TOPIC THREE

COMPUTER HARDWARE

- Computer hardware describes the physical components of a computer that can be touched and seen, like disks, disk drives, display screens, keyboards, printers, etc.

Hardware are computer equipment used to perform input, processing, and output activities.

Computer configuration
- The computer configuration (system) describes the way the physical elements of a computer and its peripherals are interconnected.

The computer system is made up of the computer i.e. CPU and its peripherals, which help the computer to communicate to, or from the environment.

Computer Peripherals
- Computer peripherals are all devices that are being attached/connected to the computer (CPU) e.g. keyboard, monitor screen, printer, diskette, scanner, mouse, etc.

Central Processing Unit (CPU)
- The central processing unit (CPU), is the hardware within a computer system which carries out the instructions of a computer program by performing the basic arithmetical, logical, and input/output operations of the system.

This is where the work of processing is done, hence the CPU can be described as the Computer "brain" or "heart" that monitors all the computer operations.

The CPU is made up of the three main components:
a. Control Unit
b. Arithmetic and Logical Unit(ALU)
c. Registers
d. Buses
e. Main Memory.

Computer Functional Organization Chart
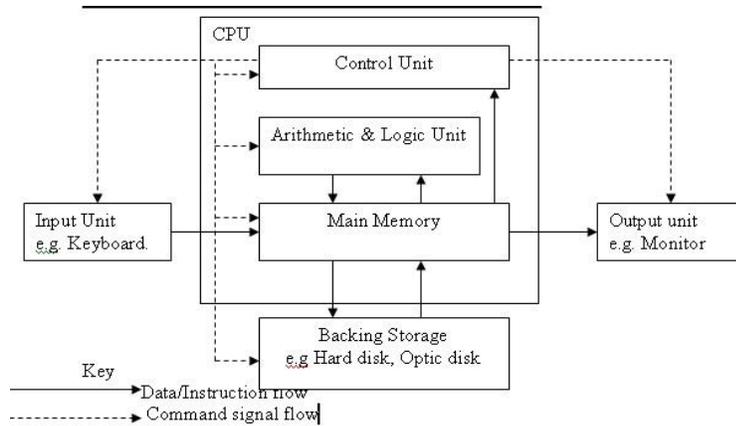
The Control Unit
- The control unit uses electrical signals to direct and supervises the entire computer system to carry out, or execute, stored program instructions.

The control unit does not execute program instructions; rather, it directs other parts of the system to do so. The control unit must communicate with both the arithmetic/logic unit and memory.

Control unit's other functions are:
i)   Retrieving and decoding program instructions from the main memory and make the computer execute these instructions. ii) Coordinating and controlling various parts of the computer system like main memory, ALU, and peripheral devices.

ii)   Controlling the transfer of data to, from and within the main memory.

iii)   To control the sequence of operations v) Store results in the CPU memory.

The Arithmetic and Logical Unit
- The arithmetic/logic unit (ALU) is a circuitry that executes all arithmetic and logical operations.

The arithmetic/logic unit can perform four kinds of arithmetic operations, or mathematical calculations: addition, subtraction, multiplication, and division.

Arithmetic/logic unit also performs logical operations. A logical operation is usually a comparison. The unit can compare numbers, letters, or special characters. The computer can then take action based on the result of the comparison.

Logical operations include:
- **Equal-to condition.** In a test for this condition, the arithmetic/logic unit compares two values to determine if they are equal. For example: If the number of tickets sold equals the number of seats in the auditorium, then the concert is declared sold out.

Greater-than condition.

In this type of comparison, the computer determines if one value is greater than another. For example: If the hours a person worked this week are greater than 40, then multiply every extra hour by 1.5 times the usual hourly wage to compute overtime pay.

Less-than condition.

To test for this condition, the computer compares values to determine if one is less than another. For example: If the number of speeding tickets on a driver's record are less than three, then insurance rates are shs.150,000; otherwise, the rates are shs250000

How ALU operates
The various data items to be processed are taken from the main memory as directed by the Control Unit, and stored in its registers. They then undergo the required operations (add, subtract, multiply, divide).
The results are placed back in the main memory.

Registers
- Registers are high speed storage areas that temporarily hold data and instructions that will be used immediately by the CPU.

Registers are not a part of memory; rather they are special additional storage locations that offer the advantage of speed.

The computer loads the program **instructions** and **data** from the main memory into the registers just prior to processing, which helps the computer to process faster.

Registers work under the direction of the control unit to accept, hold, and transfer instructions or data and perform arithmetic or logical comparisons at high speed.

The common types of Registers include:
- **An accumulator**, which collects the result of computations.
- **An address register**, which keeps track of where a given instruction or piece of data is stored in memory. Each storage location in memory is identified by an address, just as each house on a street has an address.
- **A storage register**, which temporarily holds data taken from or about to be sent to memory. - A **general-purpose register**, which is used for several functions.
- **Program Counter Register**, which holds the address of the next instruction to be fetched from the main memory.
- **Current Instruction Register**, which holds the instruction to be obeyed currently.
- **Instruction Decoder**, which interprets (decodes) the instructions currently held in the instruction register.

Buses
- Buses are electronic paths (channels) that make the element of computer systems hardware to communicate.

These channels or highways convey data, instructions, information, control command, and power among communicating elements.

Main Memory

- Main memory is a temporary storage that holds data and program instructions waiting to be processed by the computer.

Main memory forms the working area of the computer, that is, all the data/instructions to be processed must be temporarily stored on the main memory.

The main memory can alternatively be called:
- Primary memory.
- Internal Memory
- Random Access Memory (RAM)
- Immediate Access Memory (IAM)

Roles of main memory:

- To hold data that is waiting to be processed.
- To hold instructions (programs) for processing the data.
- To hold the processed data (results) before they are communicated to any of the output devices.

Main memory's Functional Areas

The main memory consists of the following functional areas:

- **Input Storage Area**, which temporarily holds data that has been read from the input device.
- **Program Storage Area**, which holds instructions from both systems software and applications software.
- **Working Storage Area**, which is used to hold the data being processed as well as the intermediate results of such processing.
- **Output Storage Area**, which holds the finished results after processing until they are released to the user.

Memory, CPU, I/O Equipment

- Memory is the part of the computer that holds data and instructions for processing.
- Although closely associated with the central processing unit, memory is separate from it.
- Memory stores program instructions or data for only as long as the program they pertain to is in operation.

Main

Computer organization refers to the operational units and their
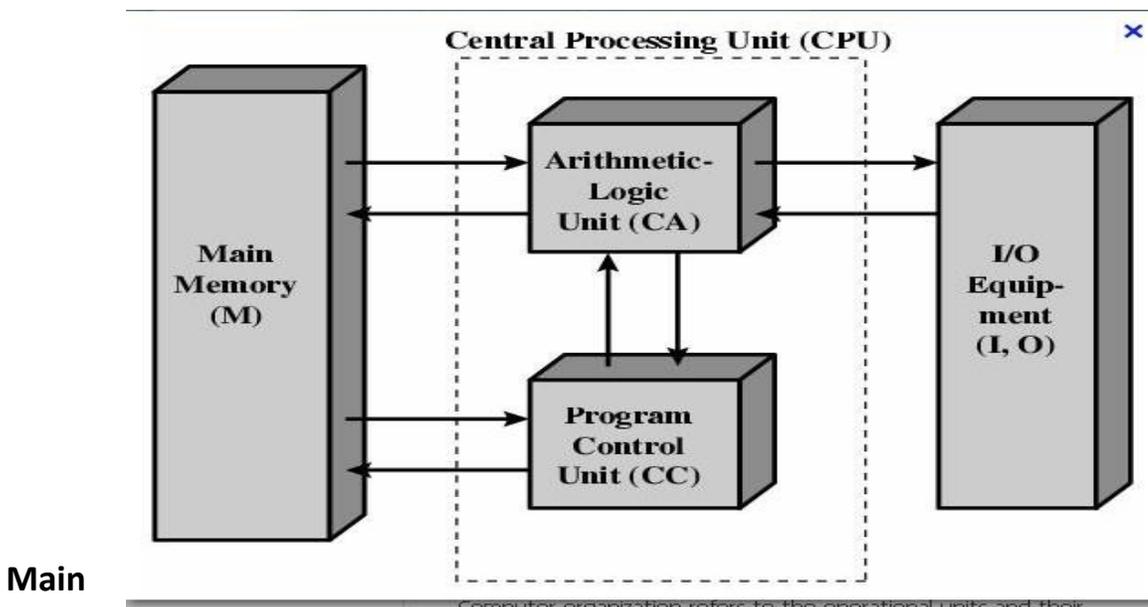
Memory Setbacks

Three reasons for not using main memory to store information include:
Most types of memory only store items while the computer is turned on; data is destroyed when the machine is turned off.

Main memory is limited therefore there may not be enough room hold the processed data.

Main memory is very expensive given its storage size compared to hard disk.

Sections of Main Memory
Main memory is divided into two major sections which include **Random access Memory** (RAM) and **Read Only Memory** (ROM)

Random Access Memory
- RAM section of memory can be described as read and write memory, as it is possible for both to write on and read its contents.
- It can be expanded to improve on its memory space.
- It's meant for the computer users who can edit its contents.
- RAM contents occupy the memory only temporarily and are swapped with other contents after they have been processed.

Characteristics of RAM include:
      i)   RAM section of memory can both be written and read.

      ii)   RAM is volatile, that is, its contents disappear when the power has been switched off.

The transfer of data or instructions to the memory is described as **writing on the memory**.
Also, the transfer of data or instructions from memory is described as **reading or retrieving the contents of memory.**

Functions of RAM.
    i)   To store data and instructions awaiting processing.
    ii)   To store instructions which are being obeyed or whose parts have been obeyed by the computer.
    iii)   To store the intermediate results of computer working before they are communicated to their recipients.

Read Only Memory (ROM)
- ROM is a type of memory that can only be read but not written by the computer users. Its contents are useful to the machine and they don't have a direct effect to the user.

Characteristics of **ROM** include:
i) ROM section of memory can only be read but not written.
ii) ROM is non-volatile, that is, its contents cannot disappear on power switch off.

The functions of ROM include:
☞ To store data and instructions that are necessary for the normal functioning of the computer system hardware.
☞ To store the control programs that are necessary for the initial activation of the hardware on power switch on.

PROM

PROM stands for Programmable Read Only Memory. The ICs of PROM are bought when they contain no data or instructions and they are being programmed by their users as appropriate, after which, their contents remain strictly read only.

EPROM

EPROM stands for Erasable Programmable Read Only Memory. The ICs of EPROM are bought when they are not programmed. They are programmed appropriately as per requirement of the user after which they can be subsequently being erased using ultra violet light or electrical pulses and be re-programmed.

Other Forms of Memory
The performance of microcomputers can be further enhanced by adding other forms of memory as follows:

a. Cache Memory
Cache memory, also called CPU memory, is random access memory (RAM) that a computer microprocessor can access more quickly than it can access regular RAM.

Cache memory is a special high speed memory area that the CPU can access quickly.

Cache memory is used with computers with very high speed CPU.

The most frequently used instructions are kept in cache memory so that the CPU can look there first. This allows the CPU to run faster because it does not have to take time to swap instructions in and out the main memory.
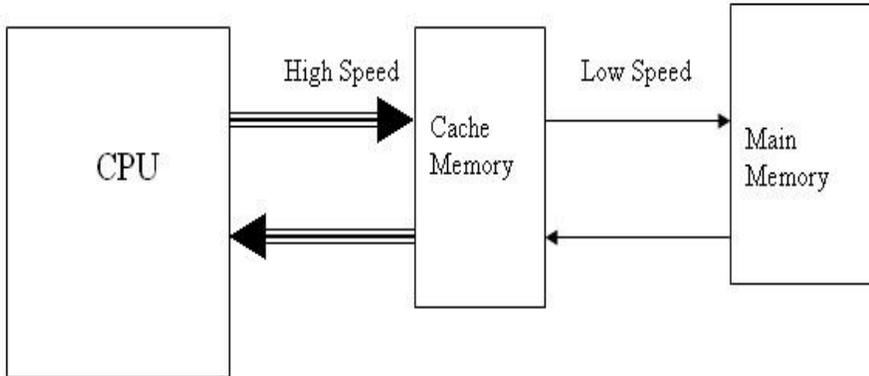
b. Video Memory
   a. Video memory or Video RAM (VRAM) chips are used to store display images for the monitor.
   b. The amount of video memory determines how fast images appear and how many colors are available.
   c. Video memories are particularly desirable when you are running programs that display a lot of graphics.

c. Flash Memory
   a. Flash memory is mainly used in note-book and sub-note book computers, cellular phones, Digital Cameras, and Personal Digital Assistants (PDAs).
   b. Flash memories are non-volatile.

BIOS ROM
   c. This type of memory contains the Basic Input/output system (BIOS) which is the sequence of instructions the computer follows to load the operating system and other files when the computer is turned on.

d. Complementary Metal Oxide Semi-Conductor (CMOS)
   a. This is used to store configuration information about the computer which includes amount of memory, disk drives, keyboard, monitor, current date and time.
   b. CMOS chips use battery to retain information even when the power is turned off. - Unlike ROM, information stored in CMOS can be changed.

e. Buffer

The computer buffer is a special purpose temporary memory location used during input/output (I/O) or processing to hold data and or instructions between communicating elements.
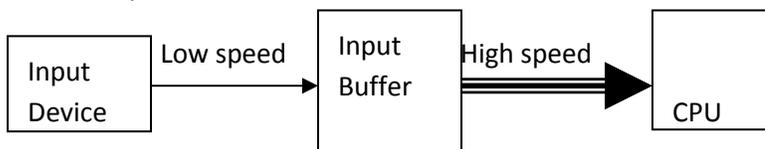
The role of Buffer:

Buffers counterbalance the speed differences between two communicating elements by accepting data/instructions at the speed of the sending element and remit them at the speed of the receiving element.

The forms of buffer are:
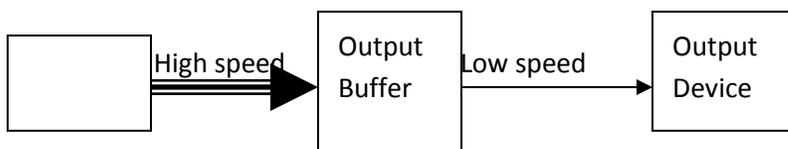 i)   Input buffer
  ii) Output buffer

Input Buffer
Input buffer is used between the input device (the sending device) and the CPU (the receiving device).

| Input Device | Low speed → | Input Buffer | High speed ⇒ | CPU |

 The role of input buffer is to accept data/instructions at the speed of input device, which is comparatively slow, and remits them at the high speed of the CPU to go as computer inputs.

Output buffer
The output buffer is used between the CPU and the output unit

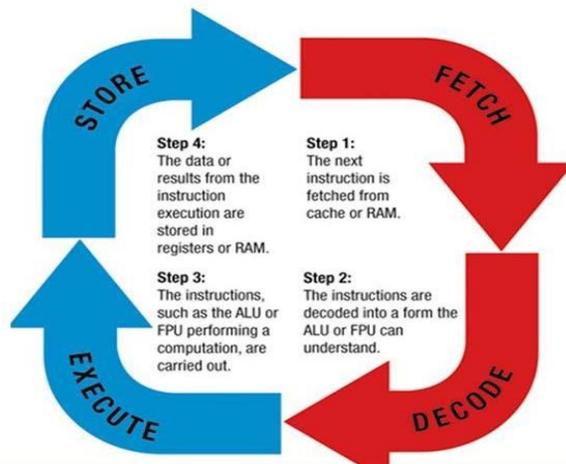| | High speed ⇒ | Output Buffer | Low speed → | Output Device |

The role of the output buffer is accept data and instructions at the high speed of the CPU and remits them at the low speed of the output device, to go as computer outputs.
The process of using the buffer to control the speed of communication between the CPU and peripheral devices is known as **buffering**.

Machine Cycle

The **machine cycle** is a series of operations performed to execute a single program instruction. The machine (CPU) cycle consists of four steps:

- Fetch
- Decode/Interpret
- Execute
- Store/write

Step 4: The data or results from the instruction execution are stored in registers or RAM.

Step 1: The next instruction is fetched from cache or RAM.

Step 3: The instructions, such as the ALU or FPU performing a computation, are carried out.

Step 2: The instructions are decoded into a form the ALU or FPU can understand.

FPU – Floating Point Unit: A part of computer that carries out operation on floating point numbers i.e. numbers with large number of decimal places.

Before an instruction can be executed, program instructions and data must be placed into memory from an **input device** or a **secondary storage device**.

Once the necessary data and instruction are in memory, the central processing unit (Machine) performs the following four steps for each instruction:

- The control unit **fetches** (gets) the instruction from memory.
- The control unit **decodes** the instruction (decides what it means) and directs that the necessary data be moved from memory to the arithmetic/logic unit. These first two steps together are called **instruction time**, or **I-time**.
- The arithmetic/logic unit **executes** the arithmetic or logical instruction. That is, the ALU is given control and performs the actual operation on the data.
- The arithmetic/logic unit **stores** the result of this operation in memory or in a register. Steps 3 and 4 together are called **execution time**, or **E-time**.

Backing Storage

The backing storage provides the permanent and massive storage of data for future reference.
Backing storage can alternatively be called:
  i)   Auxiliary memory.
  ii)   Secondary memory
  iii)   External memory

Characteristics of Backing Storage are:

i)   They provide large space for storing programs and data files.
ii)   The store data permanently for future reference.
iii)   Backing store cannot be directly be accessed by the CPU, therefore, its contents must be read into main memory before they can be processed.
iv)   It acts as both input and output device.

Backing store acts as input device when data and instructions are read from it. Also, it acts as output device when data and instructions are transferred (written) onto it.

The difference between Primary Memory and Secondary Memory

Primary Memory	Secondary Memory
i) It stores data/instructions temporarily i.e. its contents disappear when the power is turned off.	i) It stores data/instructions permanently i.e. its content remain intact when the power is turned off.
ii) It's limited on its storage capacity.	ii) It can store large amount of data.
iii) Its contents can directly be accessed by the CPU.	iii) Its contents cannot directly be accessed by the CPU.
iv) The speed at which data is accessed from the primary memory is high.	iv) The speed at which data is accessed from the secondary memory is low.

Common types of backing storage (storage media) include:
   ☞ Floppy Diskettes
   ☞ Hard disks
   ☞ Optic disks
   ☞ Magnetic tapes
   ☞ Flash disks

The following table summarizes the characteristics of the various kinds of data storage in the storage hierarchy:

Storage	Speed	Capacity	Relative Cost ($)	Permanent?
Registers	Fastest	Lowest	Highest	No
RAM	Very Fast	Low/Moderate	High	No
Floppy Disk	Very Slow	Low	Low	Yes
Hard Disk	Moderate	Very High	Very Low	Yes

Floppy Diskettes
- A floppy diskette is a thin, circular flexible plastic disk with magnetic coating enclosed in a square shaped plastic shell.
- A floppy disk drive (FDD) is a device that can read from and write to a floppy disk.

Characteristics of a floppy diskette are:
i)   They are limited in their storage capacity, usually 1.44MB only.
ii)   Floppy diskettes are very delicate and need be handled with extra care.
iii)   Floppy diskettes are very slow in both reading and writing data on them.
iv)   They are flexible, that is, can be remove and used elsewhere.
v)   They are the cheapest storage medium compared to other form of storage media.

Handling Floppy Diskettes
Some precautions for handling floppy diskettes are:
i)   Never touch the exposed magnetic surface of a diskette, always hold disks by their protective jackets
ii)   Never expose disk to: extreme heat or cold, direct sunlight, moisture or oil, and abrasive materials or dust.
iii)   Take care not to scratch, score or prick the disk or its protective cover.
iv)   Never eat, drink or smoke in areas where diskettes are stored.
v)   Use the soft-felt-tip marker, when writing on disk labels, and write lightly, don't use a pencil.
vi)   Store diskettes in a flat diskette case or box to avoid bending or folding.

Hard disk
Hard disk consists of one or more rigid rapidly rotating discs (platters) coated with magnetic material, and with magnetic heads arranged to write data to the surfaces and read it from them.

A **hard disk drive** (**HDD)** is a device for storing and retrieving digital information, primarily computer data.

Hard disk parts
- **Platter:** This is the area where information is written to the hard disk. It spins constantly as it continues to add important data to the computer hard disk.
- **Spindle:** This device helps to hold the platter in place and makes it easy for the platter to spin at the necessary speed.
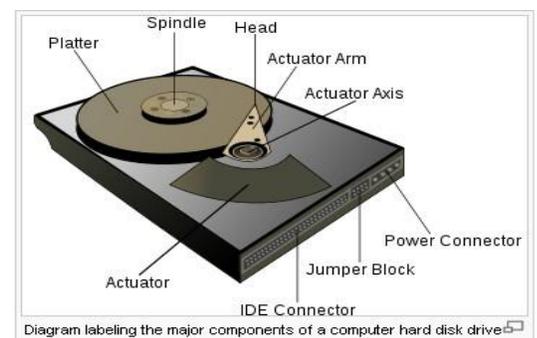

Diagram labeling the major components of a computer hard disk drive

- **Head:** This is a form of a magnet that helps in the recording of information to the hard disk drive.
- **Actuator Arm:** This allows the head to move back and forth across the disk drive as it records information.
- **Actuator Axis:** This allows the actuator arm to move back and forth easily. It is the base for the actuator arm.
- **Actuator:** Continually reads and records information.
- **Jumper Block:** This allows a cable to connect to the power supply of the computer and/or the motherboard device in the computer system.
- **IDE (Integrated Drive Electronics) Connector:** This allows a cable to run from the hard disk drive to the motherboard of the computer.
- **Power Connector:** This also assists in providing power from the power supply.

Advantages of a Hard disk

- Hard disk provides a far larger storage capacity compared to other forms of storage devices.
- Data/instructions can be read or written at a very high speed.
- Hard disk is more reliable than a floppy disk in terms of the security of the data.
- Hard disk is more protected against dusts and dirt.
- Cheap on a cost per megabyte compared to other storage media.
- Hard disks can be replaced and upgraded as necessary.
- Stores and retrieves data much faster than a floppy disk or CD-ROM.

Disadvantages of a hard disk

- If Hard disks eventually fail, stops the computer from working.
- Regular 'head' crashes can damage the surface of the disk, leading to loss of data in that sector.
- The disk is fixed inside the computer and cannot easily be transferred to another computer. **Optical Disks.**
- An optical disk is a removable disk on which data is written and read through the use of laser beams.
- The most familiar form of optical disks are the one that are used in music industry.

Types of Optical Disks

- Some of the most popular disk are:
    – CD-ROM – Compact Disc Read Only Memory
    – CD-Plus – Compact Disc Plus
    – CD-R – Compact Disc Recordable
    – WORM – Write Once Read Many
    – Erasable Optical Disks
    – DVDs – Digital Versatile Discs

CD-ROM

- CD-ROM, which stands for Compact Disk Read Only Memory is an optical disk format that is used to hold pre-recorded text, graphics, and sounds.
- "Read Only" means that the disk cannot be written on by the user except accessing the data imprinted by the disk's manufacturers.

CD ROMs can be used to store: – Entertainment and games.

- Encyclopedia, atlases, and reference work.
- Catalogs.
- Education and training materials.
- Edutainment
- Books and Magazines.

CD-Plus

A CD-Plus or enhanced CD is a digital disk that is hybrid of audio only compact disk and multimedia CD-ROM.

CD-R

CD-R, which stands for Compact Disk Recordable, is a CD is a CD format that allows you to write data onto it, using a special CD writer drive.

Like CD-ROM, CD-R disks cannot be erased.

WORM

- WORM stands for Write Once, Read Many. A WORM disk can be written or recorded onto just once and they cannot be erased, but it can be read many times.

WORM disks are useful for storing data for backup and archival purposes because it can store greater volume of data than other types of CD-ROMs and magnetic tapes.

WORM disks require special WORM drives to write or read their contents.

Erasable Optical Disks

- An erasable optical disk allows users to erase data so that the disk can be used over and over again.

The most common type of erasable optical disk is the magneto-optical (MO) disk which uses aspects of both magnetic disk and optical disk technologies.

DVD & DVD-ROM Disks

- A DVD-ROM (Digital Versatile Disk ROM) is an extremely high capacity compact disk capable of storing massive amount of data ranging from 4.7GB up to 17GB or beyond.

It represents a new generation of high density CD-ROM disks with either write once, or rewritable capabilities.

Care for Optical Disk (Compact Disk)
- Research about the care of optical devices (5 at least)

Magnetic tapes
- A sequential storage medium used for data collection, backup and archiving. Like videotape, computer tape is made of flexible plastic with one side coated with a ferromagnetic material.

Tapes were originally open **reels**, but were superseded by **cartridges** and **cassettes** of many sizes and shapes.

The major drawback of tape is its sequential format. Locating a specific record requires reading every record in front of it or searching for markers that identify predefined partitions.

Care and Handling of Magnetic Tapes
- Use and store magnetic tape reels and cassettes in a clean environment.
- Avoid contamination of the tapes by dirt, dust, fingerprints, food, cigarette smoke and ash, and airborne pollutants.
- Take care not to drop tapes or cartridges.
- Keep tapes out of strong sunlight and avoid contact with water.

Flash Disks
- A **USB flash drive** is a data storage device that includes flash memory with an integrated Universal Serial Bus (USB) interface.

A flash drive consists of a small printed circuit board carrying the circuit elements and a USB connector, insulated electrically and protected inside a plastic, metal, or rubberized case which can be carried in a pocket or on a key chain.

Tertiary storage
Tertiary memory is a third level of storage which is primarily used for archiving rarely accessed information since it is much slower than secondary storage.

Tertiary storage involves a robotic mechanism which will *mount* (insert) and *dismount* removable mass storage media into a storage device according to the system's demands; these data are often copied to secondary storage before use.

Off-line storage

- *Off-line storage* is a computer data storage on a medium or a device that is not under the control of a processing unit.
- The medium is recorded, usually in a secondary or tertiary storage device, and then physically removed or disconnected.
- It must be inserted or connected by a human operator before a computer can access it again. Unlike tertiary storage, it cannot be accessed without human interaction. Off-line storage is used to transfer information, since the detached medium can be easily physically transported.
- Additionally, in case of a disaster, for example fire, destroys the original data, a medium in a remote location will be unaffected, enabling disaster recovery.
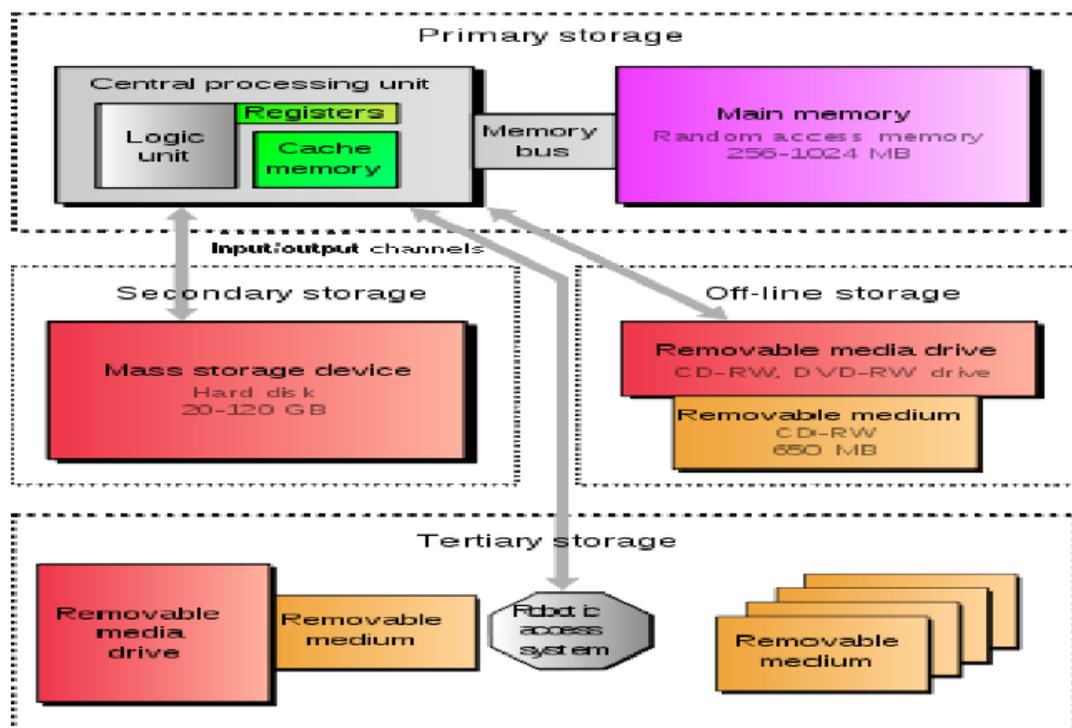
Characteristics of storage Devices

- Storage technologies at all levels of the storage hierarchy can be differentiated by evaluating certain core characteristics as well as measuring characteristics specific to a particular implementation.

These core characteristics are **volatility**, **mutability**, **accessibility**, **addressability**, **performance** and **capacity**.

Volatility

Non-volatile memory

- Will retain the stored information even if it is not constantly supplied with electric power. It is suitable for long-term storage of information.

Volatile memory

- Requires constant power to maintain the stored information. The fastest memory technologies of today are volatile ones. Since primary storage is required to be very fast, it predominantly uses volatile memory.

One of volatile memories is Random Access Memory, which may be either DRAM or SRAM.

Dynamic random-access memory (DRAM)

- A form of volatile memory which also requires the stored information to be periodically reread and re-written, or refreshed, otherwise it would vanish.

Static random-access memory (SRAM)

- A form of volatile memory similar to DRAM with the exception that it never needs to be refreshed as long as power is applied. (It loses its content if power is removed). **Mutability** Storage mutability describes the ability to "read/write" a storage device or "read only" but not write a storage device

Read/write storage or mutable storage

- Allows information to be erased or overwritten at any time. A computer without some amount of read/write storage for primary storage purposes would be useless for many tasks.

Read/write storages are very useful for secondary storages where you can store (write) information but you can erase and store new contents.

Read only storage (Immutable)

- Retains the information stored at the time of manufacture, and *write once storage* (Write Once Read Many) allows the information to be written only once at some point after manufacture. These are called *immutable storage*. Immutable storage is used for tertiary and off-line storage. Examples include CD-ROM and CD-R. ***Slow write, fast read storage*** Read/write storage which allows information to be overwritten multiple times, but with the write operation being much slower than the read operation. Examples include CD-RW and flash memory.

Accessibility

Describe a type of storage device whether its contents can be accessed at random or sequentially but not both.

Random access

- Any location in storage can be accessed at any moment in approximately the same amount of time. Such characteristic is well suited for primary and secondary storage. Most *semiconductor memories* and *disk drives* provide random access.

Sequential access

- The accessing of pieces of information will be in a serial order, one after the other; therefore the time to access a particular piece of information depends upon which piece of information was last accessed. Such characteristic is typical of off-line storage where you use *magnetic tapes*.

Addressability

Location-addressable

- Each individually accessible unit of information in storage is selected with its numerical memory address. In modern computers, location-addressable storage usually limits to primary storage, accessed internally by computer programs, since location-addressability is very efficient, but burdensome for humans.

File addressable

- Information is divided into *files* of variable length, and a particular file is selected with human-readable directory and file names. The underlying device is still location-addressable, but the operating system of a computer provides the file system abstraction to make the operation more understandable. In modern computers, secondary, tertiary and off-line storage use file systems.

Content-addressable

Each individually accessible unit of information is selected based on the basis of (part of) the contents stored there. Content-addressable storage can be implemented using software (computer program) or hardware (computer device), with hardware being faster but more expensive option. Hardware content addressable memory is often used in a computer's CPU cache.

Performance *Latency*

- The time it takes to access a particular location in storage. The relevant unit of measurement is typically nanosecond for primary storage, millisecond for secondary storage, and second for tertiary storage.

Throughput

- The rate at which information can be read from or written to the storage. In computer data storage, throughput is usually expressed in terms of megabytes per second or MB/s, though bit rate may also be used. As with latency, read rate and write rate may need to be differentiated.

Capacity

Raw capacity

- The total amount of stored information that a storage device or medium can hold. It is expressed as a quantity of bits or bytes (e.g. 10.4 megabytes).

Memory storage density

- The compactness of stored information. It is the storage capacity of a medium divided with a unit of length, area or volume (e.g. 1.2 megabytes per square inch).

Storage technologies

- The most commonly used data storage technologies are **semiconductor**, **magnetic**, and **optical**.
  Media is a common name for what actually holds the data in the storage device. Some other fundamental storage technologies have also been used in the past or are proposed for development.

Semiconductor

- Semiconductor memory uses semiconductor-based integrated circuits to store information. A semiconductor memory chip may contain millions of tiny transistors or capacitors. Both *volatile* and *non-volatile* forms of semiconductor memory exist.

Magnetic

- Magnetic storage uses different patterns of magnetization on a magnetically coated surface to store information. Magnetic storage is *non-volatile*. The information is accessed using one or more read/write heads which may contain one or more recording transducers.
- In modern computers, magnetic storage will take these forms:
- Magnetic disk
- Floppy disk, used for off-line storage
- Hard disk drive, used for secondary storage • Magnetic tape, used for tertiary and off-line storage.

Optical

- Optical storage, or optical disc, stores information in deformities on the surface of a circular disc and reads this information by illuminating the surface with a laser diode and observing the reflection. Optical disc storage is *non-volatile*.

The deformities may be permanent (read only media), formed once (write once media) or reversible (recordable or read/write media).
Units of Measurements for Capacity

A computer system's data/information storage capacity is represented by bits, bytes, kilobytes, megabytes, gigabytes, and terabytes.

⌛ **Bits**
In a binary system, each '0' or '1' is called a bit, which is short for "binary digit". A bit is a smallest unit of data storage.

⌛ **Byte**

A byte is a group of 8 bits, and a byte represents one character digit or other values. To represent letters, numbers, or special characters (such as # or *), bits are combined into groups.

⌛ **Kilobyte**
A kilobyte (K, KB) is about 1000bytes. It is actually exactly 1024bytes, but the figure is usually rounded.

⌛ **Megabyte**
• A Megabyte (M, MB) is about 1 million bytes (1, 048, 576bytes) or (1024kilobytes).

⌛ **Gigabyte**
• A Gigabyte (G, GB) is about 1 billion bytes (1,073,941,824bytes) or (1024megabytes)

⌛ **Terabyte**
• A Terabyte (T, TB) represents about 1 trillion bytes (1, 009, 511, 627, 776bytes) or (1024 gigabytes)

Practice **Questions:**
1) How may bytes in 5kilobytes?
2) Convert 4 terabytes into megabytes.

3) Convert 77309411328bits into megabytes.
4) Express 3gigabytes into bits.
   Note: Use the interval of 1024.

Access Time
- Access time on disk is time interval between the moment the command is given to transfer data from disk to main memory and the moment this transfer is completed.

The Microcomputer System Unit

The system unit or cabinet contains the following components:

- Power Supply.
- Motherboard
- Hard disk drive
- System clock
- RAM & ROM chips
- Expansion Slots and Boards
- Bus lines

Power Supply
- The Power Supply is the device that converts Alternating Current (AC) to Direct Current (DC) to run the computer.

The electricity available from a standard wall outlet is alternating current (AC) and can cause harm to the computer.

The ON/OFF switch in your computer turns on or shuts off the electricity to the power supply.

Because electricity can generate a lot of heat, a fan inside the computer keeps the power supply and other components from becoming too hot.

Motherboard
- A *Motherboard* or *system board* is the main printed, flat circuit board in an electronic device such as microcomputers.
  - The board contains expansion slots (sockets) that accept additional boards (expansion Cards). In a microcomputer, the motherboard contains the microprocessor, the primary storage chips (or main memory cards), the buses, and all the chips used for controlling the peripherals.

Microprocessor Capacity
- The capacity of a microprocessor chip is represented in word sizes. A **word size** is the number of bits (e.g., 8, 16, or 32 bits) that a computer (CPU) can process at a time.
- If a word has more bits, the computer (CPU) is more powerful and faster. For example, a 16bit-word computer can access 2 bytes (1 byte = 8 bits) at a time, while a 32-bit-word

computer can access 4 bytes at a time. Therefore, the 32-bit computer is faster than the 16bit computer.

Central Processing Unit (CPU)

- The *central processing unit* (*CPU*) is the computing part of the computer that interprets and executes program instructions. It is also known as the processor.
- In a microcomputer, the CPU is contained on a single microprocessor chip within the system unit. The CPU has two parts: the control unit and the arithmetic-logic unit.

There are two important architectures of a computer processor:

i)   **CISC** – Complex Instructions Set Computing.
ii)   **RISC** – Reduced Instructions Set Computing.

CISC and RISC Chips

- **CISC Chips**:

CISC stands for *Complex Instruction Set Computer*. CISC is a computer architecture that has large sets of instructions. CISC machines have several hundred instructions. Intel's Pentium-chip uses CISC design.

- **RISC Chip**:

RISC stands for *Reduced Instruction Set Computing*. RISC is a computer that executes a few numbers of instructions. In RISC, most programs generally use only a few instructions. This architecture has a small number of instructions built into the circuits and if those basic instructions are made to execute faster, then RISC computers increase performance.

Expansion Slots & Boards

Expansion slots are sockets on the motherboard into which you can plug expansion cards. Expansion cards or Add-on boards are circuit boards that provide more memory or control peripheral devices.

Among the types of expansion cards are the following:

- **Expanded memory**

Memory expansion cards allow you to add RAM chips, giving you more memory space.

- **Display Adapter**

    These cards allow you to adopt different kinds of color video display monitor for your computer.

- **Other Add-ons**

You can also add special circuit boards for modems, fax, sound and network cards, as well as math and graphic processor chips.

 Bus Lines

A bus line or simply bus is an electrical pathway through which bits are transmitted within the CPU and other devices in the system unit.

The different types of bus line include:
- Address bus
- Control bus
- Data bus **Address bus**
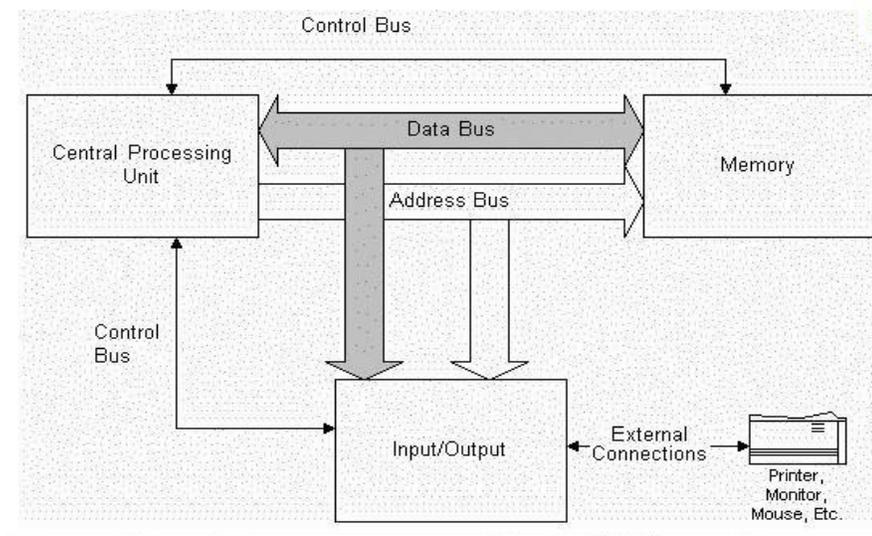
Address bus;
This is an internal channel from the CPU to memory across which the addresses of data (not the data) are transmitted. The number of lines (wires) in the address bus determines the amount of memory that can be directly addressed as each line carries one bit of the address.

Control bus;
Is a computer bus that is used by the CPU to communicate with devices that are contained within the computer. This occurs through physical connections such as cables or printed circuits.

It is the control bus that regulates which direction the **write** and **read** information need to go. The control bus contains a control line for *write instructions* and a control line for *read instructions*.

Data Bus:

- An internal channel that carries data between a computer's central processing unit and its random-access memory.

PORTS

- A port is a socket on the outside of the system unit that is connected to an expansion board on the inside of the system unit.

A port allows you to plug in a cable to connect a peripheral device, such as a monitor, printer, modem, etc. so that it can communicate with a computer system.
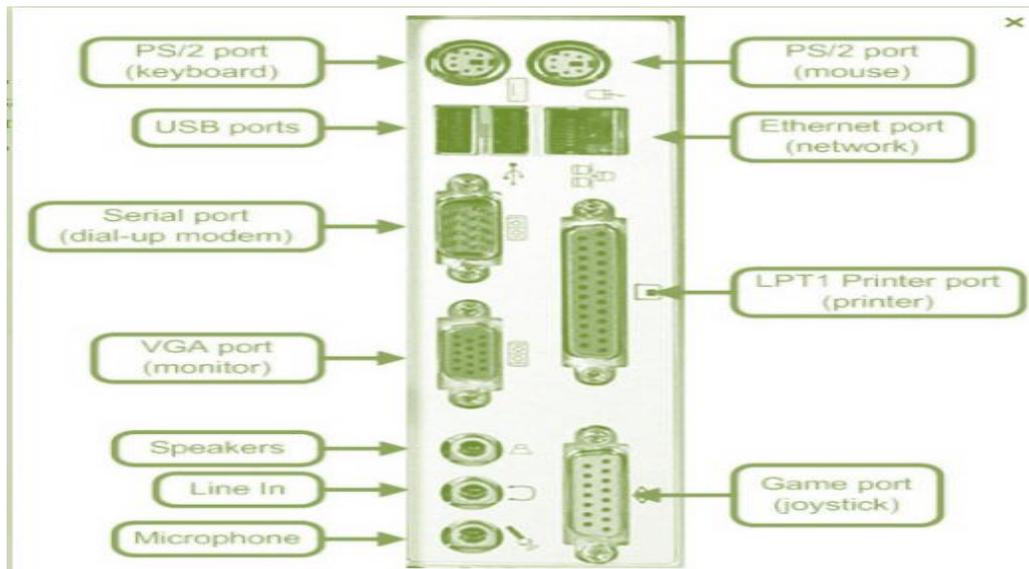
(Don't draw)

Ports are of five (5) types:

Parallel Ports:

- This allows lines to be connected that will enable 8 bits to be transmitted simultaneously. Parallel lines move information faster than serial lines do, but they can transmit information efficiently within a very short distance.

Parallel ports are used mostly for connecting the printers.

Serial Ports:

- A serial port enables a line to be connected that will send bits one at a time on a single line.
  Serial port is slower than parallel ports in transmitting data because bits are transmitted one after the other on single line.
  However, serial ports can allow information to be transmitted to long distances.

Serial ports are used principally for communication lines like modems and mice.

- **USB Ports:**
  Universal Serial Bus (**USB**) is a type of port that allows you to connect several different devices using only one port.
  For example, you can use a USB port to connect a printer, modem, joystick and scanner to your computer.

Video adapter Port:

- These are used to connect the video display monitor outside the computer to the video adapter card inside the system unit.

  Game Port:

Game port allows you to attach a joystick or similar game playing devices to the system unit