

# **CHAPTER ONE**

## **OVERVIEW OF COMPUTER**

### **Introduction**

---

**Definition:** A Computer is an electronic device that can perform activities that involve Mathematical, Logical and graphical manipulations. Generally, the term is used to describe collection of devices that function together as a system.

It performs the following three operations in sequence.

1. It receives data & instructions from the input device.
2. Processes the data as per instructions.
3. Provides the result (output) in a desired form.

**Data:** It is the collection of **raw facts, figures & symbols**.

Ex: Names of students and their marks in different subjects listed in random order.

**Information:** It is the **data that is processed & presented** in an organized manner.

Ex: When the names of students are arranged in alphabetical order, total and average marks are calculated & presented in a tabular form, it is information.

**Program:** Set of **instructions** that enable a computer to perform a given task.

**Advantages of computers:**

1. **High speed:** Computers have the ability to perform routine tasks at a greater speed than human beings. They can perform millions of calculations in seconds.
2. **Accuracy:** Computers are used to perform tasks in a way that ensures accuracy.
3. **Storage:** Computers can store large amount of information. Any item of data or any instruction stored in the memory can be retrieved by the computer at lightning speeds.
4. **Automation:** Computers can be instructed to perform complex tasks automatically (which increases the productivity).
5. **Diligence:** Computers can perform the same task repeatedly & with the same accuracy without getting tired.
6. **Versatility:** Computers are flexible to perform both simple and complex tasks.
7. **Cost effectiveness:** Computers reduce the amount of paper work and human effort, thereby reducing costs.

**Limitations of computers:**

1. Computers need clear & complete instructions to perform a task accurately. If the instructions are not clear & complete, the computer will not produce the required result.
2. Computers cannot think.
3. Computers cannot learn by experience.

### **History of computers**

---

The history of computers can be summarized as follows

#### **Abacus**

- Invented by Chinese and Egyptians, some 500 years back
- Assumed to be the first adding machine. It consisted of rows of beads in rectangular frame
- Beads represent place holders and performs arithmetic operations
- It worked on the principle of place value notation

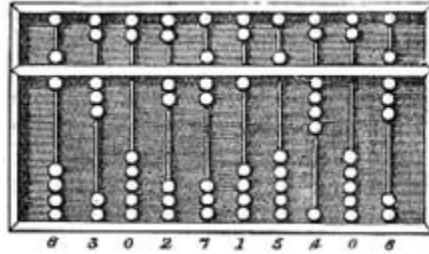


*Figure 1. The Chinese suanpan. The number represented on this abacus is 6,302,715,408.*

### **Basic Pascal (French Mathematician)**

- In 1642, Pascal invented the pascaline calculator
- He also invented syringe and the pascal law of pressure

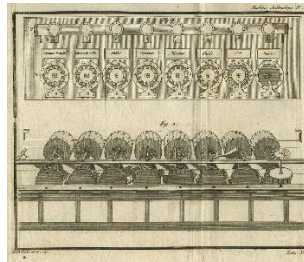


*Figure 2. Top view and overview of the entire mechanism*

### **Charles Babbage**

- Produced the first commercial calculator in 1822
- Different engine, steam powered, full automatic
- He got support from British government while doing it

### **Modern Computer**

- Modern computer was started in 1940s. Some of the most important one's are:-
- ENIAC (Electronics Numerical Integrator and Calculator)
  - Was developed by University of Pennsylvania in 1946
  - A machine that filled a 30x 50 foot room and its weight was 30 tons.
  - It had 18,000 vacuum tubes
  - No internally stored program

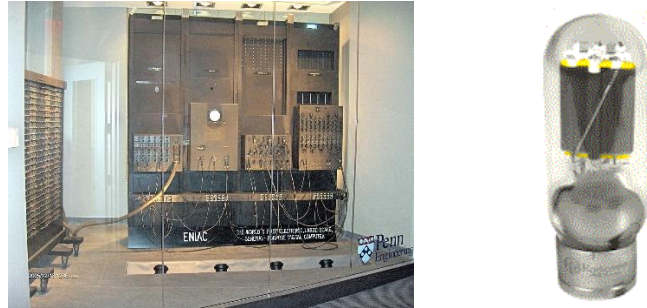


Figure 3. Electronic Numerical Integrator and Computer (ENIAC) and Vacuum tube

**EDVAC** (Electronic Discrete Variable Computer) and EDSAC (Electronic Delay Storage Automatic computer) were also invented by the University in 1949

**UNIVAC** was introduced by John Von Newman in 1945

- Newman described how a binary program could be stored electrically in a computer.
- His work served a base for the design of the first Intel chip microprocessors 8088
- The concepts of bus, registers etc. was introduced by then. They were with different names.
- Stored program concept was introduced
- First commercially available computer
- UNIVAC was delivered to the bureau of the census in 1951 where it was used for tabulating census data
- Was the first computer used for business data processing
- Some UNIVAC had the size of a grand plans and much more compact than the ENIAC
- Used RAM of 1000 words
- In 1954 IBM installed the first commercial computer, IBM 650.
- IBM's dominance in the computer world be gain in 1960 due to introduction of its 1401 computer.
- This was followed by 370 series of computers in late 1960s.

### **Generation of Computers**

All modern computers can be categorized in to five generation based on the following five dimensions including:-

- Basic electronic component used by the computer.
- Secondary storage device used
- Operating system
- Access time of the computer
- Computer language used by the computer

#### **First Generation Computers (1944-1959)**

- Characteristics:
  - Used Vacuum tubes
  - Punched cards as storage devices
  - Machine and Assembly language

- Access time measured in milliseconds (thousands of a second).
- About 1,000 circuits per cubic foot
  - Examples: Harvard Mark I (electromechanical), Whirlwind, ENIAC, EDSAC UNIVAC & IBM 650, UNIVAC I, UNIVAC II, UNIVAC 1101, IBM models 604 etc

### **Second Generation Computers (1960-1964)**

- Used transistors (discrete electronic components)
  - about 100,000 circuits per foot
- Reduced power requirement
- Increased reliability with magnetic tape as storage device
- Used Corol and Fortran language
- Access time measured in microseconds
  - Examples: -UNIVAC 1107, UNIVAC III, Philco Transact S-2000
    - NCR 300 series, IBM 7030 Stretch etc, Honeywell 800, 400 series, General Electric GE 635, LARC, Burroughs B5000, 200 series

### **Third Generation computers (1964-1975)**

- Integrated circuits in place of transistors (thousands of transistors are integrated on a silicon chip in small size)
- Large scale integrated circuits(LSI)
  - 10 million circuits per square foot
- 1000 circuits were integrated on a single clip
- Magnetic disk storage
- Faster, smaller than 2<sup>nd</sup> generations
- Access time in 100 nanoseconds (100 times that of second generation computer.)
  - Examples: Burroughs 6700, Control Data 3300, Honeywell 200, IBM System/360, System 3, System 7, NCR Century Series, RCA Spectra 70 series, UNIVAC 9000 series, General Electric GE 600 series, GE 235.

### **Fourth generation computers (1975's to current)**

- Introduction of very large scale integration (VLSI)
  - Circuit density approached 100,000 components per chip and above
- Continued miniaturization
- Billions of circuits per cubic foot
- New user oriented and application programs were introduced
- Access time approached one nanoseconds
- Programming task were simplified
- Virtual operating systems were introduced for multiple use
  - Examples: IBM System 3090, IBM RISC 6000, IBM RT, ILLIAC IV Cray 2 XMP, HP 9000

### **Fifth Generation computers (current to future)**

Combinations of some or all of the following technologies:

- Extremely large scale integration
- Parallel processing
- High speed logic and memory chips
- High performance, micro-miniaturization, Speed, Memory, etc
- Voice/data integration; knowledge-based platforms
- Artificial intelligence, expert systems
- Virtual reality generation
- Satellite links
- Generally expected to understand and processes human natural language accordingly.
  - More of intelligence (AI)

*Table 1. Computer Generation summary*

| Generation    | Time       | Circuit Elements     | Storage Devices | Languages             | Operating Systems   | Access Time    |
|---------------|------------|----------------------|-----------------|-----------------------|---------------------|----------------|
| <b>First</b>  | 1950s      | Vacuum Tubes         | Punched Cards   | Machine & Assembly    | Operator controlled | 1 Millisecond  |
| <b>Second</b> | 1959-1964  | Discrete transistors | Magnetic tape   | COBOL<br>FORTRAN      | Batch               | 10Microseconds |
| <b>Third</b>  | 1965-1970  | IC                   | Magnetic disk   | Structured language   | Interactive         | 100nanoseconds |
| <b>Fourth</b> | Late 1970s | VLSI                 | Mass Storage    | Applications oriented | Virtual             | 1nanoseconds   |

### **Types of Computers Classification by the method of operation (processing)**

There are different types of computers. The classification depends on different characteristics of computers.

Computers are classified into three by **the way they process data**.

1. **Analog computers** are one that **operates by measuring**. They deal with **continues variable**. They do not compete directly with numbers; rather, they operate by measuring physical magnitude such as pressure temperature, voltage, current and etc.

Analogue computer measures continuous types of data and uses physical quantities such as electric current. It is continuous fluctuation of voltage over time.

E.g. Thermometer, voltmeter, speedometer

Generally, they are computers designed for special purpose.

2. **Digital Computers** which deal with **discrete variables**. They **operate by counting** rather than measuring. They operate directly upon numbers (or digits) that represent numbers, letters, or other special symbols.

Digital computer is a computing device in which data is represented by discrete numerical quantities. It is represented by discrete voltage states (1s and 0s)

E.g. Personal Computers

They have **very high accuracy** and **speed** than analog ones.

### 3. Hybrid Computers

The best features of analog and digital computers can be combined into a single device to form a hybrid computer. It processes the information by collecting input data with analog method, converts it into digital quantities, processes the digital values and converts the output from digital to analog form.

#### Types of Digital Computers

Based on the **size, speed, cost** and **performance** we can divide digital computers in to four categories.

##### 1. Microcomputers

Microcomputer (often called personal computers or PCs for short) is the **smallest** but **most important** and **most frequently** used computer particularly for **end users**.

- They are relatively **small or compact in size** and are often **found on a tabletop or desktop**
- Microcomputers come in a **variety of sizes and shapes** for a variety of purposes. Basically they can be grouped into three: Laptop, Palmtop and Desktop computers.
- Laptop computers are smaller versions of microcomputers about the size of a briefcase designed for portability. People can easily carry these personal computers with them in their car, on airplane, or when walking from one location to another.
- Unlike desktop PCs that have mostly **detachable components**, laptops include all their components (except their printer) in a single unit.
- Palmtop computer is the smallest microcomputer that is about the same size as a pocket calculator. It is the most portable computer and is growing in popularity among the latest entries in the microcomputer market.
- Palmtops are typically used for limited number of functions, such as maintaining personal calendar, name and address files, or electronic worksheets.
- Desktop computer is the most widely used type of personal computer (microcomputers).
- Unlike laptop and personal computers, desktop computers have detachable parts. However, since its size is larger than the other types of personal computers, it is not easily portable.

In general, microcomputers are used for word processing, computerized worksheet analysis and modeling, graphics in the generation of charts and other graphic images, engineering activities and personal and home use.

##### 2. Minicomputers

- Minicomputers are **midrange** computers that are **larger** and **more powerful** than most microcomputers but are smaller and less powerful than mainframe computer systems.
- The minicomputers size prevents it from being easily portable although it can be moved more easily than a mainframe computer.
- Minicomputers **cost less** to buy and **maintain** than mainframe computers. Most minicomputers can function in **ordinary operating environments**, as they do not need special air conditioning or electrical wiring.
- Minicomputers are being used for a **large number of business and scientific applications**.

- They are popularly used in **scientific laboratories, research centers, universities and colleges, engineering firms, industrial process monitoring and control** etc.

### 3. Mainframes

- Mainframe computers are **large, powerful** computers that are physically larger than micros and minis and usually have **processors with faster** instruction processing speeds.
  - For example, they may be able to process from 10 to 200 million instructions per second (MIP).
- A mainframe computer is generally found in a **special computer room** where environmental factors such as temperature, humidity, dust and air conditions are closely monitored.
- Because of the computer's **cost and the value of the information stored** there, the rooms in which mainframes are located have **security systems** allowing only authorized personnel to enter.
- Mainframe computers are designed to **handle the information processing need of organization with many employees and customers or with complex computational problems**.
- To give some example, mainframes can handle the processing of thousands of customer inquiries, employee paychecks, student registrations, sale transactions, and inventory changes.
- They are also used as the **center of computer networking**. These computers are used by organizations that have enormous and complex data processing assignments.

### 4. Supercomputer

- The term supercomputer has been coined to describe a category of **extremely powerful** computer designed for **high-speed** processing. A supercomputer is generally characterized as being the **fastest, most powerful, and most expensive computer**.
- As many as **sixty miles of wiring** are closely packed inside supercomputers, and tremendous amounts of **heat are generated**. Because of this, supercomputers demand **special cooling requirement** and the room itself should be air-conditioned.
- Some supercomputers require extra floor support to hold the extreme weight of the complete system that includes storage units.
- In addition, highly trained data processing professionals are required to operate supercomputers. These computers can take inputs from over 10,000 individual computers and users at the same time.
- Super computers are largely used by **research organizations, military defense systems, national weather forecasting agencies, large corporations, aircraft manufacturer**, etc.

### Overview of Computer system

The computer system refers to the computer and all the components interconnected to it. Basically the computer system is categorized into two components:

- The hardware component and
- The software component

The computer hardware is the physical part of the computer system, which we can touch, see and break. On the other hand, the computer software is a set of instructions that instructs the hardware to perform different tasks. The instructions can be system level instruction such as instructing the printer to do some printing job or user level instruction does some data processing activities on behalf of a user.

### **Computer Hardware**

The computer hardware composed of three main components: CPU, Memory and Input/output devices.

### **The Central Processing Unit (CPU)**

At the center of computer hardware is the Central Processing Unit, otherwise known as the CPU or sometimes called the processor, which executes program instructions of the software and performs the computer's processing actions by manipulate data into information.

- The CPU is the collection of electronic circuits made up of millions of transistors placed onto integrated circuits.
- Integrated circuits are also called chips or microchips.
- Each transistor is an electrical switch that can be in one of two states “on” or “off”
- Small transistors allow more transforms to be packed on to one chip. This process, called integrating, means more of the CPU components can be placed onto a single chip, thus, eliminating the need for separate chips.
- Computer processing is electronic. Hence we don't see what is happening inside even if the cover is removed. No moving parts are observed.
- The speed at which it travels between points can be increased by either reducing the distance between the points or reducing the resistance of the medium to the electrical current.

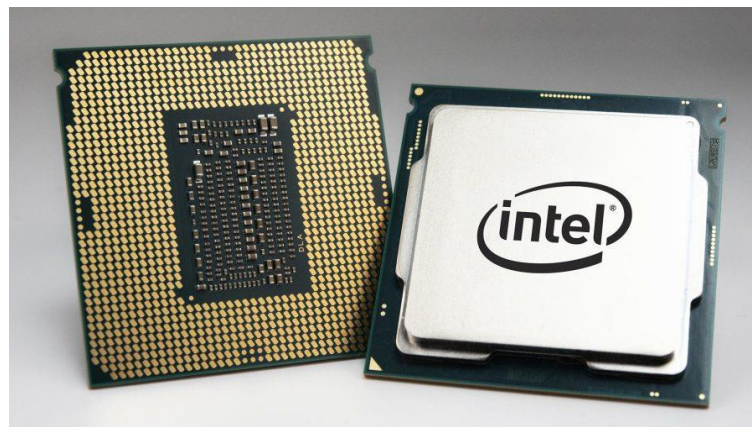


*Figure 4. Intel Core i7 9700K CPU*

### **The CPU has two major components**

- The Control Unit
- The Arithmetic/Logic Unit (ALU)

## **The control unit**

- The control unit is like the human brain and it oversees and controls all of the activities of the computer
- All computer activities are carried out according to instructions the control unit receives. Where, instructions are detailed descriptions of the actions to be carried out during input, processing, output, storage and transmission.
- The control unit does not actually execute the instructions (just as the brain does not do the walking or the talking); rather it instructs directs other processing elements to do so.
- The control unit tells the rest of the computer system how to carry out a program's instructions. It directs the movement of electronic signals between:
  - Main memory and the arithmetic/logic unit
  - Main memory and the input and output devices

## **Arithmetic/Logic Unit (ALU):**

Is the other component of the CPU which contains the electronic circuitry that performs the two activities that underline all computing capabilities -arithmetic operations and logical operations and controls the speed of those operations.

- **Arithmetic operations** are the Fundamental math operations: addition, subtraction, multiplication, and division
- **Logical operations** - Compare one element of information with the other. The comparison determines whether one information is greater than, less than or equal to the other. That is,  $A = B$ ,  $A > B$ ,  $A < B$ ,  $A \geq B$ ,  $A \leq B$

•

## **Memory (Main/primary/internal memory)**

- Memory also known as primary storage, main memory or internal memory is physically located close to the CPU (to decrease access time).
- The CPU interacts closely with memory referring to it both for instructions and data and information. However memory is separate from the CPU.
- The chief feature of memory is that it rapidly provides the data and instructions to the CPU

## **Memory space is used in five different ways**

- To hold the computers operating system program (DOS, Windows, etc.) that oversees processing and acts as an interface between the hardware and the application programs.
- To hold application programs like word processing, spreadsheet, etc.
- To hold data and information temporarily, receiving from input devices and sending them to output devices during processing
- To store other data or information needed in processing in the working storage area.
- To provide additional space for programs or data, as needed.

## **Memory size (storage capacity)**

- Like the CPU, memory devices contain thousands of circuits imprinted on a silicon chip. By representing data as a combination of on or off circuit states, the data is stored in memory.
- Computers vary widely in the amount of internal (primary) memory they have. The size of memory is measured by the number of storage locations it contains. Each storage location or byte has a predetermined capacity
- A byte is the amount of memory required to store one digit, letter or character. A byte is equal to eight bits. Bytes are generally measured by

- Kilobyte (kb, k-byte)

Although, accepted as approximately one thousand, it actually means  $2^{10}$  or 1,024. A storage device with 640 KB capacity can hold  $460 \times 1,024$  (or 655,360) bytes.

- Megabyte (mb, M-byte) millions of bytes. Accepted as approximately one million actually equal 1,048,576 ( $1,024 \times 1,024$  or  $2^{20}$ )
- Gigabytes (gb, G-bytes) → billions of bytes. Accepted as approximately one billion, actually equals 1,073,741,824 ( $1,024 \times 1,024 \times 1,024$ , or  $2^{30}$ )
- Terabyte (tb, T-byte) → trillions of bytes. Accepted as approximately one trillion, actually equals 1,099,511,627,776 ( $1,024 \times 1,024 \times 1,024 \times 1,024$  or  $2^{40}$ )

### **Types of Memory**

Main Memory is divided into two: Read Only Memory (ROM) and Random Access Memory (RAM).

#### **Read-Only Memory (ROM)**

Nonvolatile chips always hold the same data; the data in them cannot be changed except through a special process that overwrites the data. In fact, putting data permanently into this kind of memory is called "burning in the data," and it is usually done at the factory. During normal use, the data in these chips is only read and used -not changed- so the memory is called read-only memory (ROM). One important reason a computer needs ROM is that it must know what to do when the power is first turned on. Among other things, ROM contains a set of start-up instructions, which ensures that the rest of memory is functioning properly, checks for hardware devices, and checks for an operating system on the computer's disk drives.

Examples of ROM- PROM (Programmable Read Only Memory),

- EPROM (Erasable Programmable Read Only Memory)



*Figure 5. ROM (Read Only Memory)*

### **Random-Access Memory (RAM)**

A Memory that can be instantly changed is called read-write memory or random-access memory (RAM). When people talk about computer memory in connection with microcomputers, they usually mean RAM. RAM is volatile, which means couldn't retrieve the data when power is off.

A computer does not have to search its entire memory each time it needs to find data because the CPU uses a memory address to store and retrieve each piece of data. A memory address is a number that indicates a location on the memory chips, just as a post office box number indicates a slot into which mail is placed. Memory addresses start at zero and go up to one less than the number of bytes of memory in the computer. This type of memory is referred to as random-access memory because of its ability to access each byte of data directly.

Actually, read-only memory (ROM) is "random access" as well, so the names for the two types of memory can be misleading. It is best simply to remember that the data in ROM does not change while the data in RAM changes constantly. RAM is not just used in conjunction with the computer's CPU. RAM can be found in various places in a computer system. For example, most new video and sound cards have their own built-in RAM, as do many types of printers.



*Figure 6. RAM( Random Access Memory)*

### **Cache Memory**

Cache, in computer science, is an area of memory that holds frequently accessed data or program instructions for the purpose of speeding a computer system's performance. A cache consists of ultra-fast static random-access memory (SRAM) chips, which rapidly move data to the central processing unit.

By making the cache larger, it is possible to hold more "frequently" used data. Older motherboards used from 128 KB to 256 KB of cache. Current motherboards use 512 KB to 1MB of cache RAM.

It is a bridge between a slow device and a fast device. A hard disk controller with cache memory will store most recently used hard disk data on the cache. The CPU cache stores most-likely-to-be-needed-next data from the main memory so the CPU can receive it quick when the CPU is ready for another byte.

Registers are special high-speed circuitry areas that temporarily store data during processing and provide working areas for computation. Registers are contained in the processor and hold material to be processed immediately. Data and program instructions are loaded from main memory into the registers just before processing. To execute the machine cycle the control unit depends on registers, temporally storage areas in the processor. Move data more quickly than the main memory.

## Ports: Connecting Peripherals

---

Microcomputers have different types of ports. A port is a socket on the outside of the system unit that is connected by a bus to an expansion board on the inside of the system unit or connected directly to integrated circuitry on the motherboard. Using a cable, you can plug a peripheral device (monitor, printer, etc.) into its port, allowing it to communicate with the computer system.

There are several different types of ports:

- **Parallel ports.** Lines connected to a parallel port allow 8 bits to be transmitted simultaneously, like cars on an eight-lane highway. While parallel lines move information more quickly than do serial lines, they are limited to an effective transmission distance of only 15 feet (5.4 meters). So, parallel ports are used principally for connecting printers.
- **Serial ports.** Lines connected to a serial port, or RS-232 port, send bits one after the other in a single sequence, like cars on a one-lane highway. Serial ports are used principally for communications lines, modems, scanners, and mouse and in the case of the Macintosh, the printer. Serial ports are often called COM ports, for communications.
- **Video adapter ports.** Video adapter ports are used to connect the video display monitor outside the computer to the video adapter card inside the system unit.
- **SCSI (Small Computer System Interface) ports.** Pronounced as "skuzzy," a SCSI port provides an interface for transferring data at high speeds for up to seven or fifteen SCSI-compatible devices, linked together in what is called a daisy chain, along an extended cable. These devices include external hard disk drives, magnetic-tape backup units, scanners, and CD-ROM drives.
- **Game ports.** Game ports allow you to attach a joystick or similar game-playing device to the system unit.
- **Infrared ports.** These wireless, data-transfer ports are available on new computers and hardware peripherals such as printers. This type of connection uses a certain frequency of radio waves to transmit data, and so it requires an unobstructed line of sight between the transmitter and the receiver.

## PC slots and Cards

- Most of today's microcomputers have open architecture-that is, they can easily be opened, so that users can add new devices and enhance existing capabilities.
- This allows for easy upgrades without having to purchase an entirely new system.
- Expansion slots also called bus slots are sockets on the motherboard into which you can plug expansion cards, after you open the system unit. Expansion cards, or adapter cards, are circuit boards that provide more memory or control peripheral devices.

## Input/output Unit

---

The Input/output (I/O for short) subsystem also does exactly what its name implies - it takes input from the outside world and sends them to either the memory or the CPU for processing, and it also takes bits and sends them back out.

## Input Devices

Input hardware consists of devices that translate data into a form the computer can process.

- Keyboard
- Pointing devices
  - Mouse, trackballs, joysticks, and touch pads
  - Light pens
  - Digitizing tablets
- Voice recognition devices
- Scanning devices
- Digital computer cameras
- Optical data reader
- Automatic teller machines, etc.



Figure 7. Examples of manual input devices



*Figure 8. Example of output device*

## Keyboard

- Is an input device consisting of a set of typewriter-like keys that enable one to enter data into a computer.
- Input devices other than the keyboard are sometimes called alternate input devices.

The keys on the keyboard are often classified as follows

- Alphanumeric keys Letters and numbers
- Punctuation keys comma, period, semicolon, etc.
- Special keys function keys control keys, arrow keys, caps lock, etc.

In detail the following are descriptions of the keyboard.

- **Escape key**-Generally used to abort some actions.
- **Function keys**-functions vary from program to program. The purpose of each function key is defined by the software in use.
- **Enter key**- used to enter commands and to create blank lines in a document.
- **Backspace key**- used to move the cursor backwards, deleting backward.
- **Tab key**- used to access tab stop.
- **Caps lock key**-works like the shift lock.
- **Shift key**- used to produce upper case letters and sometimes to invoke commands.
- **Control key and alt key**- commonly used in combination with other keys to enter commands e.g. control home.
- **Insert key**-used to enter characters.
- **Arrow keys**-used to move the cursor around the display screen.
- **Delete keys**-used to delete characters.
- **Number locks keys**-used to activate the numeric keypad.
- **Print screen keys**-used to print the contents of the screen.

The standard layout of letters, numbers, and punctuation is known as a QWERTY keyboard because the first five keys on the top row of letters spell Q.W.E.R.T and Y. Ergonomic keyboards- are designed to

reduce the strain while typing with the aim to prevent stress related injuries. E.g. Microsoft's natural keyboard.

### **External/Secondary/Auxiliary Storage Devices**

Primary storage is the section of the computer that holds data and information and instructions before and after processing. In contrast, secondary storage, also known as auxiliary storage, is a way of storing data and information outside the computer itself. Secondary storage is any storage medium that is external to the computer but that can be read by the computer. It supplements the main storage. It is a long-term non-volatile memory.

Unlike RAM, it stores data after the computer is switched off. Unlike ROM, it is possible to write to the secondary storage anytime. It is also used to transfer data and information from one computer to the other without the need to connect the two computers. Secondary storage's can be categorized as magnetic and optical.

The most common types of secondary storage are:

- Magnetic tapes
- Magnetic discs
- Optical disk

### **Magnetic Storage**

Data are stored on the magnetic medium by a read/write head, a device that records data by magnetically aligning metallic particles (iron oxide mixed with a binding agent) on the medium.

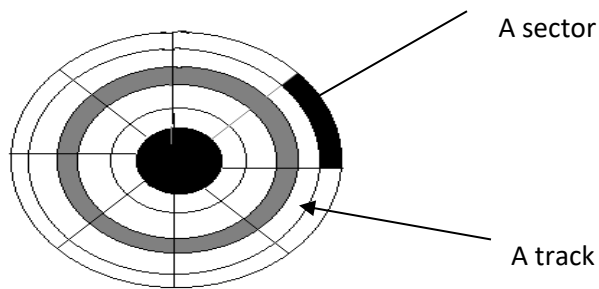
These particles correspond to binary digits (alignment represents 1 and non-alignments represent 0). Magnetic storage is of two types' magnetic tape and magnetic disk

**Magnetic tape:** It is a cartridge, slightly larger than audio cassettes. Data are stored and/or written to the magnetic tape by a read/write head on the tape drive, a peripheral device that holds and processes the tape. It is mostly used as a backup (to keep data) in different organization. The data access mechanism is sequential.

**Magnetic disk (provide Direct/random access):** Refers to floppy disk, flash disk, hard disk. Magnetic disk storage is often called random access storage or direct access storage. That is to say, a particular record or information can be obtained from track directly.

- Flexible disk (also known as flopping disks) which are made of flexible plastic. - Similar to a hard disk, just a lot less dense; they usually only store about 1.44 megabytes. Floppy disks get their name because their platter isn't made out of a hard material, but rather out of the same material that tapes are made out of.
- Hard disks, which are made of rigid aluminum material.
- Flash disk recently introduced more compact storage device.

- Magnetic tapes are examples of sequential access media.



- Magnetic disks in general consist of tracks on which data are recorded as magnetic spots. Each track is further divided into sectors. The same amount of data can be recorded on any track in a sector (512Byte) (equivalent to storing 512 characters). Bits are more tightly packed on the inside tracks than on the outside tracks because the inside tracks are shorter.

**The Floppy Disk:** Think of a floppy disk as a serving tray. Whenever you want to get information into a computer, you must deliver the information either from the keyboard or on a floppy disk. Likewise, if there is something in your computer that you want to store for safekeeping or share with another user, you can copy the information from the computer to a floppy disk.

Two characteristics describe floppy disks – size and capacity. Size refers to the physical dimension of the disk and capacity refers to the amount of information the disk can hold. Floppy disks come in two main sizes and capacities:

3 1/2-inch. This disk is a small, plastic square with a spring-loaded metal door or shutter. 3 1/2-inch disks typically come in two capacities: the most common 1.44M (high-density) disk, or 720K (double-density) disk. Some newer machines may also support extra-density floppies, which hold 2.88M --twice the amount of data as the high-density disk.

5 1/4-inch. These disks are very thin, truly floppy disks. Although there are many, many still in use today, 5 1/4-inch floppies are rapidly disappearing; they hold less data than 3 1/2-inch floppies, and they are much more easily damaged.

**The Hard Disk: it is mass storage media found mostly inside the system unit.** It uses a spinning magnetic platter(s), bits are stored in the magnetic field of this platter. Hard disks can store enormous amounts of data (40 gigabytes or more), but it is a lot slower to access them than it is to access RAM. They also don't lose their value when the power is turned off.

The hard disk is like a big floppy disk with higher capacity. You don't take the disk out; it stays in the drive forever.

**Optical disk/storage:** Optical storage devices use the principle of light to store information. The data actually recorded by burning on a tiny hole which is called pitch to store 0's/1's. Optical disks are storage medium from which data is read and to which it is written by lasers. The two common types are CD and DVD.

CD-ROM - Reads bits stored on a compact disk, usually about 700 megabytes per disk. Bits are stored as grooves in the disk surface, and an optical laser is used to read the bits.

**Compact disk (CD):** is a form of data storage that uses laser optics rather than magnetic means. CD-ROM stands for Compact-Disk Read-Only Memory. The term compact disk is used because it is exactly

the same format as the audio compact disc. In fact, the computer CD-ROM drive, given the right interface, can play music. The term ROM is used because they are read only. Like audio CDs, the data is stamped on them when they are manufactured; they cannot be erased.

CD-ROMs are portable like floppies but have much higher capacities, over 600MB per disk. Because of this they are used to distribute data and software that would normally require tens or hundreds of floppies including reference works, large software packages, and clip-art collections. The variation of compact disk includes:

- CD-R (CD Recordable, record/write once but read many times).
- CD-RW (CD rewritable, read/write many times).
- CD-ROM (CD read only memory).

**Digital Video Disk (DVD):** DVD is a type of optical disc storage technology. A digital video disc (DVD), also known as digital versatile disk, looks like a CD-ROM disc, but it can store greater amounts of data (as much as 17GB or more of data). Thus, DVDs are often used to store full-length movies and other multimedia content that requires large amounts of storage space. It requires appropriate DVD driver to read/play this type of media. CD-ROM driver does not read data from such media.

Because of the different ways memory components store bits, they all have different sizes and speeds. The speed of a memory component is the amount of time it takes for that component to read and return the requested bits or store new bits. RAM's are the fastest components, but they also generally hold the least amount of bits.

### Unit of Measurements

Storage measurements: The basic unit used in computer data storage is called a bit (binary digit). Computers use these little bits, which are composed of ones and zeros, to do things and talk to other computers. All your files, for instance, are kept in the computer as binary files and translated into words and pictures by the software (which is also ones and zeros). This two-number system, is called a “binary number system” since it has only two numbers in it. The decimal number system in contrast has ten unique digits, zero through nine.

*Table 2. Computer Storage units*

|          |      |                |
|----------|------|----------------|
| Bit      | BIT  | 0 or 1         |
| Byte     | Byte | 8 bits         |
| Kilobyte | KB   | 1024 bytes     |
| Megabyte | MB   | 1024 kilobytes |
| Gigabyte | GB   | 1024 megabytes |
| Terabyte | TB   | 1024 gigabytes |
| Petabyte | PB   | 1024TB         |
| Exabyte  | EB   | 1024PB         |

Size example

- ✓ 1 bit - answer to an yes/no question

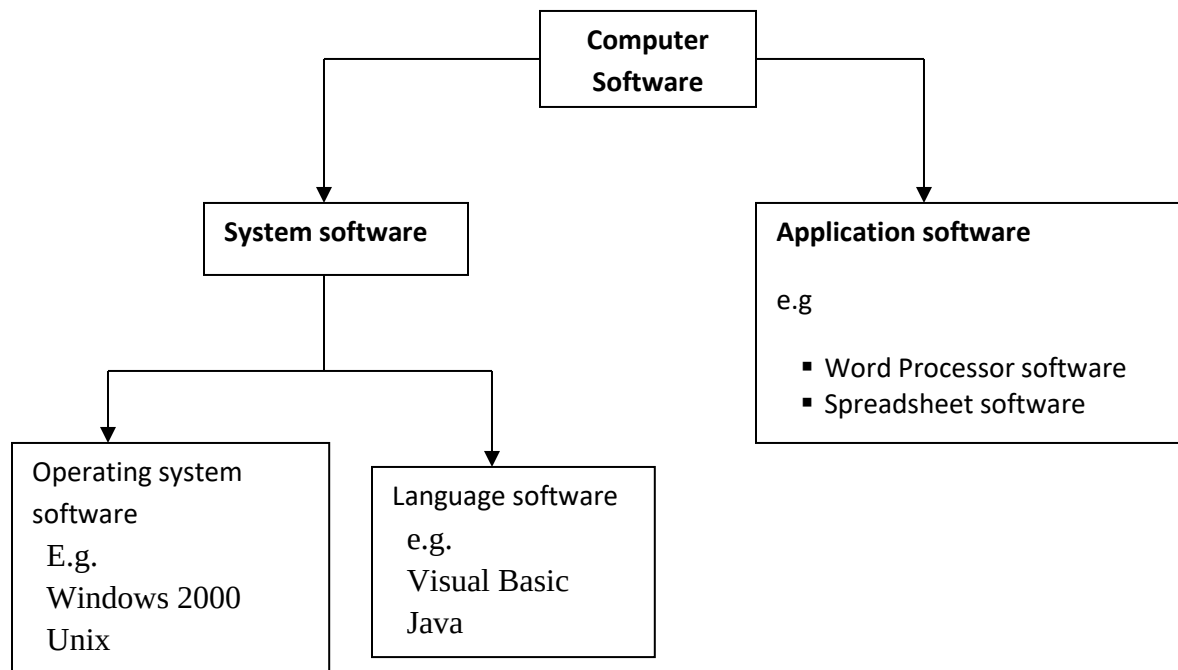
- ✓ 1 byte - a number from 0 to 255.
- ✓ 90 bytes: enough to store a typical line of text from a book.
- ✓ 4 KB: about one page of text.
- ✓ 120 KB: the text of a typical pocket book.
- ✓ 3 MB - a three-minute song (128k bitrate)
- ✓ 650-900 MB - a CD-ROM
- ✓ 1 GB -114 minutes of uncompressed CD-quality audio at 1.4 Mbit/s
- ✓ 8-16 GB - size of a normal flash drive

### **Overview Computer Software**

The computer software is collection of set of instructions that instructs the computer hardware. These set of instructions perform different functions; some deals with handling the computer hardware and the others perform user specific tasks such as managing a database. Therefore the computer software is divided into two major categories:

1. System software and
2. Application software

The following figure shows the classification of the computer software



## System Software

The system software handles the computer hardware so that the user can operate the computer with little knowledge about the computer hardware. For example, the user is not concerned where the file is saved on the hard disk. This is the responsibility of the system software to check the hard disk and use the free space of the hard disk.

The system software is further divided as operating system software and language software.

### Operating system software

An operating system is a program that acts as the link between you, the computer's software and hardware resources. It is the foundation software onto which all other application programs are loaded. It is the master program of your system that allows you, the user, to run application programs (Word Processors, Spreadsheets, Games, etc.)

Without the operating system the application software would be unable to function.

Operating System software manages most of your computer's activities, including the allocation of **computer resources, maintenance of files, and running of application** software. As a file manager the operating system is used to **name, save, retrieve and maintain program and data files** you create and use on your computer. As a resource manager, the operating system controls the flow of information through your computer. Data accepted by the keyboard, seen on the display, or sent to a printer are all under the control of the operating system.

The first segment of the operating system software is contained in the ROM (firmware) of your computer. This software tests the internal components and circuitry of the computer when it is turned on.

After completing the Startup tests, the ROM-based software activated the next segment of the operating system found on the disk.

Examples of operating system software include MS-DOS (Microsoft Disk Operating System), MS-Windows, UNIX.

“It is the first software we see when we turn on the computer, and the last software we see when the computer is turned off.” It organizes and controls the hardware on our desks and in our hands.

- The operating system allows you to concentrate on your own tasks or applications rather than on the complexities of managing the computer.

OS does the following two things at a minimum:

- Manages the hardware and software resources of the computer system such as memory, disk space, etc
  - Ensures all applications get access to the available resources such CPU and Memory
- Provides stable, consistent way for applications to deal with the hardware without having to know all the details of the hardware
  - An application can run on different computers with different RAM size, older application can work on new hardware

Generally the operating system does six things

1. Processor management

2. Memory management
3. Device Management
4. Storage management
5. Application interface
6. User interface
7. Coordinating communications on Network

How operating system boots?

- When computer turned on, instructions on ROM executed
- Makes Power on Self-Test (POST), i.e. it checks the attached hardware devices such as CPU, Memory, keyboard, printer, etc.
- Stores the result on special memory location
- Loads the first piece of OS, called Bootstrap loader from the hard disk
  - The bootstrap loader sets up the small driver programs that interface with and control the various hardware systems of the computer. It sets up the divisions of memory that hold the operating system, user information and applications

Type of operating systems

1. Single tasking operating system – one program loaded at a time. E.g. Dos
2. Multitasking operating system – load two or more programs at a time. For example Microsoft Windows 98, 2000, XP
3. Multi-user and Multi-tasking operating system – two or more programs loaded at a time and at the same time two or more users access the same application.

For example UNIX, Windows 2000 Advanced Server, Novel Netware

### Application Software

Application software is software developed to do user specific tasks such as word processing, spreadsheet and database management. It is developed using the language software.

Application software is a set of related programs designed to carry out certain tasks that fulfill users' specific needs. Among the most common software that fall in this group include Word processors such as Microsoft word and Word Perfect; Spreadsheet Packaged like Microsoft Excel; and Database Management software such as MS-Access and MS-FoxPro; Desktop Publishing software such as Corel Ventura and Page Maker; Graphics packages such as Corel Draw and Auto CAD and Accounting Software such as Peachtree and DaeEasy.

*Table 3. Comparison Application Software and System Software*

|  | <b>System Software</b>                                                                                                                                                                                 | <b>Application Software</b>                                                                                                               |
|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
|  | Computer software, or just software is a general term primarily used for digitally stored data such as computer programs and other kinds of information read and written by computers. App comes under | Application software, also known as an application or an "app", is computer software designed to help the user to perform specific tasks. |

|             |                                                                                                                                               |                                                                                                                                                                                                                                                                                                                         |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | computer software though it has a wide scope now.                                                                                             |                                                                                                                                                                                                                                                                                                                         |
| Examples    | <ol style="list-style-type: none"> <li>1. Microsoft Windows</li> <li>2. Linux</li> <li>3. Unix</li> <li>4. Mac OSX</li> <li>5. DOS</li> </ol> | <ol style="list-style-type: none"> <li>1. Opera (Web Browser)</li> <li>2. Microsoft Word (Word Processing)</li> <li>3. Microsoft Excel (Spreadsheet software)</li> <li>4. MySQL (Database Software)</li> <li>5. Microsoft PowerPoint (Presentation Software)</li> <li>6. Adobe Photoshop (Graphics Software)</li> </ol> |
| Interaction | Generally, users do not interact with system software as it works in the background.                                                          | Users always interact with application software while doing different activities.                                                                                                                                                                                                                                       |
| Dependency  | System software can run independently of the application software.                                                                            | Application software cannot run without the presence of the system software.                                                                                                                                                                                                                                            |