Taskrabbit
- **Anonymous social networks** — Communicate anonymously
  - Examples: Whisper, Ask.fm, After School

### **Social Media as a Work and Marketing Tool**

Social Media is not only meant for fun and entertainment purposes; it can also be used as a work tool. Some of the ways you can monetize your social media is by creating contents and using your platform for sponsored adverts, several celebrities with high numbers of followers use their social media to promote clients' products and they make a substantial amount as income. Social media can also be used for marketing products; social media marketing includes increasing website

traffic, engagement, brand awareness, and other marketing goals by designing various types of content for different social media platforms. The content can be in the form of videos, blogs, infographics, or any other forms that have the potential to go viral.

## 1.6 Cloud Computing & Cyber Security

### 1.6.1 Cloud Computing

You might have at one time or the other heard someone say “*my documents are in the cloud*” or “*I have files backed up in the cloud*”, and you have been wondering, “*What is the cloud?*” or does it refer to the literal cloud that is in the atmosphere? **NO**, this is not what it means.

“The cloud” refers to servers that are accessed over the Internet, and the software and databases that run on those servers. Cloud servers are located in data centers all over the world. Thus, the process of performing computing activities using these resources is known as **Cloud Computing**.

Simply put, Cloud Computing is the delivery of computing services—including servers, storage, databases, networking, software, analytics, and intelligence—over the Internet (“the cloud”) to offer faster innovation, flexible resources, and economies of scale. By using cloud computing, users and companies don't have to manage physical servers themselves or run software applications on their own machines.

The cloud enables users to access the same files and applications from almost any device, because the computing and storage takes place on servers in a data center, instead of locally on the user device. This is why a user (like you) can log into their Instagram account on a new phone after their old phone breaks and still find their old account in place, with all their photos, videos, and conversation history. It works the same way with cloud email providers like Gmail or Microsoft Office 365, and with cloud storage providers like Dropbox or Google Drive.

### 1.6.2 Cyber Security

Now, a large percentage of computing activities and resources being used by individuals and corporate bodies (essentially everyone using the internet) are accessed from the cloud.

In that the cloud is available anytime and capable of being run from anywhere, cloud computing provides a perfect solution to operational challenges witnessed by many organizations, an example is the challenge posed by the recent COVID-19 pandemic, where most workers are forced to work remotely. However, as cloud computing grows in popularity across all use cases, cloud workloads have never been more attractive to malicious actors and hackers, thus, there is now an urgent and very crucial need to protect our cyberspaces.

While cloud service providers like Google Cloud Platform (GCP), Microsoft Azure, and Amazon Web Services (AWS) continue to expand cloud security services to protect their cloud infrastructures, it is ultimately the customer's responsibility to implement proper cyber security in the cloud and secure their data stored within them.

*Thus, what exactly is Cyber Security?*

#### Box 3.1: Definition of Cyber Security

Cyber Security refers to the specialization of computer network security that consists of technologies, policies, and procedures that protect networked computer systems from unauthorized use or harm.

Broadly speaking, *cyber security* topics can be subdivided into two complementary areas: *cyber-attacks*, which are essentially offensive and emphasize network penetration techniques; and *cyber defenses*, which are essentially protective and emphasize counter-measures intended to eliminate or mitigate cyber-attacks.

The terms *cyber-attack*, *cyber-threat*, and *cyber-risk* are interrelated. A cyber-attack is an offensive action, whereas a cyber-threat is the possibility that a particular attack may occur, and

the cyber-risk associated with the subject threat estimates the probability of potential losses that may result.

## **Elements of Cyber Security**

Cyber security comprises three core elements:

- **People** – Almost every cyber-attack is targeted at people, even if the ostensible victim is a business or government institution. Hackers are invariably after private information about people or seeking to disrupt people’s lives. People thus need to be aware of their role in reducing and preventing threats.
- **Processes** – Organizations need to create policies and processes that reduce threats. They need to adapt to the shifting cyber security landscape. Regulations are part of this mix. Laws like GDPR and data breach notification statutes help protect people and businesses from cyber-attacks.
- **Technology** – People and companies need to invest in technology that protects them from cyber-attacks. The attackers use tech, so the defenders must as well. These include things like firewalls, encryption, intrusion detection and so forth.

## **The 3 Types of Cyber Security**

While the cyber security field encompasses a vast range of tools and techniques, it falls into three rough categories:

- i. **Data security** – Hackers are often after data. They want to see or steal information that’s off limits. Their reasons vary. In some cases, the hacker is simply stealing information like credit card numbers to sell on the black market (The “Dark Web”). Other times, the information thief wants to embarrass the target by revealing private conversations (e.g. Sony Pictures) or spy on a geopolitical enemy. Data security involves protecting data from unauthorized access. It includes data encryption, data access control technologies and policies.
- ii. **Network security** – In order for a cyber-attack to work, in almost every situation it is first necessary for the hacker to gain access to the target’s network. Protecting networks is one of the most serious areas of cyber security and typically the focus of significant investment. Network security is the province of firewalls, bastion hosts, appliance hardening, intrusion

detection systems (IDS), security incident and event management (SIEM) systems and so forth.

- iii. **Application security** – Hackers also like to get inside software applications like Enterprise Resource Planning (ERP), CRM, email servers and the like. Sitting inside an app is a great way to spy on the target or disrupt its operations. Application security has many facets, but it usually combines policies (e.g. who is allowed to access the application and its administrative “back end”) and controls over the Application Programming Interfaces (APIs) that let other software programs gain access to the app.

### 1.6.3 Types of Cyber Security Threats

There are literally hundreds of millions of cyber threats out there. Some of the most popular forms of these threats or attacks are:

1. **Viruses/Malware** – A virus is a form of malicious software (malware) code that installs itself on your device. Once implanted, a virus can do a number of different bad things, including freezing the system, stealing data or even hijacking the device for criminal purposes like mining cryptocurrencies without your permission, this is called crypto-jacking. Some of the popular and very powerful malware are Emotet malware, Dridex malware, Robin Hood, WannaCry, etc.
2. **Identity theft** – Identity theft is a crime where a hacker steals enough of your private, personal information (e.g. Social security number, birth date, address, etc.) so he or she can impersonate you. Pretending to be you, the hacker may be able to steal money from your bank account, open credit card accounts in your name and more.
3. **Password attacks** – If a hacker has your password, he or she can get into your accounts. Password attacks use special software to guess at passwords, often trying thousands of possibilities before hitting the correct one.
4. **Trojans** – Like the famed Trojan horse of ancient times, a Trojan is a cyber-attack that gets inside the target’s network under false pretenses. For example, a hacker might embed a virus into a PDF document and send it to you as an email attachment. When you open the PDF, the file implants the virus into your system while the document opens in Acrobat Reader.

5. **Ransomware** – A subset of malware, in which an attacker locks a victim’s computer (often through an encryption method), demanding a ransom, usually in Bitcoin, to decrypt and unlock the victim’s computer.
6. **Phishing** – A phishing attack is an attempt, usually via email, to trick you into clicking on a hyperlink that will put malware on your computer. A more sophisticated form of the attack, known as Spear Phishing, involves the attacker impersonating a friend or coworker, usually with the goal of getting you to share account login credentials.
7. **Advanced Persistent Threat (APT)** – APTs are arguably the most potent cyber threats. They are often the product of national intelligence agencies, so they have the absolute best brains behind them. An APT is designed to penetrate stealthily and then lurk inside your network for months, undetected. It moves laterally, installing itself over and over in different parts of your infrastructure until it is activated. Then, it can do incredible damage.
8. **Data breaches:** Perhaps the most common threat to cloud computing is the issue of leaks or loss of data through data breaches. A data breach typically occurs when a business is attacked by cybercriminals who are able to gain unauthorized access to the cloud network or utilize programs to view, copy, and transmit data.

If you use cloud computing services, a data breach can be extremely damaging, but it can happen relatively easily. Losing data can violate the General Data Protection Regulation (GDPR), which could cause your business to face heavy fines. Remember that a data breach can cause many different issues for your business. Aside from the fines and loss of data, you can also lose the trust of your customers, or even have your own intellectual property stolen

9. **Denial of service:** One of the most damaging threats to cloud computing is a denial of service (DoS) attack or a distributed denial of service (DDoS). These can shut down your cloud services and make them unavailable both to your users and customers, but also to your staff and business as a whole. Cybercriminals can flood your system with a very large amount of web traffic that your servers are not able to cope with. This means that the servers will not buffer, and nothing can be accessed. If the whole of your system runs on the cloud, this can then make it impossible for you to manage your business.

**10. Insider threats:** When we think of cyber security challenges, we often consider the concept of malicious criminals hacking into our systems and stealing data – however, sometimes the problem originates from the inside of the company. In fact, recent statistics suggest that insider attacks could account for more than 43 percent of all data breaches. Insider threats can be malicious – such as members of staff going rogue – but they can also be due to negligence or simple human error.

In addition to the afore-explained cyber threats, there are so many other forms of cyber threats and attacks. Examples include:

- Identity theft, fraud, extortion
- Spamming, Spoofing, Spyware
- Password sniffing, System infiltration, Website defacement
- Man-in-the-middle attack
- SQL Injection
- Man-in-the-browser (MitB) Attack
- Exploit Kit                      and so many more.

#### **1.6.4 How to Mitigate or Prevent Cyber Threats**

Cyber Crimes have caused a tremendous loss to not only individuals, but to businesses, nation's economy and many more. These costs include the damage and destruction of data, stolen funds, theft of intellectual property, fraud etc. In a special report on Cyberwarfare by Cybercrime Magazine (<https://cybersecurityventures.com/hackerpocalypse-cybercrime-report-2016/>), it was reported that cybercrimes will inflict damages totaling \$6 trillion USD globally by 2021. It is also predicted that global cybercrime costs will grow by 15 percent per year over the next five years, reaching \$10.5 Trillion USD annually by 2025, up from \$3 trillion USD in 2015.

As Cyber Attacks continue to increase every day, both in numbers, ferocity and approaches, it is now pertinent that businesses and individuals should guard and safekeeping themselves and their resources against cyber threats. Some of the ways by which Cyber Threats can be prevented or mitigated include:

### **A. End-user protection**

- Update your software and operating system regularly. This means you benefit from the latest security patches.
- Use a well reputed endpoint security solution (such as anti-virus software, anti malware) across all network endpoint devices. Security solutions like Kaspersky Total Security will detect and removes threats. Keep the security solutions updated for the best level of protection.
- Be vigilant and talk to your family –including children – about how to stay safe online
- Regularly check and update the privacy settings on your social media accounts;
- Use strong passwords: Ensure your passwords are not easily guessable (a mix of uppercase, lowercase, numbers and special characters); change them regularly
- Use your endpoint security solutions like antivirus to scan the system regularly.
- Do not open or click on links in emails from unknown senders or unfamiliar websites as this is a common way that malware is spread. Double-check emails that ask you sensitive information or request that you open an attached document
- Avoid using unsecure WiFi networks in public places: Unsecure networks leave you vulnerable to man-in-the-middle attacks.

### **B. Corporate of Business Protection (Network Protection)**

- Protect your network using an anti-DDoS solution and deploy technology that monitors it thoroughly for any signs of an attack.
- Train Employees to be Security Conscious. Continuous employee education, plus necessity to strengthen policy on Password protection is very important
- Monitor network traffic for suspicious activity – can you “see” in & outbound encrypted messages?
- Upgrade and patch firewalls and other software immediately and promptly. This must be done frequently as patches are released by the software vendor.
- Know where sensitive data resides, then develop data protection strategy to include encryption monitoring.
- Develop and implement real-time monitoring strategy and analysis of log files and wire data.

- Perform annual penetration assessments and vulnerability assessments
- Prepare for the worst case scenario. Develop emergency incident response (IR) plans.

### **Anti-Virus**

A virus is a computer program intentionally designed to cause harm to your computer. Just like their biological namesakes, viruses also replicate themselves. Viruses may rename files so they are unusable, delete files, replicate themselves through an e-mail program or other application, or simply tie up valuable computer resources such as CPU and RAM by attacking those resources. Viruses do not generally bring down a system though. Viruses most often cause system-wide slowdowns, produce annoying pop-up messages, and cause nagging error messages.

To prevent cyber-attacks on your systems and networks generally, it is advised that you secure your devices by installing antivirus software and regularly updating it. Without this software there is a high chance that your systems and networks will be hit and will suffer hacking attacks and also can be affected by the various viruses.

It is important that the antivirus scan engine and virus signatures to be updated regularly; we do this because if your system is hit by the latest malware it will be detected.

### **Basic Functions of Antivirus Engines**

All antivirus engines have three components to function accordingly. It is important to have a look at these functions because it will help us for better manual cleaning of viruses in case we need.

- Scanning – When a new virus is detected in the cyberspace, antivirus producers start writing programs (updates) that scans for similar signature strings.
- Integrity Checking – this method generally checks for manipulated files in OS from the viruses.
- Interception – this method is used basically to detect Trojans and it checks the request made by the operating system for network access.

### **Online Virus Testing**

If you do not have an antivirus installed on your platform but suspects a file that is infected, then it is recommended to use the online testing antivirus engine which (according to me) is one of the best. You can check out the site – <https://virustotal.com/>.

**Question.**     **Why this option?**

**Ans.**           **It is a free and independent service.**

This platform uses multiple antivirus engines (41 anti-virus engines), so its result will be showing for all the 41 engines. It updates the engines in real-time.

### **Free Antivirus Software**

The free versions of anti-viruses have nearly identical malware detection scores to the paid versions produced by the same company, but the commercial antivirus makes a small difference in the performance of security and in our case we are system administrators and we want maximum protection in the work environment.

- Avast Antivirus
- AVG Antivirus
- Panda Antivirus
- Bitdefender Antivirus
- Microsoft Security Essentials and so many more.

### **Commercial Antivirus**

It should be noted that all the producers of free antiviruses offer their commercial versions too. According to PC magazine (<http://www.pcmag.com/article2/0,2817,2372364,00.asp>), the best commercial antiviruses are –

- McAfee AntiVirus Plus
- Norton AntiVirus Plus
- Kaspersky Anti-Virus
- Bitdefender Antivirus Plus
- Webroot Secure Anywhere AntiVirus

### **How to install antivirus software step by step guide**

1. Decide on which Antivirus you want to use. Free or paid?
2. If you downloaded the antivirus program on the Internet, find the downloaded file on your computer.
3. If the downloaded file is a zip file, unzip the file to extract and access the installation files.

4. Look for a file named setup.exe, install.exe, or something similar, and then double-click that file.
5. Follow and comply with prompts till antivirus is installed

### **Practice Exercise:**

#### **A. How to Install Avast Free Antivirus?**

- Go to the avast official site <https://www.avast.com/index> and download the software specific to your OS version.
- Wait till the download process is complete and then run the file by following how to install antivirus software step by step guide.
- Click the Avast Security option on the next page and follow the prompts displayed to install the avast Antivirus software on your system.
- The app will launch once the installation process is complete.
- Go to the Status Menu available on the left panel of the window.
- Tap the Start button available near the Full System Scan option. Once the scan process is over, follow the Antivirus Setup prompts to rectify the threats detected.

#### **B. How to Install McAfee Antivirus in Windows 10?**

- First, go to the manufacturer's site (<https://www.mcafee.com/en-us/index.html>) and download the McAfee Antivirus Setup on your system.
- Run the **.dmg** file on your system and install it using the prompts that appear on your screen.
- Go to the My Account option and tap the Sign In option.
- Enter the login credentials in the respective places and tap the Log In option.
- Select the Are You a New User? Register now option to create an account with MacAfee.
- Subscribe to a Protection Plan once you log in. Comply with the End User License Agreement and configure the software based on your choice.

## Virtual Private Network (VPN)

It is a common knowledge that many people spend a lot of time online performing diverse activities. Likewise, the pandemic covid19 served as a catalyst that proliferated the use of internet enabled smart devices, even more than prior the lockdown. While using these technologies, the amount of sensitive data you transmit over an Internet connection is inherently insecure. A VPN, or virtual private network, is a way to create secure connections between remote computers and present the connection as if it were over a local private network, allowing for secure communications between servers.

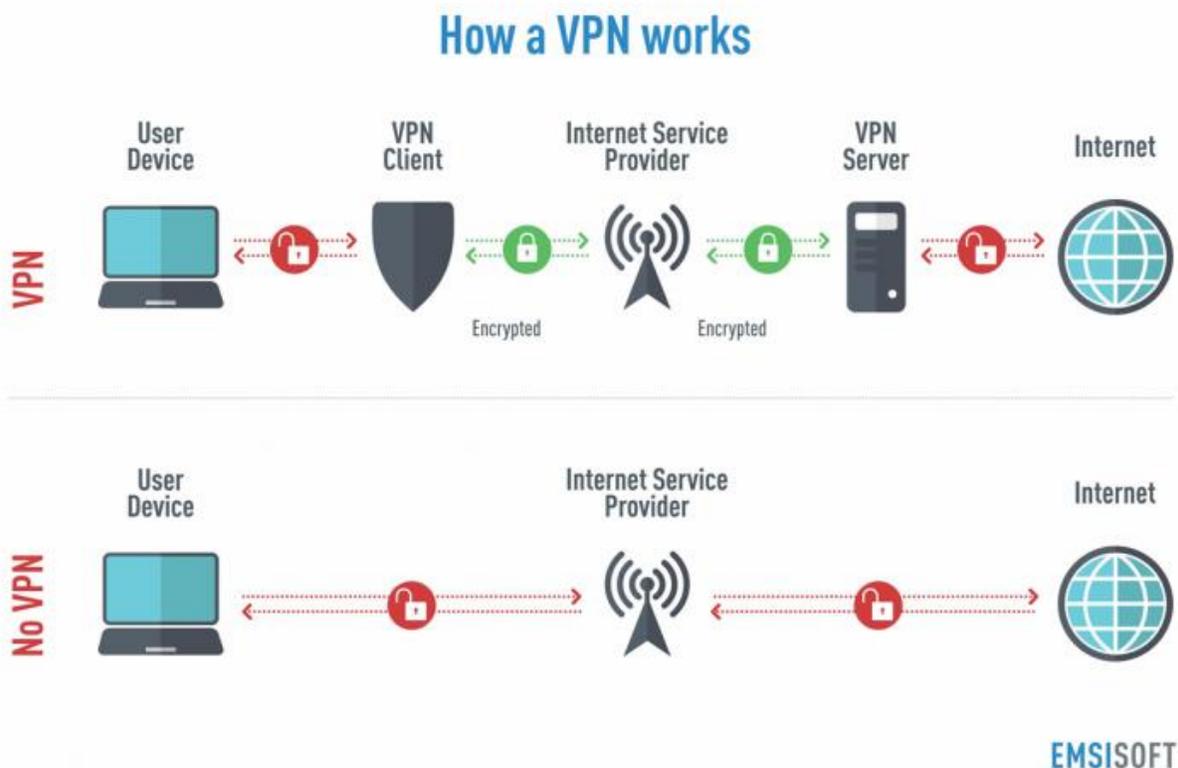


Image source: [https://www.yellowstonecomputing.net/uploads/2/2/1/6/22165724/how-a-vpn-works-infographic-730x484\\_orig.png](https://www.yellowstonecomputing.net/uploads/2/2/1/6/22165724/how-a-vpn-works-infographic-730x484_orig.png)

A VPN provides varying levels of security so that traffic sent through the VPN connection stays isolated from other computers on the intermediate network, either through the use of a dedicated connection from one “end” of the VPN to the other, or through encryption. VPNs can connect individual users to a remote network or connect multiple networks together.

For example, users may use a VPN to connect to their work computer terminal from home and access their email, files, images, etc. Through VPNs, users are able to access resources on remote networks, such as files, printers, databases, or internal websites. VPN remote users get the impression of being directly connected to the central network via a point-to-point link.

VPN can be installed and used on devices (laptops, phones), and also on routers. The advantage of using VPN on your router is you don't have to install the application on every device that uses the router.

Some of the popular VPNs are

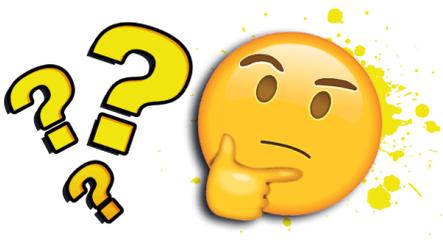
- SuperVPN
- Proton
- ExpressVPN
- NordVPN
- Surfshark
- CyberGhost
- IPVanish
- Tunnelbear
- Windscribe



### **Workshop**

*(One of the learners will teach the others – Ask for a Volunteer)*

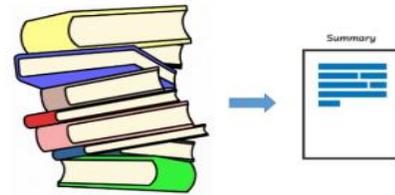
- How does a VPN work?
- Is there any danger to using VPN?
- What are the possible functions or use cases of VPN?



### **Study Unit 1 Quiz 2**

Attempt this Quiz before the deadline. It forms part of your Continuous Assessment (CA)

## Summary of Study Unit 1



In this study unit, you have learnt that:

1. A computer is any electronic device that accepts input, process data and produces an output.
2. A computer can be classified based on size, purpose, data handling or applications and age or generation of technology.
3. The Architecture of a Computer is composed of five basic units that help the computer to perform its operations, these are: Input Unit, Output Unit, Memory or Storage Unit, Arithmetic Logic Unit and Control Unit
4. A computer can be programmed to do any function i.e. we can instruct a computer to do whatever we want it to do. However, a Computer cannot do anything without a Program. A Computer Program is a collection of instructions that can be executed by a computer to perform a specific task.
5. Every computer uses an Operating System to operate. An Operating System is the application that serves as an interface between hardware and software while managing all system activities and resources.
6. There are four (4) parts of an OS. These are The Kernel, The Device Drivers, The User Interface, and The System Utilities.
7. Hardware refers to the physical components of a computer that a human can see and touch. Hardware are classified into four different categories which are Input Devices, Processing Devices, Output Devices and Memory/Storage Devices
8. Software is a set of programs, which is designed to perform a well-defined function. There are two types: System Software and Application Software.
- 9.

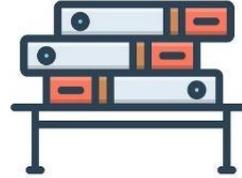
## **Self-Review Questions for Study Unit 1**

Now that you have completed this study unit, you can assess how well you have achieved its Learning Outcomes by answering these questions.

1. What is

## **Self-Review Answers (SRA) to Self-Review Questions of Study Unit 1**

## References and Bibliography



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