Lecture 1 : introducing Computer system

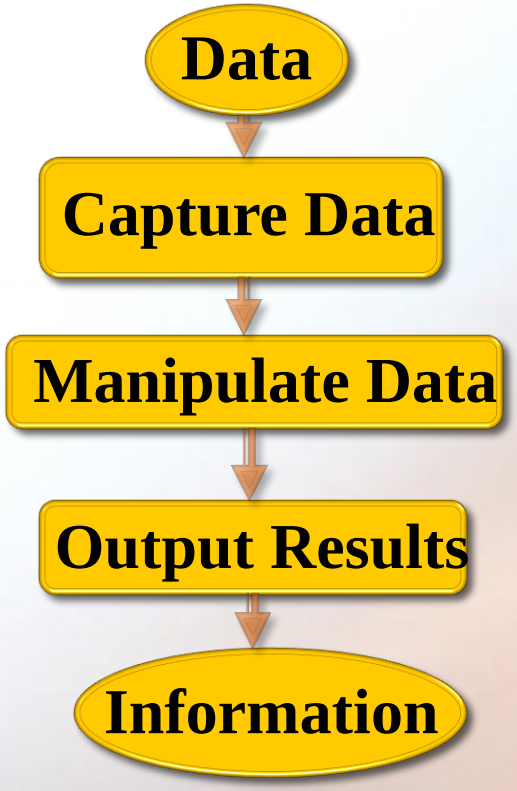


What is Computer?

- The word computer comes from the word "compute", which means, "to calculate"
- Thereby, a computer is an electronic device that can perform arithmetic operations at high speed
- A computer is also called a data processor because it can store, process, and retrieve data whenever desired

Data Processing

- The activity of processing data using a computer is called data processing



- Data is raw material used as input and information is processed data obtained as output of data processing

Characteristics of Computers

1) **Automatic:** Given a job, computer can work on it automatically without human interventions.

2) **Speed:** Computer can perform data processing jobs very fast, usually measured in microseconds (10^{-6}), nanoseconds (10^{-9}), and picoseconds (10^{-12}).

3) **Accuracy:** Accuracy of a computer is consistently high and the degree of its accuracy depends upon its design. Computer errors caused due to incorrect input data or unreliable programs are often referred to as *Garbage-In-Garbage-Out* (*GIGO*).

4) **Diligence:** Computer is free from monotony, tiredness, and lack of concentration. It can continuously work for hours without creating any error and without grumbling.

Characteristics of Computers

5) **Versatility:** Computer is capable of performing almost any task, if the task can be reduced to a finite series of logical steps.

6) **Power of Remembering:** Computer can store and recall any amount of information because of its secondary storage capability. It forgets or looses certain information only when it is asked to do so.

7) **No I.Q.:** A computer does only what it is programmed to do. It cannot take its own decision in this regard.

8) **No Feelings:** Computers are devoid of emotions. Their judgement is based on the instructions given to them in the form of programs that are written by us (human beings)

Classification of computers

There are basically three main ways to classify computers. These are:

- ✓ By Type
- ✓ By Purpose
- ✓ By Size/ Capacity

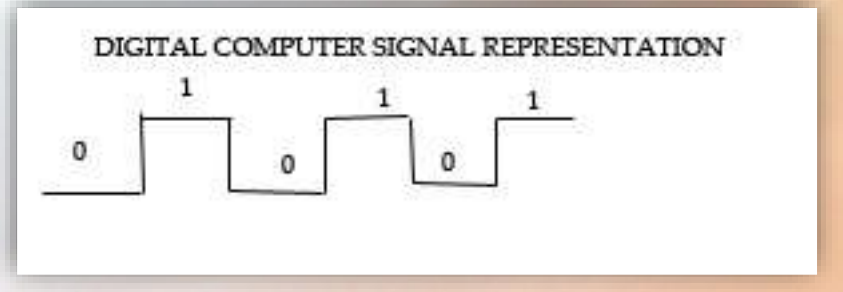
Classify By Type

There are three main types of computers under this class.

I. Digital Computers:

These are computers that represent **data /information** in a **binary** form. That is they represent **signals** in just **two** states. **0s** and **1s** are used during data communication. Examples of **digital** computers:

- **Desktop computers**
- **Laptop computers**
- **Mobile phones**
- **Tablets**
- **Scientific calculators**



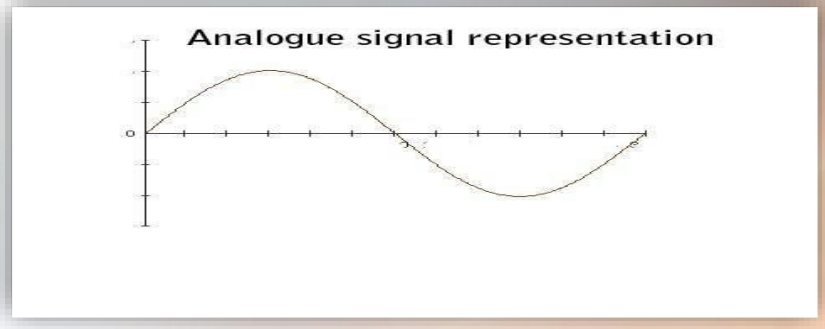
Classify By Type



II. Analog Computers:

These computers represent **data/information** in a **continuous** form. That is there are **no breaks** during **signal transmission**. They represent information by **processing measurable physical quantities**. Examples of **analog** computers:

- **Speedometer**
- **Thermometer**
- **Conventional watch**







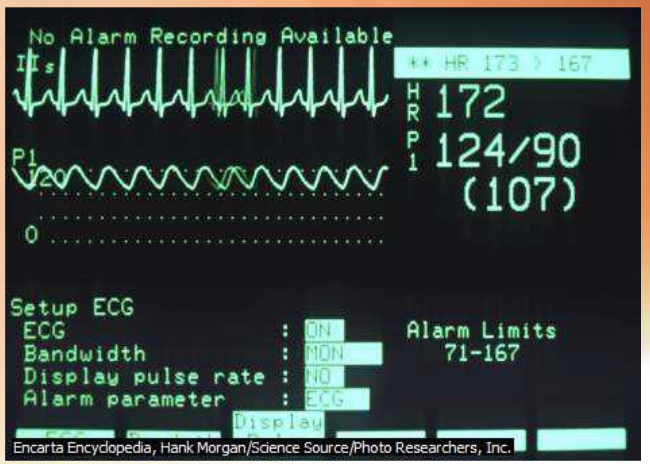
Classify By Type

III. Hybrid Computers:

These computers **exhibit** features of **analogue** computers and **digital** computers. The **digital component** normally serves as the **controller** and **provides** logical operations, while the **analogue component** normally serves as **a solver** of **different equations**. Example of **hybrid** computers:

- **Automated teller machine (ATM)**
- **Electrocardiogram**





Classify By Purpose

Computers can also be classified according to the purpose or application to which it is put. There are two main groups under this category, these are:

- ✓ Special purpose
- ✓ General purpose

Classify By Purpose

I. Special Purpose Computers:

A **computer** is said to be **special** purpose if it is designed to **solve** a **specific class** of problem for which it was made. **Examples** of special purpose computers:

- **Computers for chemical processes.**
- **Computers in digital watches.**
- **Cash machine.**
- **Vehicle computer.**



Classify By Purpose

I. General Purpose Computers:

A **general** purpose computer is **not limited** to the number of **applications** it can be used for. **Examples** of general purpose computers:

- **Servers**
- **PC.**
- **Laptop.**



Classify By Size/Capacity

The capacity of a computer refers to the volume of data or information it can process or store and the speed at which it works. The three main computers under this group are:

- ✓ Macro Computers
- ✓ Mini Computers
- ✓ Micro Computers

Classify By Size/Capacity

I. Macrocomputers:

They are the **largest** of all the computers in terms of **price**, **memory size**, **power** and **speed** of processor. Their **characteristics** are:

- **Very expensive**
- Generate **a lot of heat**
- **Large memory** size
- **Wider variety** of peripheral support.
- Supports **multiple users**



Examples of macro computers:



- **Supercomputers:** The **fastest**, most powerful, most expensive computer. Used for applications requiring complex mathematical calculations.(e.g., Weather forecasting, simulating explosions of nuclear bombs, finding oil, etc.)
- **Mainframes:** Very powerful, expensive computer that supports thousands of connected users usually used in large business environment (e.g., bank)

Classify By Size/Capacity

II. Minicmputers:

A **mini** computer is one whose **size**, **speed** and **capacity** lies **between** those of **macro** computers and **micro** computers.

Individual departments of a large company or organizations use Mini-computers for specific purposes.

A production department can use Mini-computers for **monitoring** certain production process



Classify By Size/Capacity

III. Microcomputers:

They are the **smallest** of all the computers. They are also called **Personal Computers** because they are used by **one person** at a time. Their **characteristics** are:

- **Small in size**
- Used by **one person**
- Generate **less heat**
- **Less expensive, to upgrade or expand.**

The main uses of desktop computers:

- **office and business work**
- **educational use**
- **use as a gaming device**
- **general entertainment**

Examples of microcomputers:

I. **Desktop computers**: A single-user computer that can perform all input, processing, output and storage operations on its own. Such as:

1) **Tower PC** - PC in which the case sits as a “tower,” often on the floor beside a desk, thus freeing up desk space.

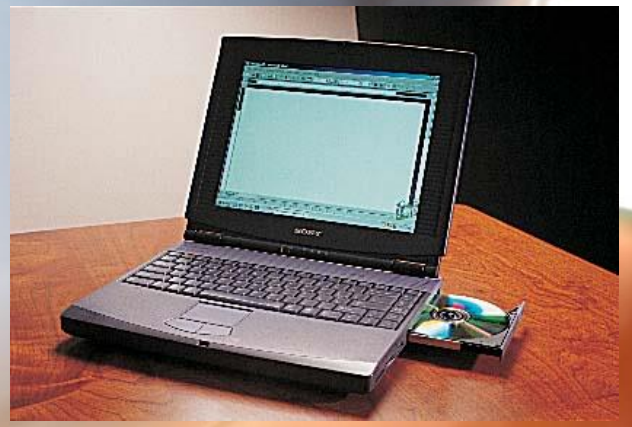
2) **Desktop PC** - those in which the case or main housing sits on a desk, with keyboard in front and monitor (screen) often on top.





Examples of microcomputers (cont..)

II. Notebook Computer: computers are lightweight portable computers with built-in monitor, keyboard, hard-disk drive, battery, and AC adapter.



- ✓ Portable, small enough to fit on your **lap**.
- ✓ Also called a **laptop computer**.
- ✓ Usually **more expensive** than a desktop computer with equal capabilities.

III. Tablet PC: A computer that is shaped like a **slate** or **notebook**.
Normally fitted with a touch screen for users to enter input through a **stylus**.



Examples of microcomputers (cont..)



IV. Smartphones: allow normal phone calls to be made, but also have an operating system (such as **iOS**, **Android** or Windows) allowing them to run a number of computer applications They allow users to send/receive emails, use a number of apps, use a camera feature and **MP3/4** players. Smartphones communicate with the internet either by using **Wi-Fi** or by using **3G/4G/5G** mobile phone networks.



V. Workstation: is a special computer designed for technical or scientific applications. Intended primarily to be used by a single user, they are commonly connected to a **local area network (LAN)** and run **multi-user** operating system. The term **workstation** has been used to refer to everything from a **mainframe terminal** to a **PC** connected to a network.

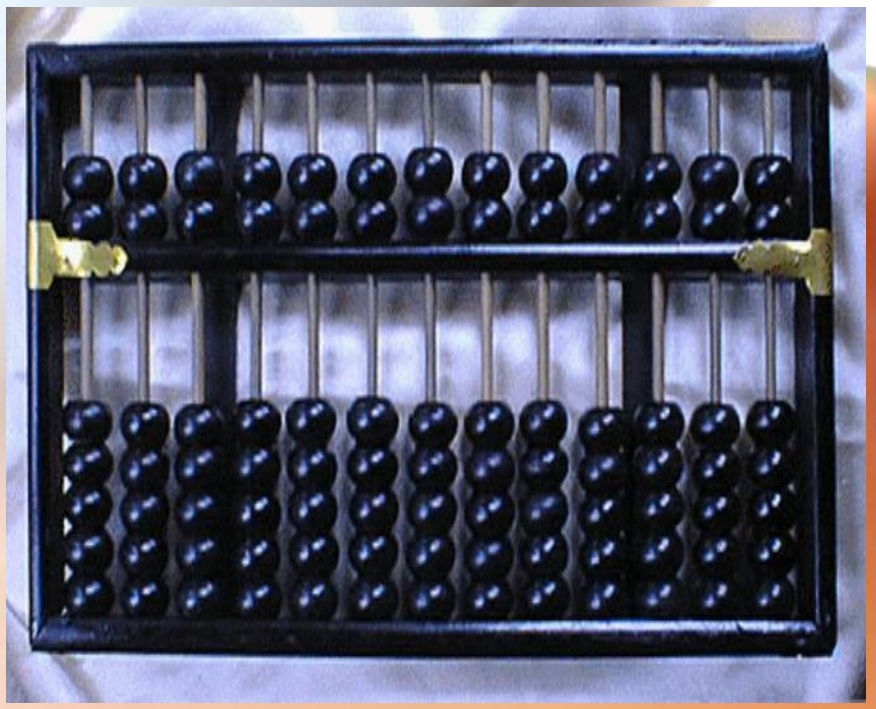
Lecture 2: Evolutions of Computer



Evolutions of Computers

The Abacus

- Earliest archaeological evidence of a Greek abacus used around the 5th century BC.
- Earliest documents illustrating the use of the Chinese abacus (suan pan) from the 13th century AD.
- Other abacus forms: Soroban (Japan), Choreb (Afghanistan), Schoty (or stchoty) (Russia)



Evolutions of Computers (cont...)

Mechanical Arithmetic Machines



Pascaline (1642) : mechanical calculator used to add and subtract two numbers



Leibniz' machine (1671): a calculating machine expanded on Pascal's ideas and did multiplication by repeated addition and shifting.

Evolutions of Computers (cont...)

Harvard Mark I

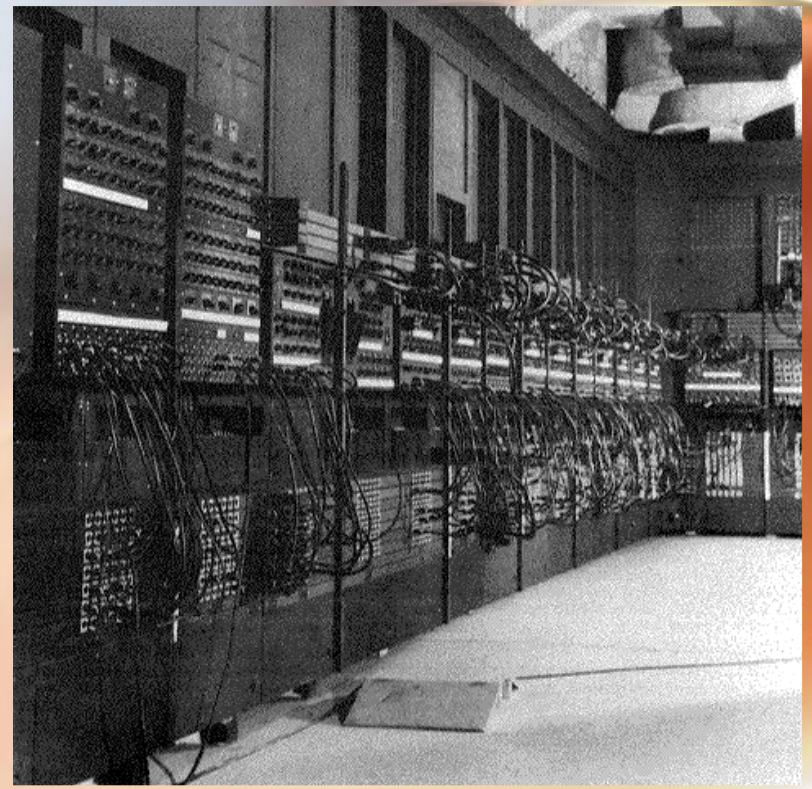
- IBM Automatic Sequence Controlled Calculator (1937-44)
- Constructed out of switches, relays, rotating shafts and clutches
- Contained more than 750,000 components
  - ✓ over 50 feet long
  - ✓ 8 feet tall
  - ✓ weighed approximately 5 tons



Evolutions of Computers (cont...)

ENIAC

Electronic Numerical Integrator and Computer (1943-46)



- Collaboration between Moore School of Electrical Engineering at the University of Pennsylvania
- An electronic computer to solve differential equations for ballistic trajectories. Constructed completed in the fall of 1945 after WWII ends, and dedicated in February 1946.
- Weighed 30 tons
- Reportedly consumed 150-200 kW of power. Contained a huge amount of parts:
  - ✓ approx. 19,000 vacuum tubes and 1,500 relays
  - ✓ over 100,000 resistors, capacitors and inductors
  - ✓ Input and output via an IBM card reader and card punch

Computer Generations

- *"Generation"* in computer talk is a step in technology. It provides a *framework* for the growth of computer industry

- Originally it was used to distinguish between various hardware technologies, but now it has been extended to include both hardware and software

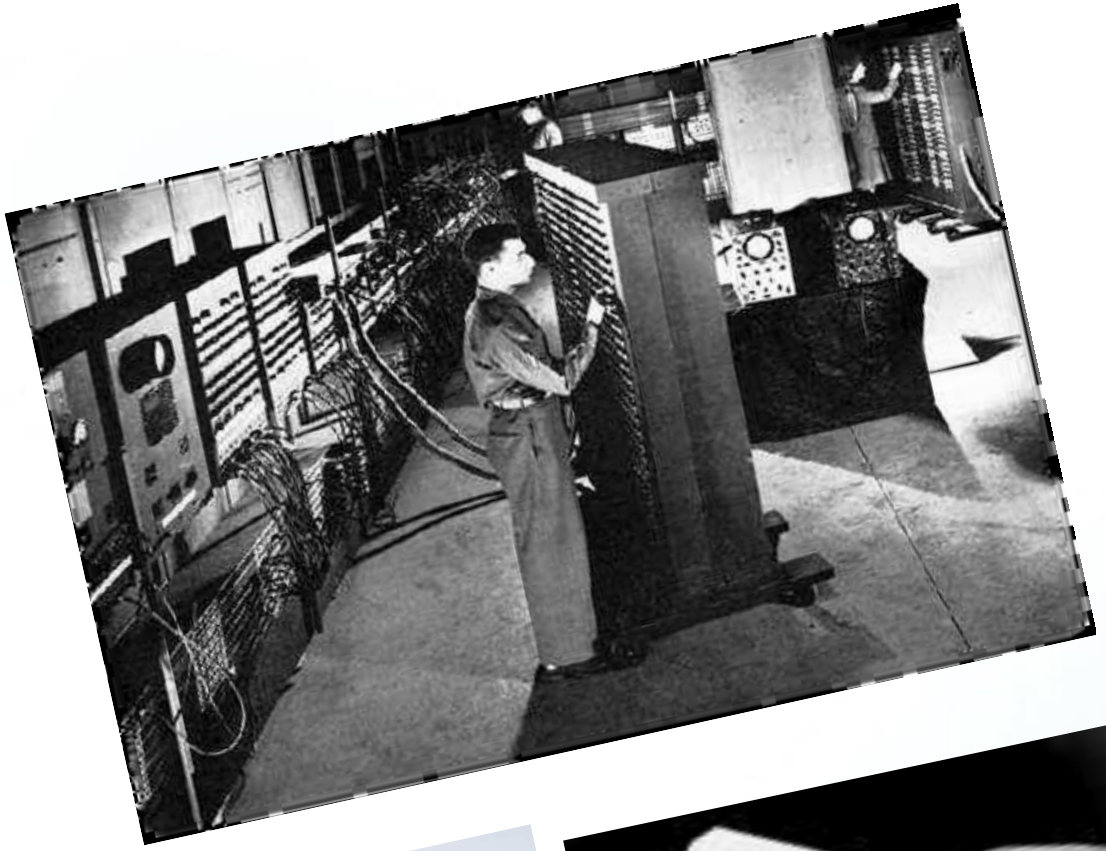
- Till today, there are five computer generations

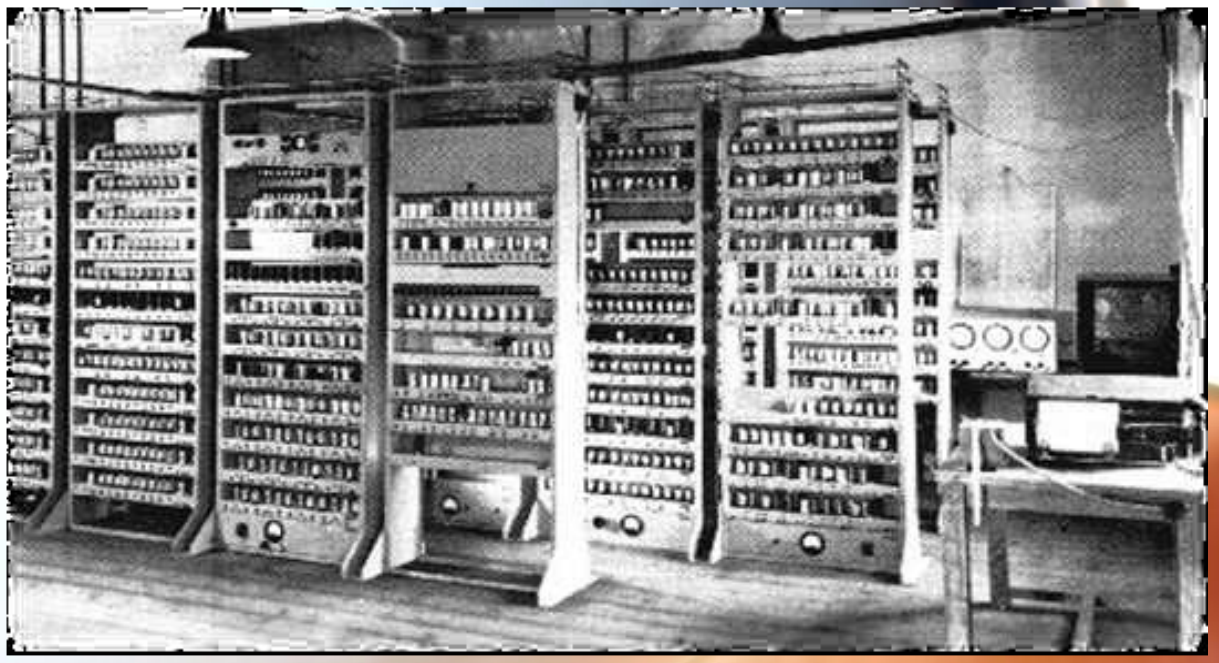
1st. Generation (Vacuum tubes generation)

- The period of the generation was 1945-1955.
- Computers of these generation used vacuum tubes as the basic components for the memory and circuitry for CPU.
- In this generation Punched cards, Paper tape, Magnetic tape Input & Output device were used.
- There were Machine code and electric wired board languages used.
- Some computer of this generation were: ENIAC / EDVAC / UNIVAC

Features of 1st. Generation

1. **Vacuum tube** technology
2. Unreliable
3. Supported **machine language** only
4. Very **costly**
5. Generate **lot of heat**
6. **Slow** Input/output device
7. **Huge** size
8. Need of **A.C.**
9. Consumed **lot of electricity**
10. **No** operation system









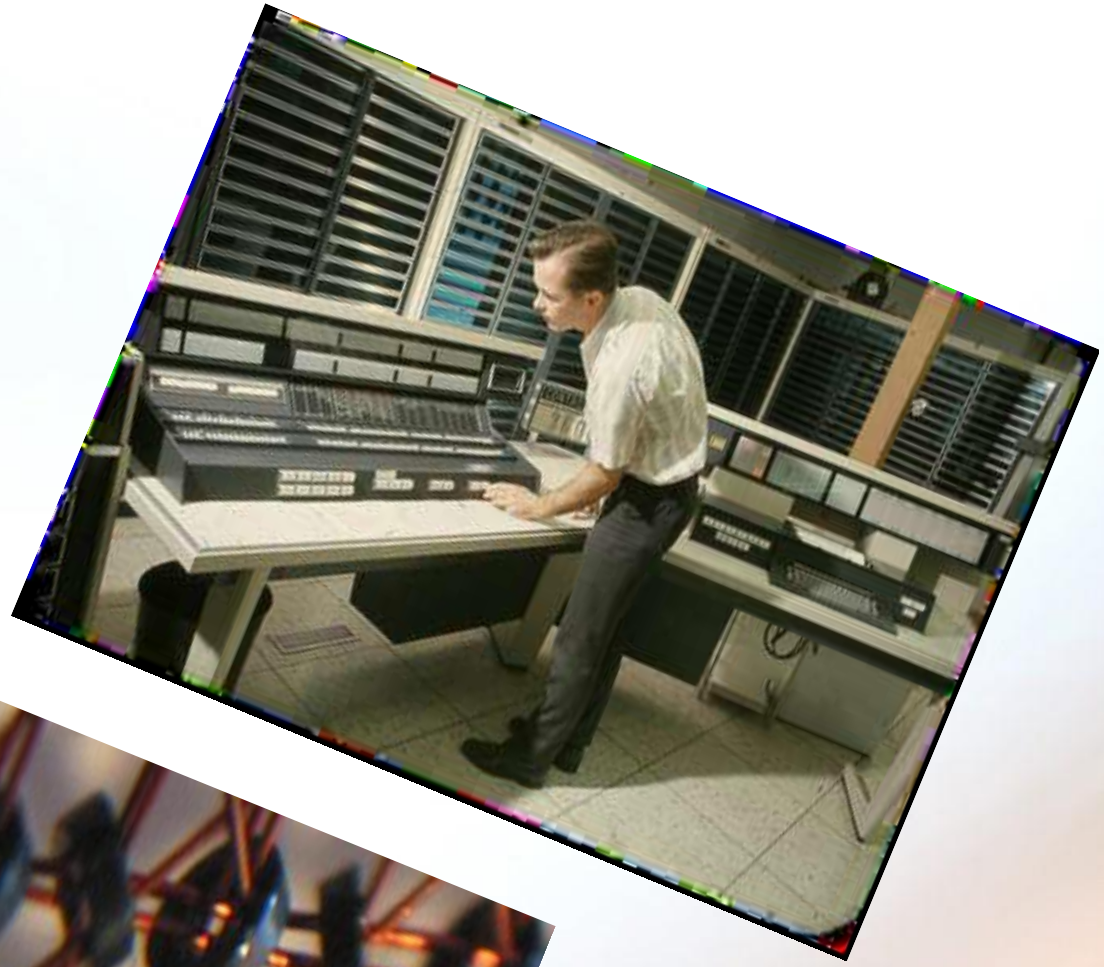

U N I V A C

2nd. Generation (Transistor generation)

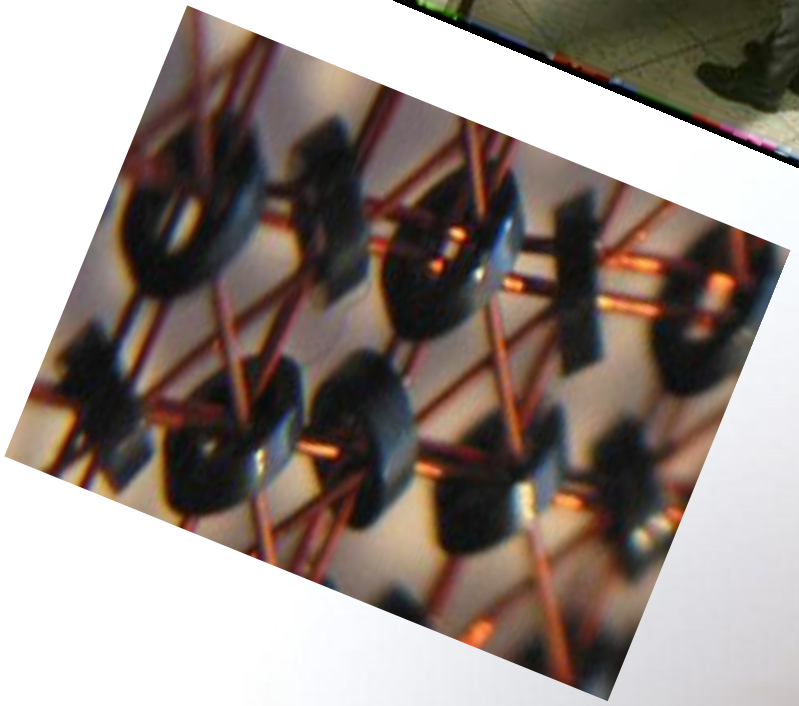
- The period of this generation was 1956-1964.
- This generation using the transistor were cheaper, consumed less power, more compact in size, more reliable and faster than vacuum tubes.
- In this generation, magnetic cores were used as primary memory and magnetic tape and magnetic disk as secondary storage devices.
- In this generation high level programming language like FORTRAN, COBOL were used. Compliers were developed to translate high level language programs to assembly language
- Some computer of this generation were:
  IBM 7094/ CDC 3600/ UNIVAC 1108

Features of 2nd. Generation

1. Use of **transistors**
2. **Reliable**
3. **Smaller**
4. Generate **less heat**
5. Consumed **less electricity**
6. **Faster**
7. Still **very costly**
8. **A.C. needed**
9. Support **machine** and **assembly languages**




IBM





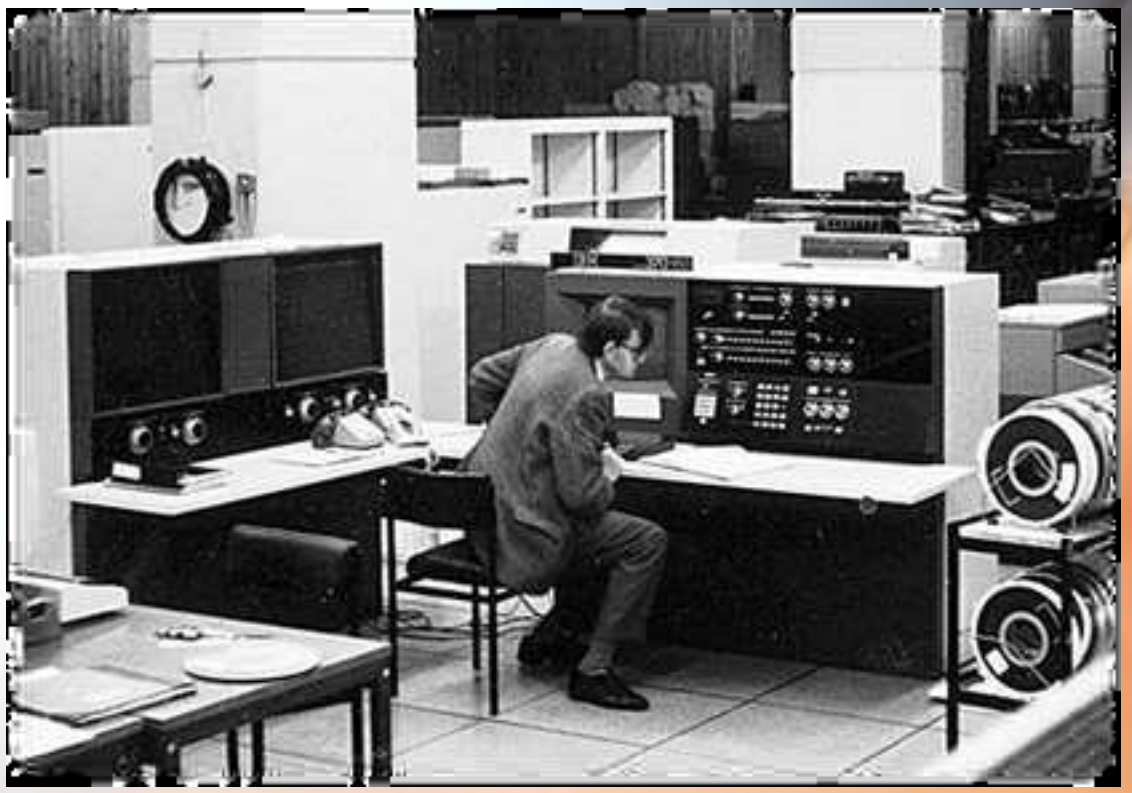
3rd. Generation (IC generation)

- The period of this generation was 1965 -1971.
- The use of Integrated Circuits (IC's) a single silicon chip in place of transistors.
- Use of Magnetic Tapes and Disks for Storage
- Timesharing Operating system
- Minicomputers
- Computer speed measured in nanosecond.
- I/O devices become more efficient.
- Some computer of this generation were: IBM-360 series

Features of 3rd. Generation

1. **IC** used
2. Increased **speed** and **efficiency**
3. **Smaller** size and **lower** Cost
4. Improved reliability
5. **Multiprogramming** and **batch processing** systems
6. Support **high level** language
7. Early computer **networking**
8. **Scientific**, **commercial** applications
9. Introduction of **keyboard** and **monitors**


speakjet

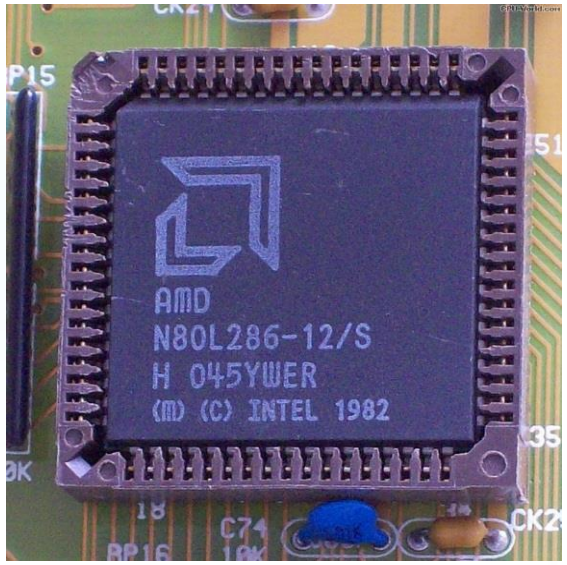


4th . Generation (microprocessor generation)

- The period of this Generation was 1971-1989.
- the use of Very Large Scale Integrated (VLSI) circuits having thousands transistors.
- associated circuits on a single chip made it possible to have microprocessor and semiconductor memories
- computers became more powerful, compact, reliable, and affordable.
- Personal computer (PC) revolution.
- Network and supercomputing.
- UNIX Operating System were used
- The Higher level languages like C and C++ and object-oriented design and programming
- Some computer of this generation were: Apple II / CRAY-1(Supercomputer)

Features of 4th. Generation

1. **Microprocessors**
2. Very **cheap, portable** and **reliable**
3. Use of **PC**'s
4. Use of **ICs** and **VLSI**
5. Improved **software** and **GUI**
6. Improved **performance**
7. Concept of **internet** was introduced
8. Great developments in the fields of **networks**
9. Computers became **easily available**
10. Totally **general purpose** machines


AMD
N80L286-12/S
H 045YWER
(M) (C) INTEL 1982





5th . Generation (AI generation)

- The period of this Generation is 1989-till date.
- the VLSI technology became ULSI (Ultra Large Scale Integration) technology, so microprocessor chips having ten million electronic components.
- This generation is based on parallel processing hardware and AI (Artificial Intelligence) software.
- AI is an emerging branch in computer science, which interprets means and method of making computers think like human beings.
- Multimedia, Internet applications.
- All the Higher level languages like C and C++, Java, .Net etc. are used in this generation.
- Some computer of this generation were: Desktop, laptop, notebook, workstation …

Features of 5th. Generation

1. **AI** & Machine Learning
2. **Parallel** Processing
3. **Expert** Systems
4. Advanced **User Interfaces** (Natural Language, Voice Recognition)
5. **Neural Networks**
6. Distributed & **Cloud Computing**
7. **VLSI** and **ULSI** Technologies
8. Integration with **IoT**
9. **Robotics** and **Automation**


intel
Core™ i7






Flash
Floppy Disk
CD + R
Zip Disk
DVD + RW
CD + RW
Smart Media
DVD + R
Removable Hard – Drive
Storage Tape
Micro Drive
Smart Cards
Memory Stick
Online Storage Site
PC Card

Lecture 3: Basic Computer System Organization



The Parts of a Computer System

A complete computer system consists of four parts.

1) **Hardware:**
   - ✓ the **mechanical** devices that make up the computer are called *hardware*.
   - ✓ Hardware is any part of the computer you can ***touch***.
   - ✓ A computer's hardware consists of ***interconnected electronic devices*** that you can use to control the computer's operation, ***input***, and ***output***.
   - ✓ The generic term 'device' refers to any piece of hardware.

2) **Software:**
   - ✓ is a set of ***instructions*** that makes the computer perform ***tasks***. In other words, software ***tells*** the computer what to do.
   - ✓ The term *program* refers to any *piece* of.
   - ✓ Some programs exists ***primarily*** for the computer's use to help it performs tasks and ***manage*** its software own resources. Other types of programs exist for the user, enabling to perform tasks such as ***creating documents***. **Thousands** of different software programs are available for use on **personal computers**.

The Parts of a Computer System (cont...)

3) Data:

✓ data consists of *individual facts* or pieces of *information* that by themselves may not make much sense to a person.

✓ A computer's primary job is to *process* these tiny pieces of data in various ways, *converting* them into useful *information*.

4) Users:

✓ People are the computer ***operators***, also known as **users**.

✓ Some computer systems are complete ***without*** a person's involvement; however, no computer is totally **autonomous**.

✓ If a computer can do its job without a person sitting in front of it, people still design, build, program, and repair computer systems.

The Information Processing Cycle:

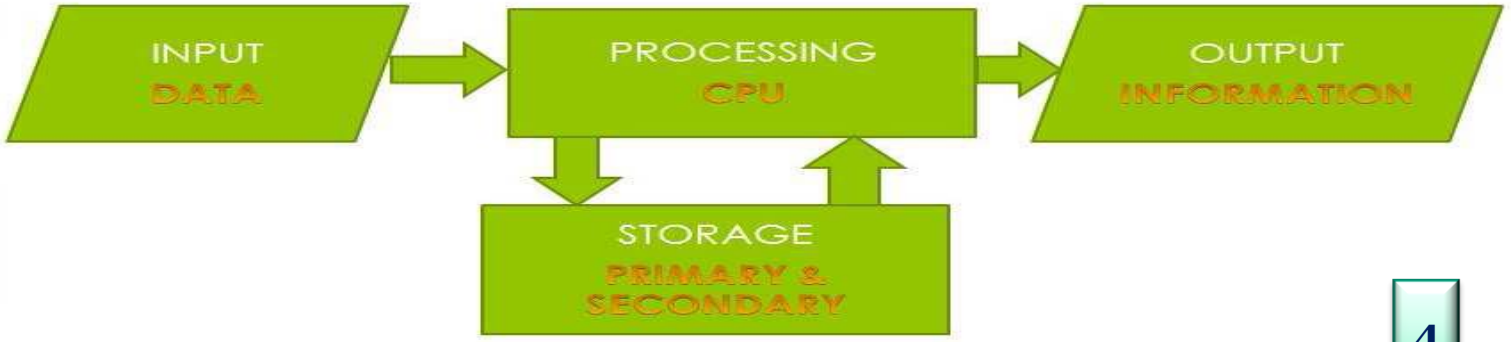
Using all its parts together, a computer **converts** *data* into *information* by performing various actions on the data. **For example**

I. A computer might perform a *mathematical operation* on two numbers,
II. Then display the **result**.
III. Or the computer might perform a *logical operation* such as comparing two numbers, then display that **result**.

These *operations* are part of a process called the ***information processing cycle,*** which is a set of *steps* the computer follows to **receive** data, **process** the data according to *instructions* from a program, **display** the resulting information to the user, and **store** the results..

The Information Processing Cycle has Four Parts:

1) **Input:** During this part of the cycle, the computer ***accepts*** data from some source, such as the user or a program, for processing.
2) **Processing:** During this part of the cycle, the computer's ***processing*** components perform actions on the data, based on ***instructions*** from the *user* or a *program*.
3) **Output:** the computer ***display*** the results of its processing. For example, the results may appear as ***text***, ***numbers***, or a ***graphic*** on the computer's screen or as ***sounds*** from its speaker. The computer also can send output to a ***printer*** or transfer the output to another computer through a ***network*** or the ***Internet***. Output is an *optional* step in the information processing cycle but may be ordered by the user or program.
4) **Storage:** the computer *permanently* stores the results of its processing on a ***disk***, ***tape***, or some other kind of storage medium. As with output, storage is *optional* and may not always be required by the user or program



Essential Computer Hardware:

A computer's hardware devices fall into one of *four* categories:

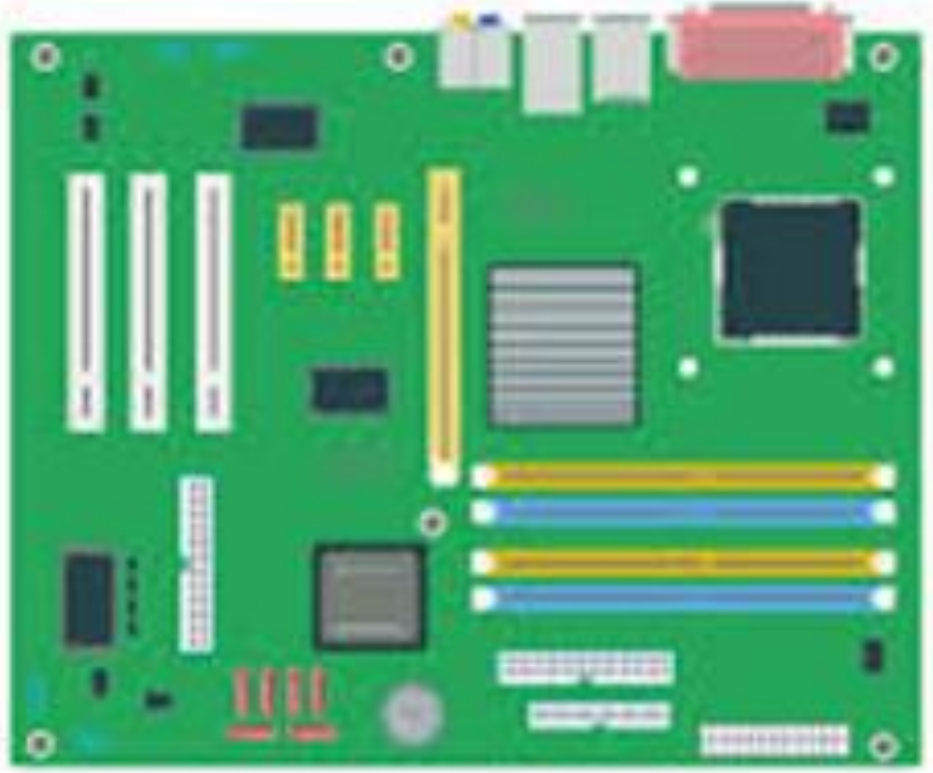
- **Processor**
- **Memory**
- **Input and Output**
- **Storage**

Motherboard

- This is where most of the electronics is located. Its is the "**Heart**" of computer



- It is the **main circuit** board inside the case. It **holds** the **microprocessor**, **memory** and other crucial circuits and components that control the operation of the **Personal Co**mputer.

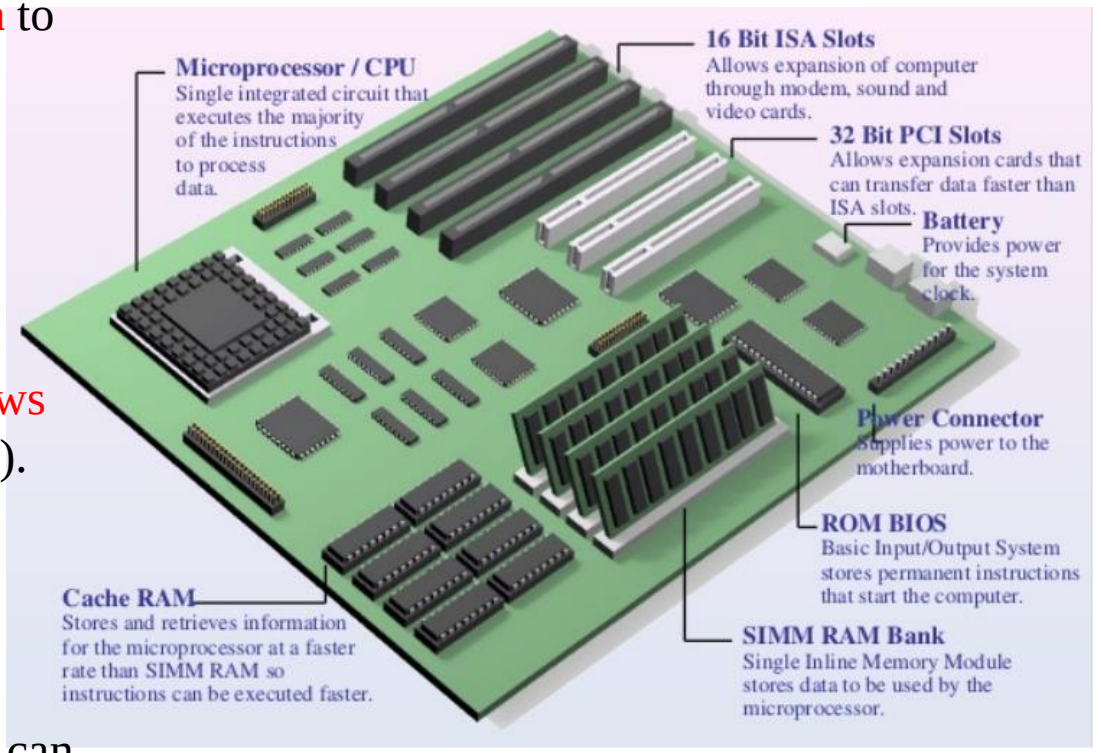


- **Every device** inside or connected to a Personal Computer finds it's way to this board.

- Your computer **couldn't work** without the motherboard. It **ties** everything together! It **allows** every part of your computer to **receive power** and **communicate** with each other.

➢ Major Components of Motherboard

1. **SIMM** (**Single Inline Memory Module**) **RAM** Bank **stores data** to be used by the **microprocessor**.
2. **ROM BIOS** (**Basic Input/Output System**) **stores permanent instructions** that **start** the computer.
3. **Power Connector** **Supplies** power to the motherboard.
4. **Slots, such as 16 Bit ISA Slots, 32 Bit PCI Slots, AGP slot** Allows expansion of computer through (**modem, sound and video cards**). PCI slots can transfer data **faster** than **ISA** slots.
5. **Battery** Provides **power** for the **system clock**.
6. **Cache RAM** Stores and retrieves **information** for the **microprocessor** at a faster rate than **SIMM RAM** so instructions can be **executed faster**.
7. **Microprocessor** / **CPU** Single integrated circuit that executes the majority of the instructions to process data.
8. **Ports** which **allows** **peripherals** devices to **connect** with computer.



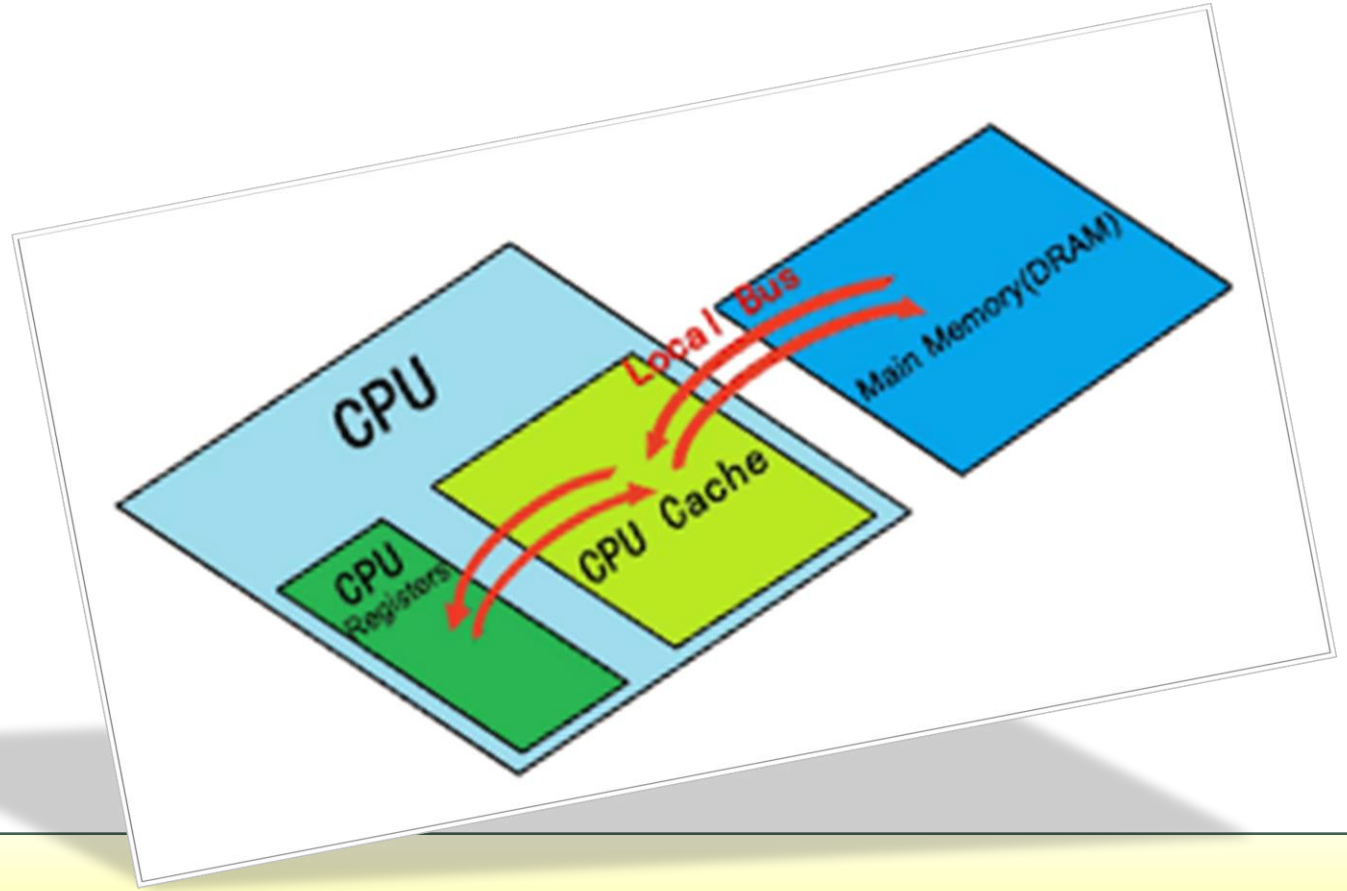
ISA (Industry Standard Architecture)
PCI (Peripheral Component Interconnect)
AGP(Accelerated Graphics Port)

➢ Motherboard Major Ports

Port Type	Description and Usage	
PS/2	**Personal System/2**, using to connect the **Keyboard** and **mouse** interfaces	
Serial ports	It is a Serial **communication** physical **interface** through which information transfers **in** or **out** **one bit** at a **time**, using to connect **modem** or other device.	 
VGA port	Using to connect **VGA monitor**	
Parallel ports	It is a type of **interface** used to connect a **printer** to the computer. It **transfers** **8** or **more** data **bit** **simultaneously**.	
USB (Universal Serial Bus)ports	It **combines** all the **advantages** of multi-platform serials ports. We can connect **mouse**, **keyboard**, **digital camera**, **printer** and **storage devices** to **USB**.	 
SCSI port	**Small Computer Systems Interface** that connects **internal** and **external** components to the **system unit** and **provides** for **high-speed** data transfer.	
HDMI port	**High-Definition Multimedia Interface** is a proprietary **audio/video interface** for **transmitting** **video data**	
FireWire ports	**FireWire** connection that **provides** a **high-speed interface** for peripheral devices that are **designed** to use the **IEEE 1394** standard	
Other ports	**Network** and **Audio** ports	 

Lecture 4: Essential Computer Hardware

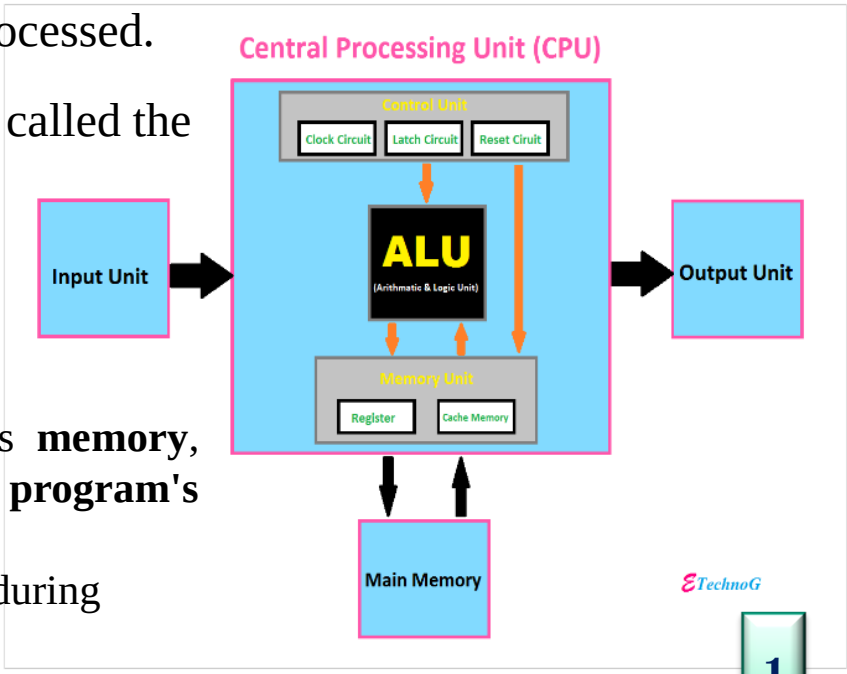
Processer And Memory



Processor [Central Processing Unit (CPU)]



1) Also called a **processor** which **Carries** out **instructions** that tell computer what to do.
2) The **CPU** refers to the **microprocessor** chip.
3) It's speed is measured in Megahertz (**MHZ**) (Millions of cycles per second) or Gigahertz (**GHZ**) Billions of cycles per second.
4) A **CPU cycle** is the time required for executing an instruction step.
5) Once information has been sent to a computer by one of the **input devices** it's processed.
6) The computer uses it's **brain** to process the information. The computer's brain is called the **CPU**.
7) The **CPU** consists of **:**



I. **ALU (Arithmetic and Logic Unit):** performs **arithmetic** and **logical** operations.

II. **Control Unit(CU):** It directs operation of the processor. It tells the computer's **memory**, **arithmetic/logic** unit and **input** and **output** devices how to **respond** to a **program's instructions**.

III. **Cache Memory :**It is used to **temporarily** store **very active data** and **instructions** during processing.

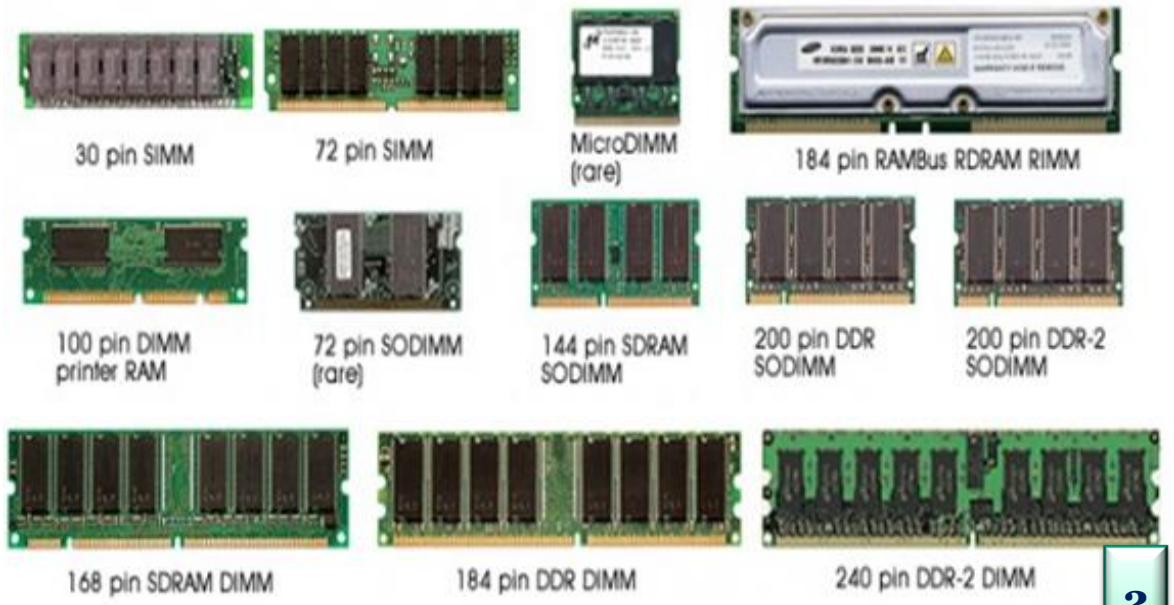
Main Memory Types

RAM (Random Access Memory)

1) Usually refers to "**primary storage**"
2) RAM is a **temporary** memory used by the computer to run **Active Programs** and store **current Data** to make it readily available.
3) **Each program** requires a certain amount of electronic memory, or RAM to run correctly.
4) The amount of Ram available will **determine** how **fast** a program will **run**. **Measured** in **Gigabyte (GB)**
5) ***Byte*** – the amount of memory it takes to **store** a single character, such as a ***letter*** of the alphabet or a ***numeral***.
6) Ram memory is considered **Volatile / temporary** because it disappears when the **power** is turned **off**.
7) More **RAM**, **faster** the work.
8) Many types of RAM, such as
   - ✓ Synchronize Dynamic RAM (**SDRAM**)
   - ✓ Double Data Rate (**DDR**)
   - ✓ Graphics DDR (**GDDR**)

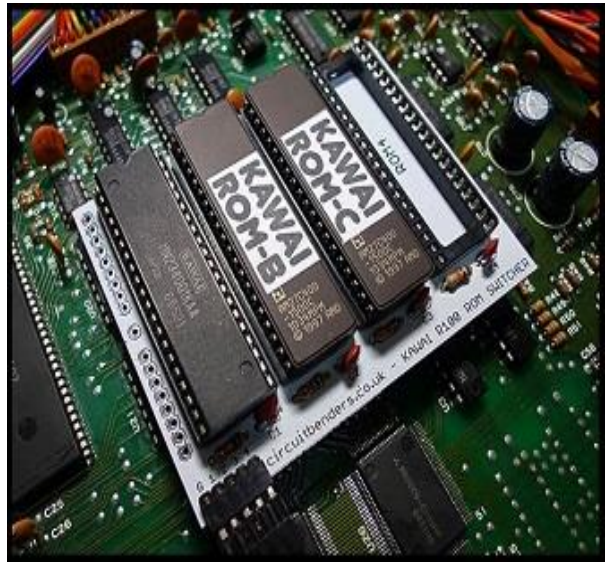
Table 1: Units of Measure for Computer Memory and Storage

Unit	Abbreviation	Approximate value (bytes)	Actual value (bytes)
Kilobyte	KB	1,000	1024
Megabyte	MB	1,000,000 (1 million)	1,048,576
Gigabyte	GB	1,000,000,000 (1 billion)	1,073,741,824
Terabyte	TB	1,000,000,000,000 (1 trillion)	1,099,511,627,776



ROM (Read Only Memory)

1) A **second kind** of computer memory is **ROM**, which stands for **Read-Only Memory**.
2) This memory is **permanent**. The **information** there was put there when the computer was made, this **cannot** be **changed**.
3) The computer **needs** the **information** in it's ROM memory in order to **function**.
4) It keeps its **contents** even in **absence** of **power**. Its **nonvolatile**.
5) **ROM chips contain programs** that start the computer and perform system **diagnostics**.
6) Many **Types** of **ROM**, such as



- ✓ **PROM** (**programmable read-only memory**). which data can be **written** only **once**, it remains there **forever**.
- ✓ **EPROM**(**erasable programmable read-only memory**) can be **erased** by exposing it to **ultraviolet light**. it can be **reprogrammed**.
- ✓ **EEPROM** (**electrically erasable programmable read-only memory**) can be erased by **exposing** it to an **electrical charge**, referred to as **flash memory**.

☙ Cache Memory

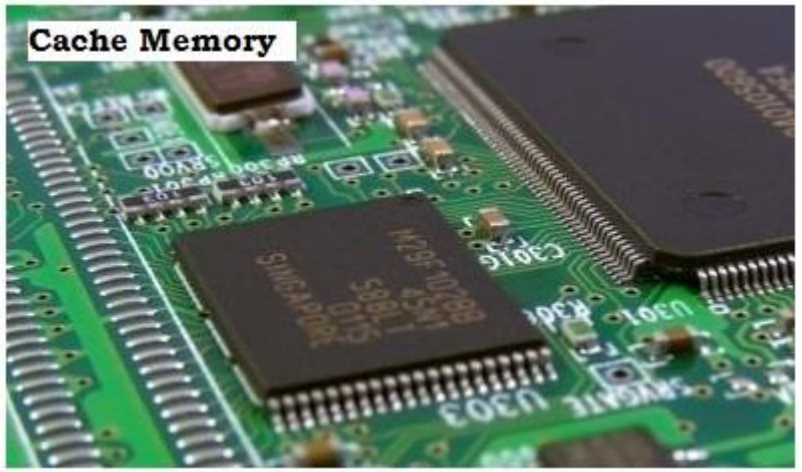
1) **Cache** memory, also called **CPU memory**.

2) It's a random access memory (RAM) that a computer **microprocessor** can **access** more **quickly** than it can access regular **RAM**.

3) This memory is typically **integrated directly** with the **CPU** chip or placed on a **separate chip** that has a **separate bus** interconnect with the **CPU**.

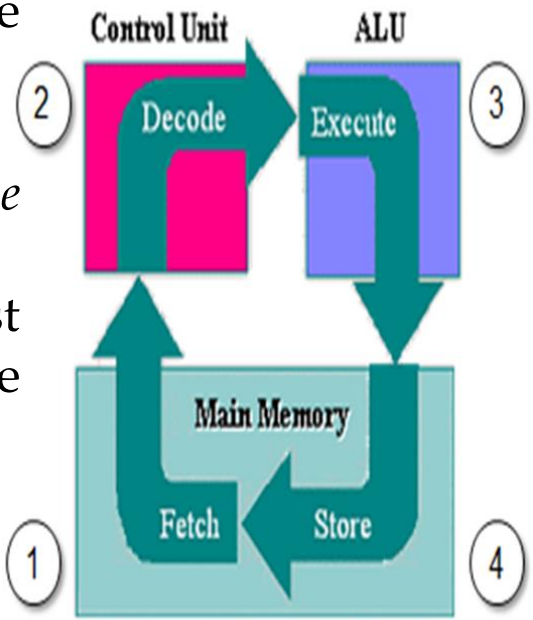
4) **Small memory** and Its **measured** in **kilobytes** (**KB**) or **Megabyte** (**MB**)

5) It is used to **temporarily** store **very active data** and **instruction** during **processing**.



☙ Machine Cycles

Each time the **CPU** executes an instruction, it takes a *series* of steps. The completed series of steps is called a ***machine cycle***. A machine cycle itself can be broken down into <u>two smaller cycles</u>: the ***instruction*** cycle and the ***execution*** cycle. At the beginning of the machine cycle (that is, during the instruction cycle), the CPU takes ***two*** steps:



1) **Fetching**: Before the CPU can execute an instruction, the control unit must *retrieve* (or *fetch*) a command or data from the computer's memory.
2) **Decoding**: Before a command can be executed, the control the control unit must *break down* (or *decode*) the command into instructions that correspond to those in the CPU's

instruction set. At this point, the CPU is ready to begin the ***execution*** cycle:

3) **Executing**: When the command is executed, the CPU *carries* out the instructions in order by *converting* them into *microcode*.
4) **Storing**: The CPU may be required to *store* the *results* of an instruction in *memory* (but this condition is not always required).

CPU performance is often *measured* in ***millions*** of instructions per ***second*** (***MIPS***).

BIOS Chip

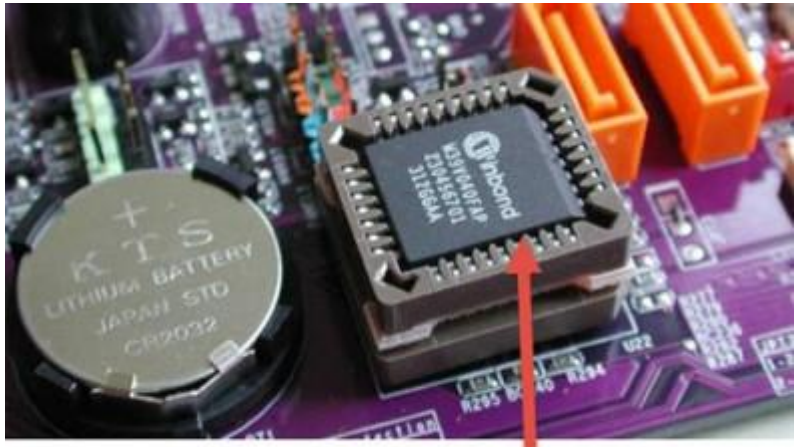
1) The **BIOS** (**Basic Input Output System**) is boot **firmware**, designed to be the **first code** run by a **PC** when **powered on** .

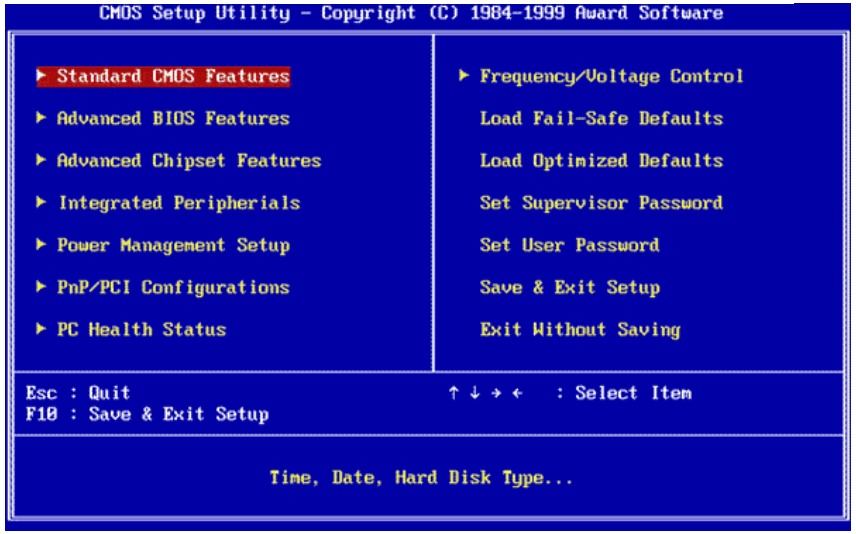
2) The **initial function** of the BIOS is to **identify**, **test**, and **initialize** system **devices** such as the **video display** card , **hard disk** , **optical disk** and other hardware .

3) ROM BIOS it is a ROM chip contains the **startup programs** and **drivers** used to get the system **running** and act as the **interface** to the basic hardware in the system .

4) Additionally, you can **run** a setup program to **store** system **configuration** data in the **CMOS** (**Complementary metal–oxide–semiconductor**) **nonvolatile** RAM, which is powered by a **battery** on the **motherboard**

5) BIOS can be **setup** system **configuration**, it **enables** you to **configure** the **motherboard** and **chipset** settings along with the **date** and **time**, **passwords**, **disk drives**, **boot-drive sequence**, CPU **timing** and **clock-multiplier** settings and other basic system settings.

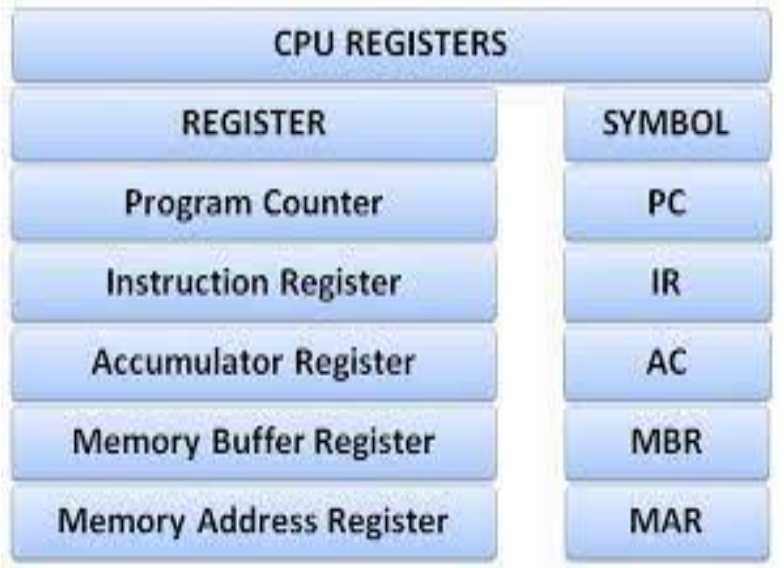




Factors Affecting Processing Speed

1) Registers:

- ✓ The size of the **registers**, which is sometimes called the ***word size***, indicates the amount of data with which the computer can work at any given time.
- ✓ The bigger the word size, the more quickly the computer can process a set of data. "***32-bit processors***" or "***64-bit processors***"



CPU REGISTERS	
REGISTER	SYMBOL
Program Counter	PC
Instruction Register	IR
Accumulator Register	AC
Memory Buffer Register	MBR
Memory Address Register	MAR

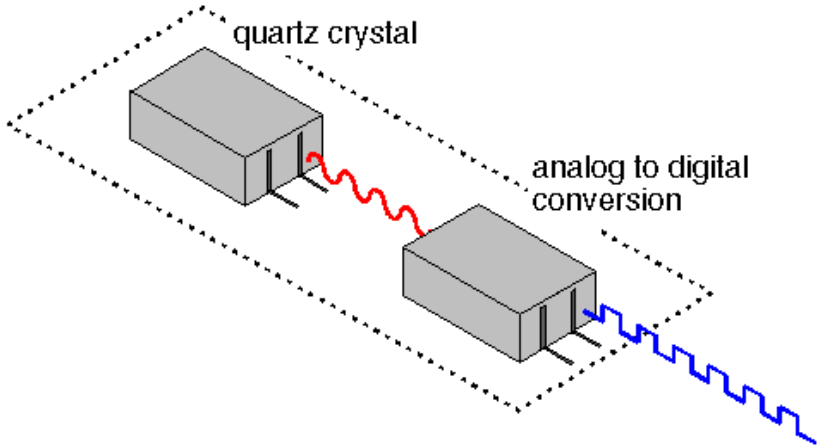
2) Memory and Computing Power:

- ✓ The amount of **RAM** in a computer can have a profound effect on the computer's power.
- ✓ More RAM means the computer can use bigger, more powerful programs, and those programs can access bigger data files.
- ✓ More RAM also can make the computer run *faster*.
- ✓ To run Windows, *for example*, the computer usually does not need to *load* all its files into memory to run properly; it loads only the *most essential* parts into memory.

Factors Affecting Processing Speed (cont..)

3) The Computer's Internal Clock :

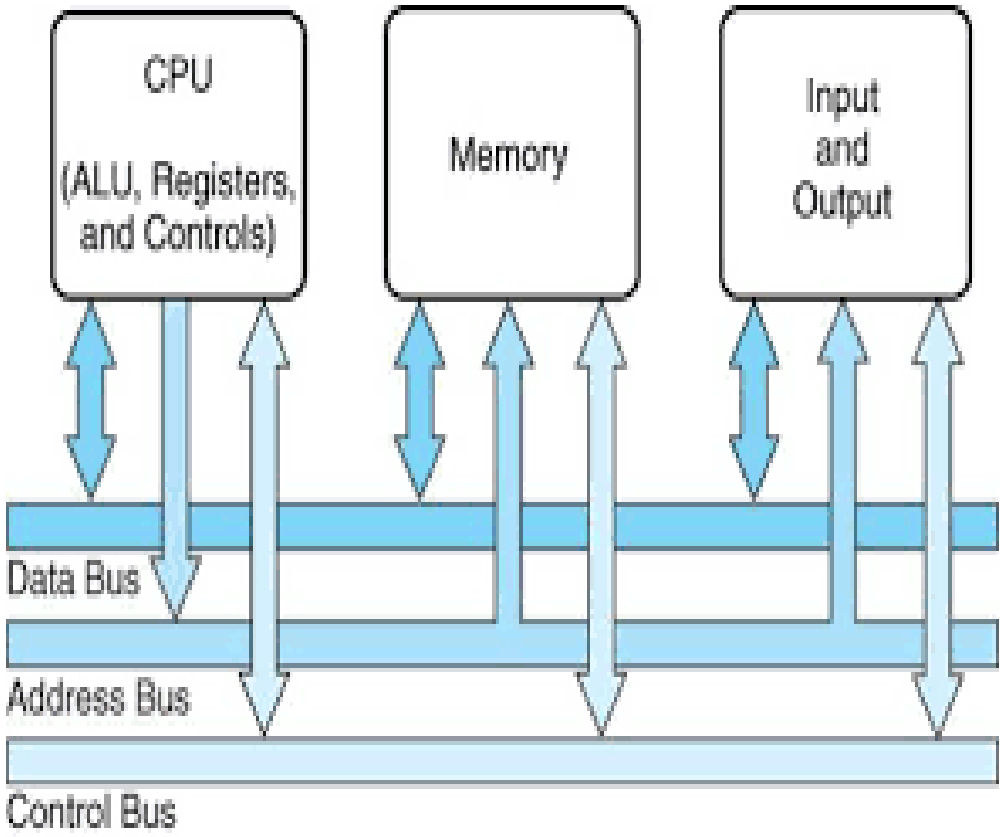
- ✓ Every *microcomputer* has a **system clock**.
- ✓ The first PC operated at ***4.77*** *megahertz*.
- ✓ **Hertz** (Hz) is a measure of cycles per second. **Megahertz** (MHz) means "millions of cycles per second." **Gigahertz** means "billions of cycles per second."
- ✓ The computer's operating speed is *tied* to the speed of the system clock.
- ✓ A **clock cycle** is a single tick, or the time it takes to turn a transistor off and back on again.
- ✓ A processor can execute an *instruction* in a given number of clock cycles. As the system's clock speed *increases*, so does the number of instructions it can carry out each second.



Factors Affecting Processing Speed (cont..)

4) The Bus:

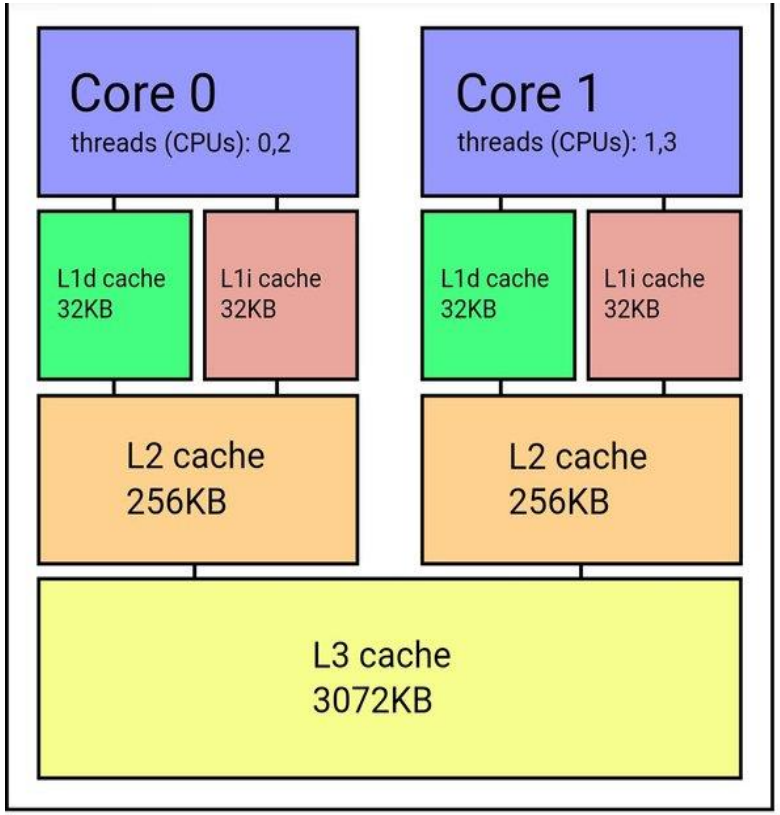
- ✓ A **bus** is a path between the components of a computer.
- ✓ There are two main buses in a computer:
  - ➢ the ***internal*** (or system) bus.
  - ➢ the ***external*** (or expansion) bus.
- ✓ The system bus resides on the motherboard and connects the CPU to other devices that reside on the motherboard.
- ✓ An ***expansion*** bus connects external devices, such as the *keyboard*, *mouse*, *modem*, *printer*, and so on, to the CPU.
- ✓ ***Cables*** from disk drives and other internal devices are plugged into the bus.
- ✓ The system bus has **two** parts:
  - ➢ **The Data Bus :** is an *electrical* path that *connects* the *CPU*, *memory* and the other hardware devices on the motherboard.
  - ➢ **The Address Bus :** is a ***set*** **of** ***wires*** similar to the data bus. The address bus connects *only* the *CPU* and *RAM* and carries only *memory addresses*.



Factors Affecting Processing Speed (cont..)

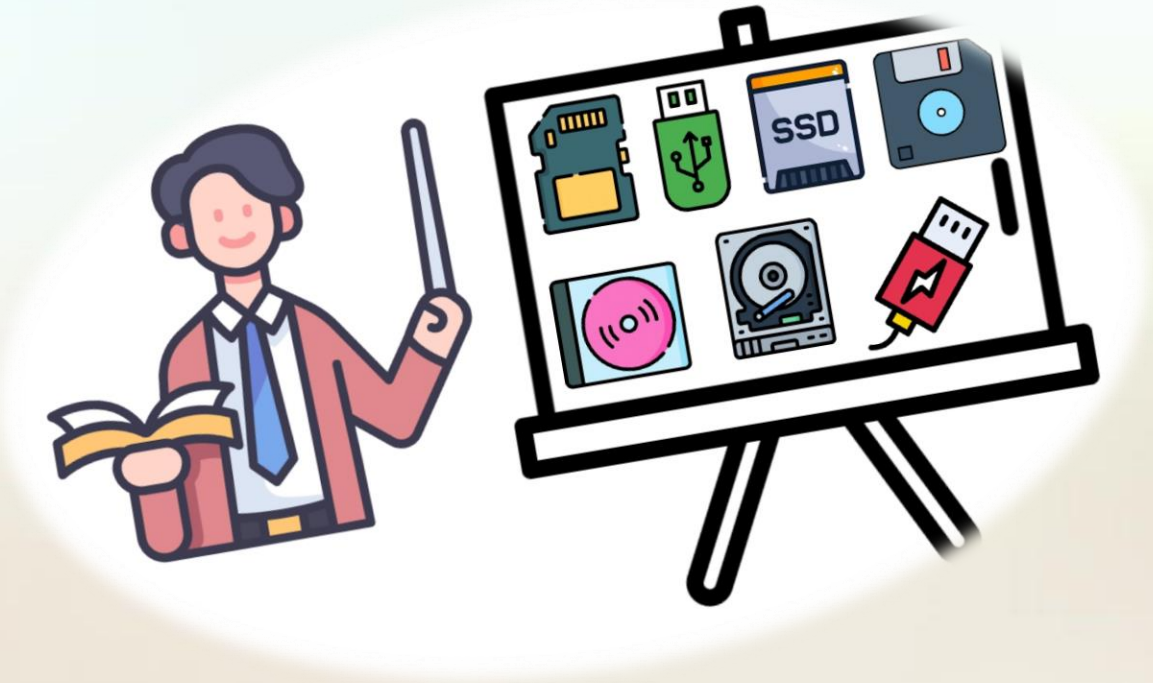
5) Cache Memory :

- ✓ Cache memory is similar to RAM except that it is extremely fast compared to normal memory and it is used in a different way.
- ✓ This CPU-resident cache is often called *Level-1* (**L1**) cache with ***256 KB-*** built in.
- ✓ an additional cache is added to CPUs. This cache is called ***Level-2*** (**L2**) cache with **512** ***KB*** or ***1024 KB***. This cache used to be found on the motherboard. *Higher-end* systems can have ***2 MB***
- ✓ This motherboard-resident cache is now called ***Level-3*** (**L3**) cache.



- ➢ **L1** cache holds **instructions** that have *recently* run.
- ➢ **L2** cache holds **potential upcoming** *instructions*.
- ➢ **L3** holds many of the **possible** *instructions*.

Lecture 5: Secondary Storage



What is Secondary Storage Devices

- ✓ A computer also needs a place to **keep** yeht nehw atad detaler dna selif margorp era**not** in use .
- ✓ The purpose of storage is to **hold** data ***permanently*** si retupmoc eht nehw neve ‹ ***turned off***.
- ✓ Used in a computer system to **overcome** the limitations of primary storage.
- ✓ Has virtually **unlimited** capacity because the cost per bit of storage is very low.
- ✓ Has an operating speed far **slower** than that of the **primary** storage with store **large** volumes of data.
- ✓ Also known as ***auxiliary memory***

Magnetic Tape Basics

1) Commonly used **sequential-access** secondary storage device
2) Tape ribbon is stored in reels or a small **cartridge** or **cassette**
3) A typical value of **data transfer** rate is **7.7 MB/s.**
4) Tapes can be **erased** and **reused** many times.
5) **Very large** amount of data can be stored in a **small** storage space.
6) They are **not suitable** for storage of those data that frequently require to be accessed **randomly**
7) Must be stored in a **dust-free** environment because specks of dust can cause tape-reading errors.
8) Must be stored in an environment with properly controlled **temperature** and **humidity** levels.

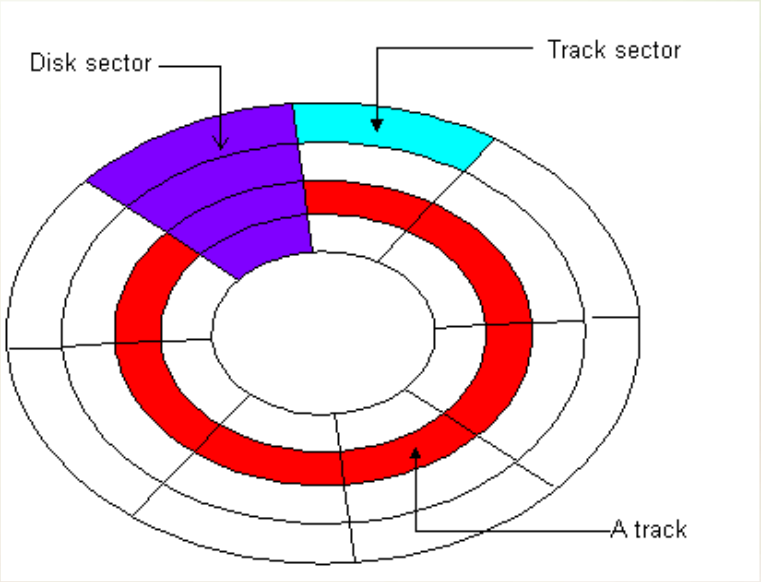




Hard Disk Drive (HDD)



1) **Classifies** as **secondary storage** device.
2) The Hard Drive is the **magnetic storage** device the computers main, long term storage.
3) All the **computer programs** and **files** you **create** and **save** are located here, specially the **operating system**.
4) It is **referred** to as **non-volatile** storage, because it does **not disappear** when the power is **turned off**.
5) The **size** of the Hard Drive is **measured** in **Gigabytes**. (Billions of Bytes) or **Terabytes** (trillion of bytes).
6) On the **HDD**, there are many **tracks**, or **cylinders**, each track is divided into **sectors**.
7) **Reading information** from the disk or **writing** to using **device** called the **head**.
8) Hard Disk Drives use **Magnetic Recording** Techniques.
9) **Low** cost **comparing** with its **huge** data **storage capacity**.
10) **Slower** than main memory **RAM**



Optical Storage Drives

CD-ROM Drive



1) Stands for **C**ompact **D**isk-**R**ead **O**nly **M**emory.
2) **Classifies** as **secondary storage** device.
3) Using **red laser** to **read/write** data.
4) **Cheap** comparing with its **storage** capacity and **slower data transfer** than **HDD**
5) Packaged as **shiny**, **silver** color metal disk of **5¼** inch **diameter**, having a storage capacity of about **700 MB.**
6) **CD-ROM** disk can hold a complete **encyclopedia**, or a **dictionary**, or a **world atlas**, or **biographies** of great people, etc.
7) Used for **distribution** of **electronic version** of **conference** proceedings, **journals**, **magazines**, **books**, and **multimedia** applications such as **video games**
8) **Types** of compact disks, such as:
   - ✓ **WORM** (**W**rite **O**nce **R**ead **M**any) data can be written only once , but read many times
   - ✓ **CD-R** (**CD-recordable**) allow users to **create** their **own** disks
   - ✓ **CD-RW** **(CD-Read/Write) c**an be **erased** and **written afresh** many times**.**



Optical Storage Drives (Cont.)

DVD-ROM Drive



1) **Stand for Digital Video / Versatile Disk (DVD)**
2) **Classifies** as **secondary storage** device.
3) Using **red laser** to **read/write** data.
4) **Cheap** and **slower comparing** with **HDD.**
5) Looks same as **CD-ROM** but has capacity of **4.7 GB** or **8.5 GB**
6) Designed **primarily** to store and distribute **movies.**
7) Can be used for **storage** of **large** data.

Blu-Ray Drive



1) **Blu-ray** or **Blu-ray Disc** (**BD**) its name refers to the **blue laser**
2) It is capable of **storing** hours of video in **high-definition HD** (**720p** and **1080p**)
3) The main application is a **medium** for **video** material such as **feature films** and **video games.**
4) **Blu-ray** storage capacity is **25GB** and **50GB**
5) **Expensive** and **faster** comparing with **CD** and **DVD**

Solid-state drives (SSD)

1) Stores data by controlling the **movement** of **electrons** within **NAND** chips.
2) The data is stored as **0s** and **1s** in **millions** of tiny **Transistors**
3) They are rapidly taking over from **HDDs** as the main type of backing storage.
4) They have enabled **laptop** computers to become **thinner** and much **lighter.**
5) They have given rise to the development of **smartphones** and **tablets.**
6) More **reliable** and **lighter** with **lower** power consumption.
7) Much faster, **SSD** data access time is only **0.1** milliseconds compared to **10** milliseconds for **HDD.**



Flash Drive (Pen Drive)

1) Relatively **new secondary** storage device based on **flash memory**, enabling easy transport of data from one computer to another
2) Compact device of the **size** of a **pen**, comes in various **shapes** and **stylish** designs and may have different added features
3) **Plug-and-play** device that simply plugs into a **USB** (**U**niversal **S**erial **B**us) port of a computer, treated as removable drive
4) Available **storage** capacities are range today from **1 GB** to **3 TB**



Memory Card (SD/MMC)

1) Similar to **Flash Drive** but in card shape
2) **Plug-and-play** device that simply plugs into a port of a computer, treated as removable drive
3) Useful in **electronic** devices like *Camera, music player, smart mobiles, tablets, video game consoles, etc.*
4) Available **storage** capacities today are range from **8 MB** to **4 TB**



Differences between Primary and Secondary Storage

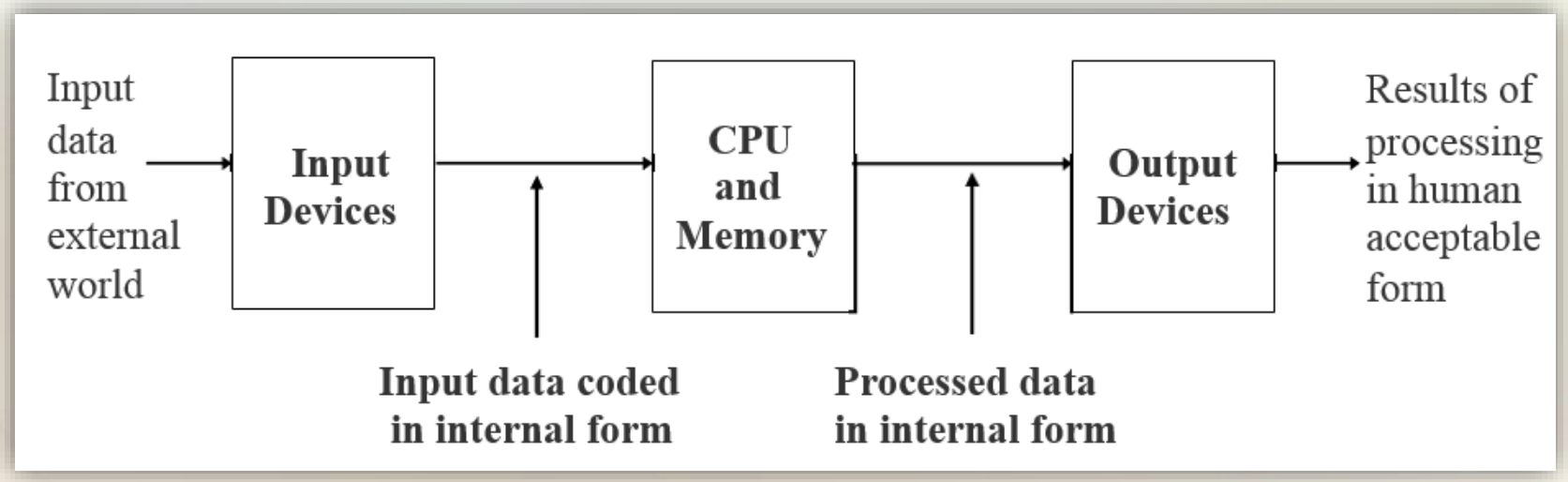
PRIMARY STORAGE	SECONDARY STORAGE
1) Limited capacity. 2) Store data temporarily. 3) Expensive. 4) Fast data access. 5) Directly accessible to the CPU.	1) Extendible capacity. 2) Store data permanently. 3) Cheaper. 4) Slower data access. 5) Contents copied to main memory before being accessed by CPU.

Lecture 6: (Input/Output) devices



Input/output Devices

- Provide means of communication between a computer and outer world
- Also known as **peripheral** devices because they surround the **CPU** and memory of a computer system
- **Input** devices are used to enter data from the outside world into primary storage
- **Output** devices supply results of processing from primary storage to users



Input Devices

1) Keyboard:

The keyboard was one of the **first peripherals** to be used with computers is a **portable wired** or **wireless** electronic device that contains all the **alphabets, numerics, symbols and special characters**, which is used for entering input data into computer system. The various types of computer keyboards are a **QWERTY** keyboard, Based on the connectivity, it is classified as a **wired** keyboard, a **wireless** keyboard, a **Bluetooth** keyboard and an **USB** keyboard.

❑ Types of Keyboard

I. Mechanical Keyboard:

The **primitive** keyboard which uses **physical buttons** for each key is called a mechanical keyboard. It makes **noise** when each key is pressed.



II. Multimedia Keyboard:

The keyboard that has all **multimedia** buttons is called multimedia keyboard. The buttons include **play, pause, previous, next, volume up, volume down, mute** and special button to launch media. Also, a button to **launch a browser, my computer, and calculator** is available.



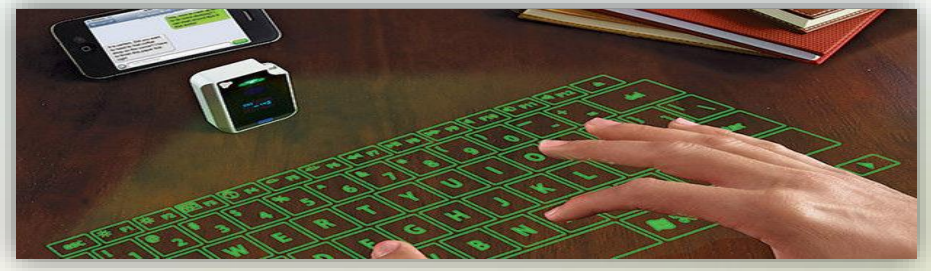
III. Wireless Keyboard

Bluetooth, **IR** technology or **Radio** Frequency is used to **connect** the keyboard with the computer device. These keyboards are **lightweight** and **smaller** in size.



IV. Virtual Keyboard

The keyboard used in **smartphones** is called a virtual keyboard. Also **Virtual laser keyboard**, it is **projects** a working keyboard onto any **surface** and **connects** to devices via **Bluetooth**



V. Ergonomic Keyboard

This keyboard is mainly designed for users who use **both hands** for typing. The advantage of this keyboard is **less muscle strain.** This keyboard is **expensive** and not **affordable** for common people.



❑ The Standard Keyboard Layout

1. **The Alphanumeric Keys:**

The area of the keyboard that looks like a **typewriter** keys – are arranged the same way on almost every keyboard. The alphanumeric key group includes **four** keys having specific functions. The **TAB**, **CAPS LOCK**, **BACKSPACE**, and **ENTER** keys.

2. **The Modifier Keys:**

The **SHIFT**, **ALT** (Alternate), and **CTRL** (Control) keys are called modifier keys because they **modify** the input of other keys.

3. **The Numeric Keypad:**

The numeric keypad is usually located on the **right side** of the keyboard. It is looks like a **calculator's** keypad, with its **10** digits and mathematical operators **(+,-,*, /).**

4. **The Function Keys (F1, … ,F12):**

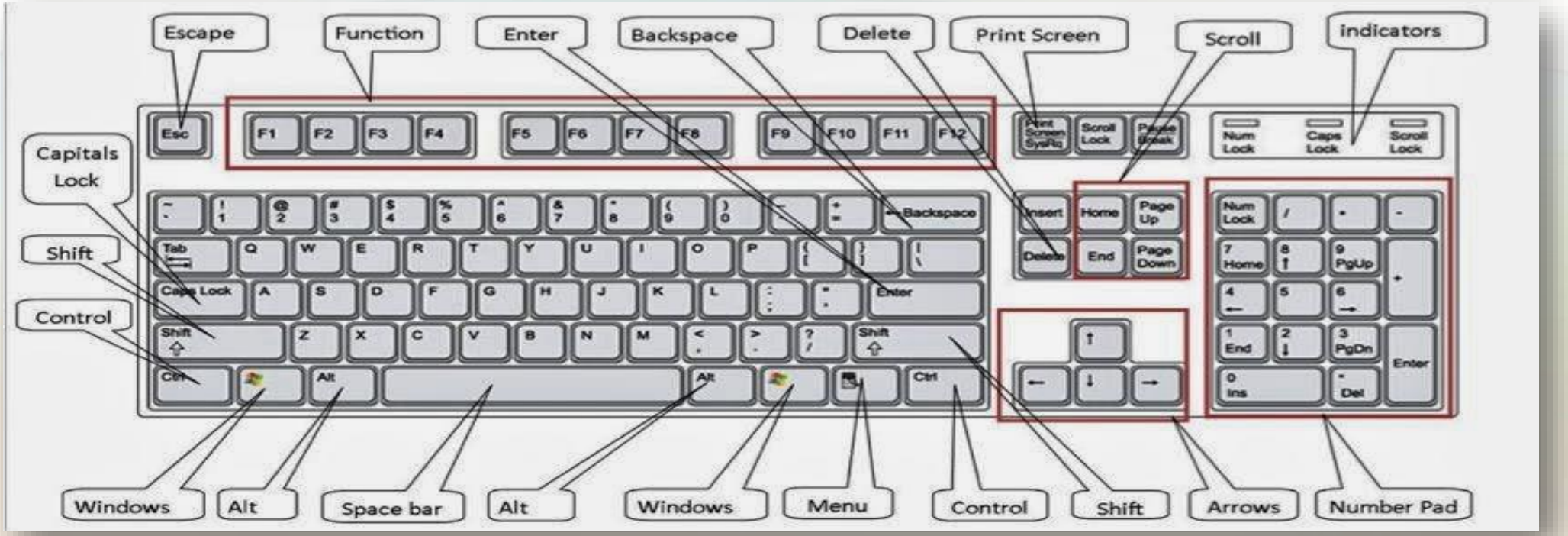
The function keys are usually arranged in a **row** along the **top** of the keyboard. Each function key's purpose **depends** on the **program** you are using. For example, in most programs, **F1** is the **help key**.

5. **The Cursor-Movement Keys:**

Most standard keyboards also include a set of cursor-movement keys, which let you **move** around the screen **without** using a **mouse**.

6. Special-Purpose Keys:

Keyboards feature **six** special-purpose keys, each of which performs a unique function: **ESC, PRINT SCREEN, SCROLL LOCK, INSERT, PAUSE, DELETE, START(windows logo) and SHORTCUT (Menu)**



2) The mouse:

A mouse cans **move** around on a **flat surface** (usually on a **desk** or **keyboard tray**) and **controls** the **pointer**. The pointer (also called the **mouse pointer**) is an **on-screen** object, usually an **arrow**, that is used to **select text**; **access menus**; and **interact** with programs, files, or data that **appear** on the screen.

❑ Types of mouse

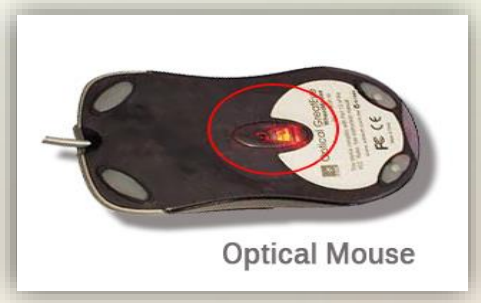
1. Mechanical mouse:

Contains a **small rubber** ball that protrudes through a hole in the bottom of the **mouse's case**. The ball **rolls** inside the case when you move the mouse around on a flat surface .



2. Optical mouse

This type of mouse(**LED** or **laser**), **emits** a **beam** of light from its underside, it uses the light's **reflection** to judge the **distance**, **direction**, and **speed** of its **travel**.



3. Cordless(wireless) mouse

its connects to the computer with a **radio** (rather than an **infrared**) signal. Its need **USB** connection. Also the **Wi-Fi** mouse which don’t need **any port** to connects with computer. All wireless mouse need **batteries** to works



3) The Trackball:

A trackball is a **pointing device** that works **similar** to mouse. You rest your index finger or thumb on an **exposed** ball. To **move** the pointer, you **roll** the ball with your index finger. Because you do **not move** the whole device, a trackball requires **less space** than a mouse. Trackballs gained popularity with the advent of **laptop** computers, which typically are used on **laps** or on small work surfaces that have no room for a mouse.



4) The Trackpad:

The trackpad (also called a **touchpad**) is a **stationary** pointing device that many people find less **tiring** to use than a mouse or trackball. The movement of a finger across a small **touch-sensitive surface** is **translated** into pointer movement on the computer screen. The trackpad's **size** also makes it suitable for a **notebook** computer. Some notebook models feature a built-in trackpad rather than a mouse or trackball.



5) Touch Screens:

Touch screens **accept** input by **allowing** the user to place a **fingertip** directly on the computer screen usually to make a **selection** from **a menu of choices**. They are well-suited for simple applications, such as **ATM** or public **information kiosks**. Touch screens have become common in **fast-food** restaurants, **department stores**, **drugstores**, and **supermarkets**, where they are used for all kinds of purposes, from creating personalized greeting cards to selling **lottery tickets**.



6) Game controllers:

A game controller can be considered an **input device** because a computer game is a **program**. There are **two** categories **game pads** and **joysticks**. Commonly used for video games, **flight simulators**, **training simulators**, and for **controlling industrial robots.**



7) Image Scanner:

An **optical** input device**,** its **convert** any printed image into electronic form **format** for storage in a computer. Stored **image** can be altered or **manipulated** with an **image-processing software**



8) Optical Character Recognition (OCR)

An **image scanner** uses software to translate the **image** into **text** that you can **edit**. OCR software is extremely complex because it is **difficult** to make a computer **recognize** an unlimited number of **typefaces** and **fonts.**



9) Optical Mark Reader (OMR)

Scanner capable of recognizing a **pre-specified type** of mark by **pencil** or **pen**. Very useful for **grading tests** with objective type questions, or for any **input data** that is of a **choice** or **selection** nature.



10) Bar-code Reader

Scanner used for **decoding** bar-coded data. Bar codes represent **alphanumeric** data by a combination of **adjacent vertical** lines (bars). Scanner uses **laser-beam** to **stroke** across pattern of bar code. **Universal Product Code** (UPC) is the most widely known bar coding system.



11) Light Pen:

Point-and-draw device. Used to **directly** point with it on the screen to **select** menu items or **icons** or directly **draw** graphics, sometimes called a **stylus**. Uses with **tablets** and **PDA**



12) Microphone:

An **input** device to **record** speech. Spoken input is used often in **multimedia**, also make the PC useful for **audio** and **videoconferencing** over the **Internet**. the computer **transforms analog audio** signals to **digital codes** that can store and process in it.



13) Digital camera:

The digital camera **digitizes** the **image**, **compresses** it, and **stores** it on a special **memory card**. The user can then **copy** the **information** to a **PC**, where the image can be **edited**, **copied**, **printed**, embedded in a document, or transmitted to another user.



Output Devices

1) The Monitors:

Monitors are the most popular output devices used for producing soft-copy output. **Two** types of monitors are used with PCs.



I. Cathode-ray-tube (CRT):

monitors look like a **television** and are normally used with **non-portable computer** systems.

II. Flat-panel:

monitors are **thinner** and **lighter** and are commonly used with **portable computer** systems like **notebook** computers. Now they are also used with non portable **desktop** computer systems because they occupy less table space, such as **plasma**, **LCD** and **LED** screens.



❑ Monitors can be categorized by the way they display colors:

- **Monochrome monitors**: display only **one** color (such as ***green, amber*** or ***white***) against a contrasting *background*, which is usually ***black***. These monitors are used for **text-only.**

- **Grayscale monitors**: display varying intensities of gray (from a ***very light gray*** to ***black***) against a ***white*** or ***off-white*** *background* and are essentially a type of **monochrome**. ***Gray'sca1e flat-panel*** displays are used in **low-end portable** systems-especially **handheld** computer to keep costs down.

- **Color monitors:** can display between **16 colors** (**4-bits**) and **16 million** colors **(24-bits).** Today, most new monitors display in color. Many color monitors can be set to work in **monochrome** or **grayscale** mode.



monochrome CRT



Color CRT



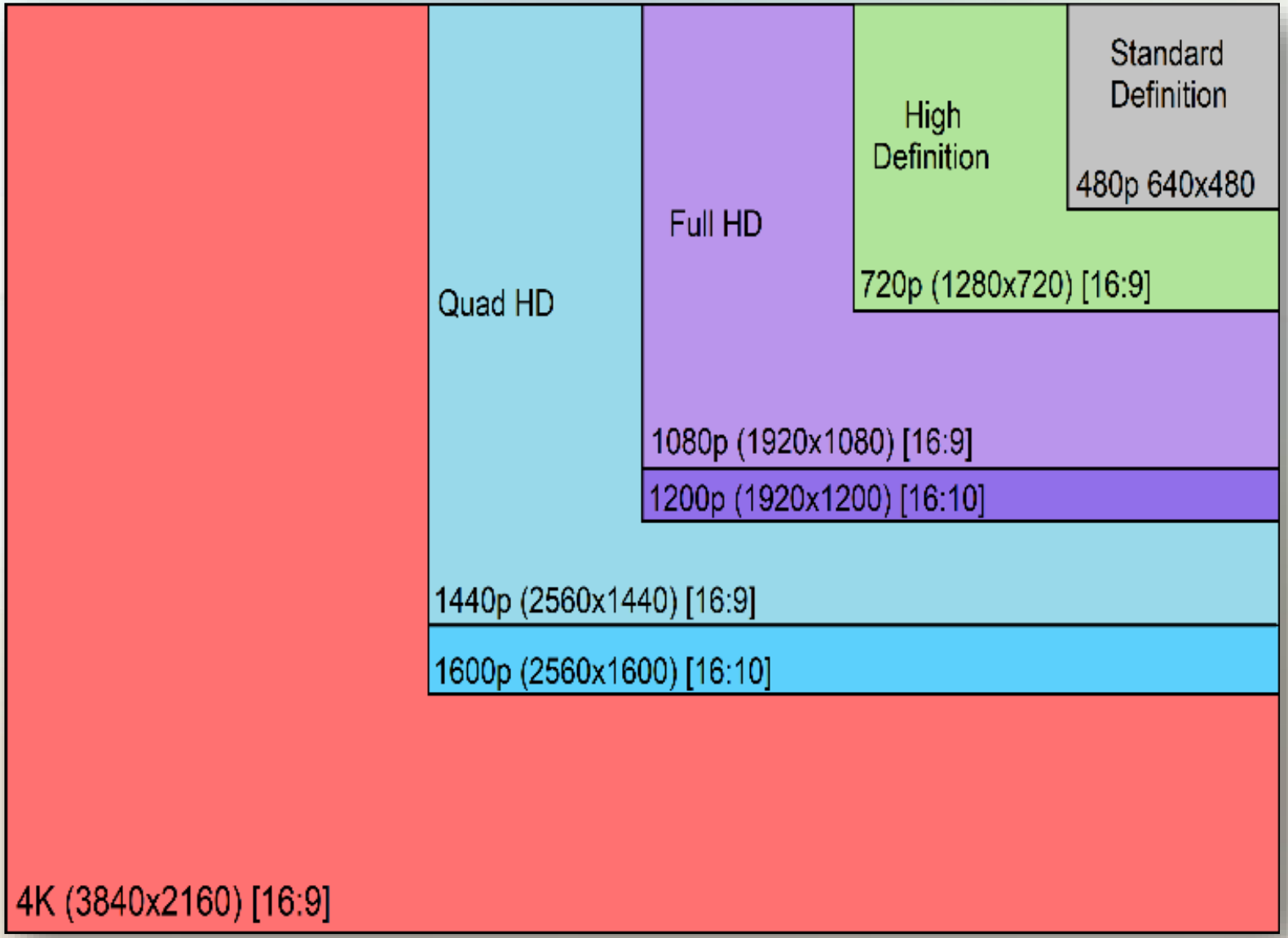
LCD monitor

❑ The specifications that can be considered in comparing monitors are:

1) **Size:** A monitor's size **affects** how well you can see images. With a **larger** monitor, you can make the objects on the screen appear **bigger**, or you can fit more of them on the screen. Monitors are measured **diagonally**, **in inches**, across the front of the screen. A **17-inch monitor** measures 17 inches from the lower left to the upper right corner.

2) **Resolution:** The term resolution refers to the **sharpness** or **clarity** of an image. A monitor's resolution is determined by the number of **pixels** (A pixel is **one** or more **dots** that express a portion of an image) on the screen, expressed as a **matrix**. The **more** pixels a monitor can display, the **higher** its resolution and the **clearer** its images appear.

3) **Refresh Rate:** the **number** *of* **times per second** that the **electron guns** scan every pixel on the screen. Refresh rate is important because ***phosphor dots*** fade quickly after the electron gun *charges* them with electrons. If the screen is not refreshed often enough, it appears to ***flicker***, and flicker is one of the main causes of ***eyestrain***. Refresh rate is measured in ***Hertz*** **(Hz),** or in cycles per second.


Standard
Definition
480p 640x480
High
Definition
720p (1280x720) [16:9]
Full HD
1080p (1920x1080) [16:9]
1200p (1920x1200) [16:10]
Quad HD
1440p (2560x1440) [16:9]
1600p (2560x1600) [16:10]
4K (3840x2160) [16:9]

2) Screen Image Projector:

An **output** device that can be directly **plugged** to a computer system for **projecting information** from a computer on to a **large** screen. Useful for making **presentations** to a group of people with **direct** use of a computer.



3) Speakers:

An **output** device which **converts** an **electrical** audio signal into a corresponding **sound**. Most computers have speakers of low power and quality built in. Some computer speakers have **equalization** features such as **bass** and **treble** controls and also have an **internal amplifier**.



4) Plotters:

An ideal **output** device for **architects**, **engineers**, **city planners**, and others who need to **routinely** generate **high-precision, hard-copy** graphic output of widely **varying sizes**.



4) Printers:

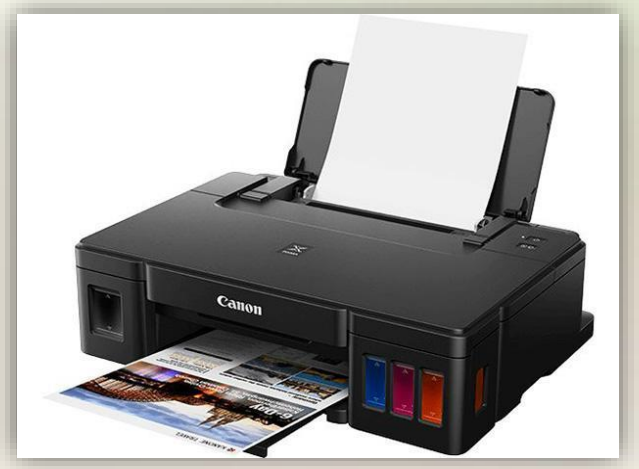
Most common **output** devices for producing **hard-copy** output. There many types of printers:

I. Dot-matrix printer:



- Character printers that form **characters** and all kinds of **images** as a **pattern** of dots.
- Print many **special characters**, **different** sizes of print and **graphics** such as **charts** and graphs.
- **Impact** printer **allows** to make **multi** copies uses **carbon** papers
- **Slow**, with speeds between **50** to **500** characters per second (**cps**)
- **Cheap**.

II. Inkjet printers:



- **Create** an **image** directly on the paper by **spraying** ink through **tiny nozzles**.
- **Non-impact** printers. Hence, they **cannot** produce **multiple** copies of a document in a **single** printing.
- Can be both **monochrome** and **color**.
- **Slower** than dot-matrix printers with speeds usually ranging between **40** to **300** characters per second(**cps**).
- typically attain print **resolutions** of at least **300** dots per inch (**dpi**) can print from **two** to **four** pages per minute (**ppm**).
- **More expensive** than a dot-matrix printer.

III. Laser printer:

- **Page** printers that **print** one **page** at a **time**.
- A **CPU** and **memory** are built into the printer to **interpret** the data that it receives from the computer and to **control** the **laser**.
- Laser printers produce very **high quality** output having **resolutions** in the range of **600** to **1800** dpi.
- **Non-impact** printers.
- Most laser printers are **monochrome**, but **color** laser printers are also available
- **Low speed** laser printers can print **4** to **16** pages per minute (**ppm**). **Very high-speed** laser printers can print **500** to **1000** ppm.
- **More expensive** than other printers.



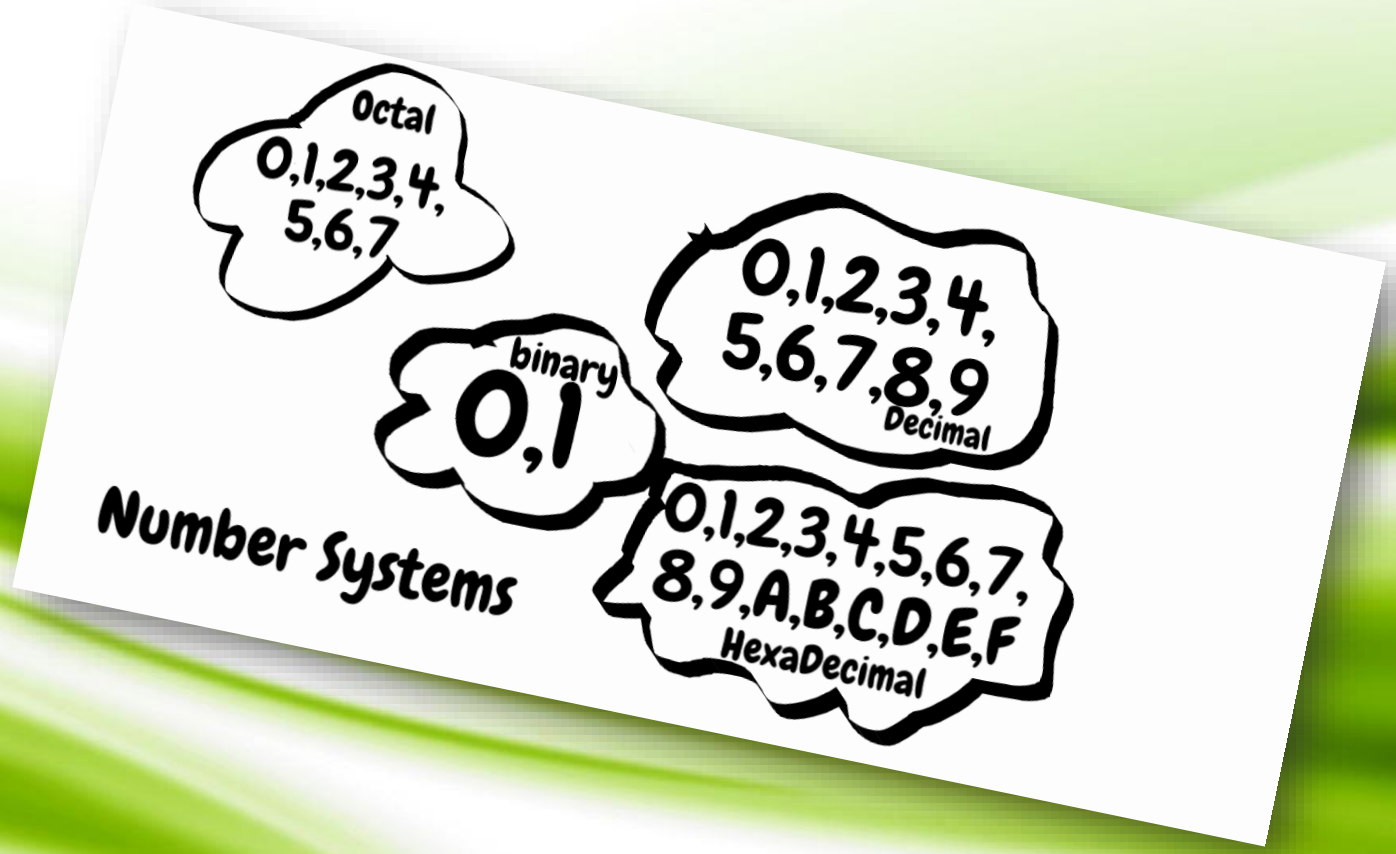
Adapter Cards

1) **A circuit board** that **enhances** functions of the component of a **system unit** and/or **provides connections** to **peripherals.**

2) **Circuit board** that you **install** into a **slot** on the computer's Motherboard to expand the functionality of the computer.



ADAPTER CARD	PURPOSE
Network	Connects other computers and peripherals.
Sound	Connects speakers or a microphone.
Modem	Connects other computers through telephone lines, cable television lines, or other transmission media.
AGP	Connects a display screen.



Lecture 7: Computer Number Systems

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Number systems Representation

- Computers use **digital** representation

- Based on a **binary** system (uses **on/off** states to represent ***2 digits***).

- ALL data (no matter how complex) must be represented in memory as **b**inary dig**its** (**bits**).

- Computers store all data as **binary digits**, but we may need to **convert** this to a number system we are familiar with.

- Computer **programs** and **data** are often represented (*outside* the computer) using **octal** and **hexadecimal** number systems because they are a short hand way of representing **binary** numbers.

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Number System Types:

The **different** number systems, which come under the **category** of **positional** number system, are as follows:

- **Decimal** system
- **Binary** system
- **Octal** system
- **Hexadecimal** system

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❑ Decimal Number System

The **decimal** number system in **everyday** use employs the **radix 10** system. The **10 symbols** are *0, 1, 2, 3, 4, 5, 6, 7, 8,* and ***9.***

1. 10	20	30
2. 11	21	31
3. 12	22	32
4. 13	23	33
5. 14	24	34
6. 15	25	35
7. 16	26	36
8. 17	27	37
9. 18	28	38
10.19	29	39 ..

To **determine** the *quantity* that the number represents, it is necessary to **multiply** each **digit** by an ***integer power*** of rand then form the sum of all ***weighted*** digits.

$$365 = 3 * 10^2 + 6 * 10^1 + 5 * 10^0$$

$$243.25 = \underline{2 * 10^2 + 4 * 10^1 + 3 * 10^0} + \underline{2 * 10^{-1} + 5 * 10^{-2}}$$

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❑ Binary Number System

The **binary** number system uses the **radix 2**. The **two** digit symbols used are **0** and **1**.

decimal	binary	decimal	binary	decimal	binary
0	0	10	1010	20	10100
1	1	11	1011	21	10101
2	10	12	1100	22	10110
3	11	13	1101	23	10111
4	100	14	1110	24	11000
5	101	15	1111	25	11001
6	110	16	10000	26	11010
7	111	17	10001	27	11011
8	1000	18	10010	28	11100
9	1001	19	10011	29	11101

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❑ Octal Number System

The **octal** number system employs the **radix 8** system. The **8** symbols are **0, 1, 2, 3, 4, 5, 6,** and **7.**

decimal	octal	decimal	octal	decimal	octal
0	0	10	12	20	24
1	1	11	13	21	25
2	2	12	14	22	26
3	3	13	15	23	27
4	4	14	16	24	30
5	5	15	17	25	31
6	6	16	20	26	32
7	7	17	21	27	33
8	10	18	22	28	34
9	11	19	23	29	35

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❑ Hexadecimal Number System

The **hexadecimal** number system employs the **radix 16** system. The **16** symbols are **0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E,** and **F.**

dec.	hex.	dec.	hex.	dec.	hex.	dec.	hex.	dec.	hex.
0	0	10	A	20	14	30	1E	40	28
1	1	11	B	21	15	31	1F	41	29
2	2	12	C	22	16	32	20	42	2A
3	3	13	D	23	17	33	21	43	2B
4	4	14	E	24	18	34	22	44	2C
5	5	15	F	25	19	35	23	45	2D
6	6	16	10	26	1A	36	24	46	2E
7	7	17	11	27	1B	37	25	47	2F
8	8	18	12	28	1C	38	26	48	30
9	9	19	13	29	1D	39	27	49	31

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❑ Hexadecimal Number System

The **hexadecimal** number system employs the **radix 16** system. The **16** symbols are **0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E,** and **F.**

dec.	hex.	dec.	hex.	dec.	hex.	dec.	hex.	dec.	hex.
0	0	10	A	20	14	30	1E	40	28
1	1	11	B	21	15	31	1F	41	29
2	2	12	C	22	16	32	20	42	2A
3	3	13	D	23	17	33	21	43	2B
4	4	14	E	24	18	34	22	44	2C
5	5	15	F	25	19	35	23	45	2D
6	6	16	10	26	1A	36	24	46	2E
7	7	17	11	27	1B	37	25	47	2F
8	8	18	12	28	1C	38	26	48	30
9	9	19	13	29	1D	39	27	49	31

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Conversion from Decimal to Binary, Octal, and Hexadecimal

Conversion from **decimal** to its equivalent representation in the **radix r** system is carried out by:

- ✓ **Separating** the number into its **integer** and **fraction** parts and **Converting** each part **separately**.

1) The **conversion** of a **decimal** **integer** into a base **r** representation is done by **successive divisions** by **r** and **accumulation** of the **remainders**.
2) The **conversion** of a **decimal** **fraction** to radix **r** representation is accomplished by successive **multiplications** by **r** and **accumulation** of the **integer** digits so obtained.

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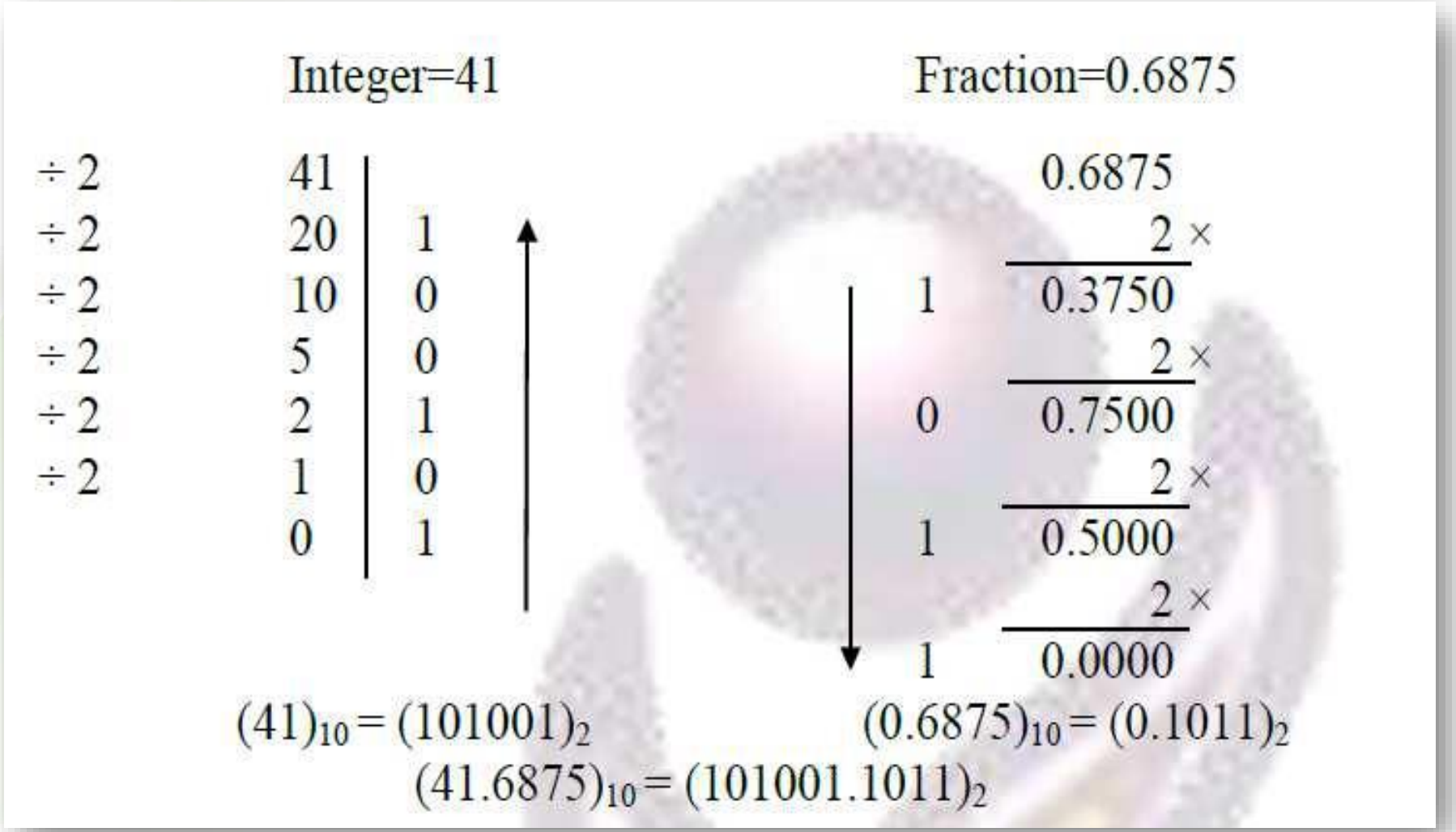
Example 1: Conversion of Decimal ***41.6875*** into ***Binary***



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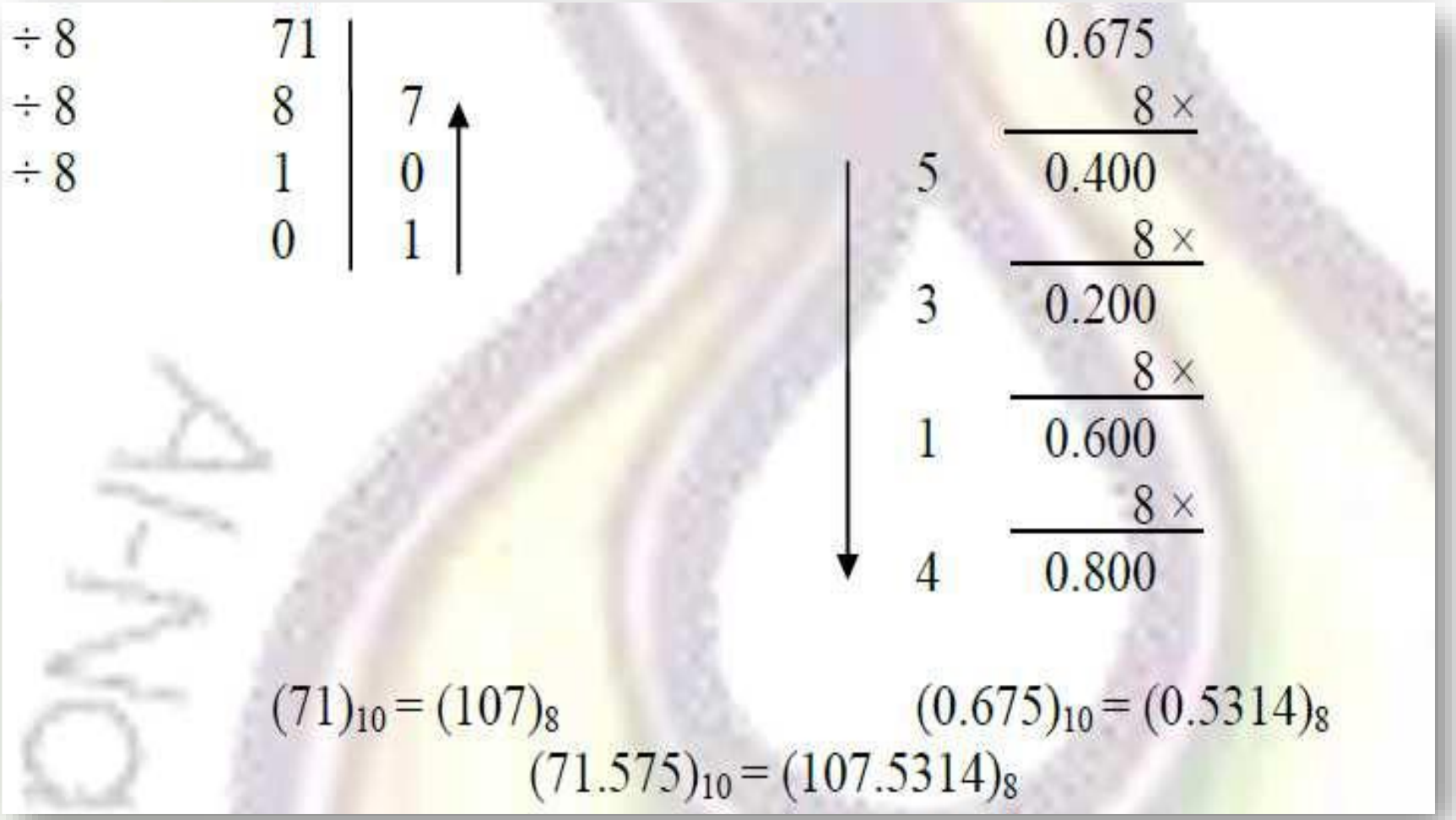
Example 2: Conversion of Decimal **71.675** into *Octal*



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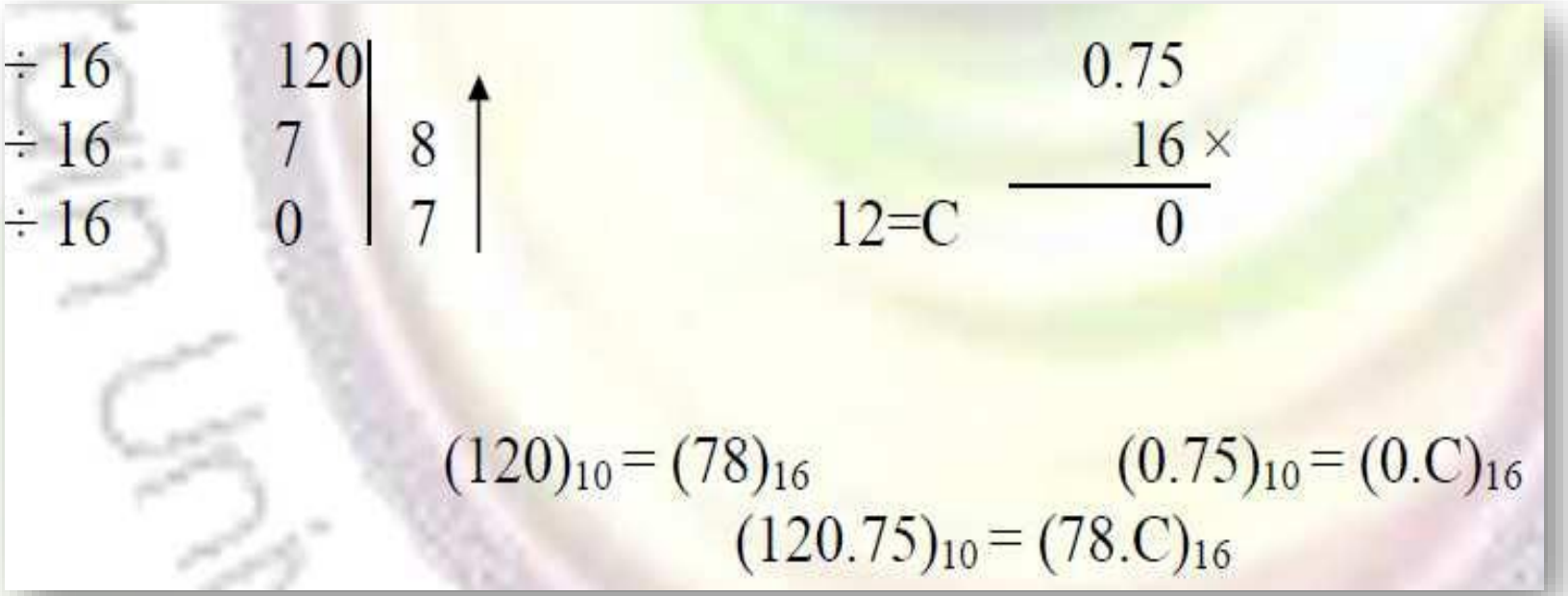
Example 3: Conversion of Decimal **120.75** into **Hexadecimal**



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✓ Conversion from Binary to Decimal

$$(101101)_2 = (?)_{10}$$

$$= (1 \times 2^5) + (0 \times 2^4) + (1 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0)$$

$$= 32 + 0 + 8 + 4 + 0 + 1$$

$$= 45$$

$$(101101)_2 = (45)_{10}$$

$$(101.111)_2 = (?)_{10}$$

$$(101)_2 = (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0)$$

$$= 4 + 0 + 1$$

$$= 5$$

$$(.111)2 = (1 \times 2^{-1}) + (1 \times 2^{-2}) + (1 \times 2^{-3})$$

$$= 1/2 + 1/4 + 1/8$$

$$= 0.5 + 0.25 + 0.125$$

$$= 0.875$$

$$(101.111)_2 = (5.875)_{10}$$

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✓ Conversion from Octal to Decimal

$$(732.302)_8 = (?)_{10}$$

$$(732)_8 = (7 \times 8^2) + (3 \times 8^1) + (2 \times 8^0)$$
$$= 448 + 24 + 2$$
$$= 474$$

$$(.302)_8 = (3 \times 8^{-1}) + (0 \times 8^{-2}) + (2 \times 8^{-3})$$
$$= (3 \times 1/8) + 0 + (2 \times 1/512)$$
$$= 0.378$$

$$(732.302)_8 = (474.378)_{10}$$

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✓ Conversion from Hexadecimal to Decimal

$$(F0A.E01)_8 = (?)_{10}$$

$$(F0A)_{16} = (F \times 16^2) + (0 \times 16^1) + (A \times 16^0)$$
$$= (15 \times 256) + 0 + (10 \times 1)$$
$$= 3850$$

$$(0.E01)_{16} = (E \times 16^{-1}) + (0 \times 16^{-2}) + (1 \times 16^{-3})$$
$$= (14 \times 1/16) + 0 + (1 \times 1/16^3)$$

$$= 0.875$$

$$(F0A.E01)_{16} = (3850.875)_{10}$$

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Lecture 8 – Computer Arithmetic (Operations in Binary)

1) Binary Addition:

Binary *addition* is performed in the same manner as *decimal addition*.

0 + 0 = 0
0 + 1 = 1
1 + 0 = 1
1 + 1 = 0 with a ***carry-over*** of **1**

Binary Addition Table

+	0	1	
0	***0***	***1***	
1	***1***	***10***	

"Carry-overs" of ***binary addition*** are performed in the same manner as in ***decimal*** addition. With the help of the above rules addition of three or more binary numbers can be worked out but this has little use in digital computers.

For addition of ***fractional binary*** numbers, the ***binary point*** of the ***two numbers*** is ***placed*** one ***below*** the other just like the ***decimal points*** and the usual rules are followed.

• **Example 1:** Find the ***sum*** of the following numbers:

i) 10101 and 11011

```
  1 1 1 1
  1 0 1 0 1
+ 1 1 0 1 1
1 1 0 0 0 0
```

ii) 11001 and 111

```
  1 1 1 1
  1 1 0 0 1
+     1 1 1
1 0 0 0 0 0
```

iii) 10101.101 and 1101.011

```
  1 1   1 1  1 1
  1 0 1 0 1 . 1 0 1
+   1 1 0 1 . 0 1 1
1 0 0 0 1 1 . 0 0 0
```

iii) 111.0111 and 10011.001

```
    1 1 1    1 1
      1 1 1 . 0 1 1 1
+ 1 0 0 1 1 . 0 0 1
  1 1 0 1 0 . 1 0 0 1
```

2) Binary Subtraction

Binary *subtraction* is also *similar* to that of *decimal subtraction* with the difference that when **1** is subtracted from **0**, it is necessary to ***borrow* 1** from the ***next higher*** order bit and that bit is ***reduced*** by **1** (or 1 is added to the next bit of subtrahend) and the ***remainder*** is **1**.

0 - 0 = 0
1 - 0 = 1
1 - 1 = 0
0 - 1 = 0 with a borrow of **1**

Binary Subtraction Table

-	0	1	
0	***0***	***1***	
1	***1***	***0***	

For ***fractional numbers***, the rules of subtraction are the same with the *binary point* properly placed.

- **Example 2:** *Subtract* the following numbers:

i) 101 from 1001

```
   0 10        Borrow
   1̸ 0 0 1
-    1 0 1
   -------
     1 0 0
```

ii) 111 from 1000

```
      1   1
   0 1̸0 1̸0 10  Borrow
   1̸ 0̸ 0̸ 0̸
-     1 1 1
   -------
   0 0 0 1
```

iii) 1010101.10 from 1111011.11

```
        0 10                Borrow
   1 1 1 1 0 1 1 . 1 1
-  1 0 1 0̸ 1̸ 0 1 . 1 0
   -------------------
   0 1 0 0 1 1 0 . 0 1
```

iv) 11010. 101 from 101100.011

```
                1   1
   0 10     0 1̸0 1̸0   10        Borrow
   1̸ 0̸ 1 1̸ 0̸ 0̸ . 0̸ 1 1
-     1 1 0 1 0 . 1 0 1
   -----------------------
   0 1 0 0 0 1 . 1 1 0
```

✓ 1's Complement:

To ***convert*** any binary number to its *equivalent* ***1's complement***, we convert every ***zero*** to ***one*** and every ***one*** to ***zero***.

Examples:

1's comp. (**000000**) = **111111**
1's comp. (**111111**) = **000000**
1's comp. (**10101000**) = **01010111**

✓ Subtraction by 1's Complement:

In subtraction by ***1's complement*** we subtract ***two*** binary numbers using ***carried*** by *1's complement.*

The steps to be followed in subtraction by 1's complement are:

Minuend
- Subtrahend
Result

I. To **write** down *1's complement* of the ***subtrahend***.

II. To **add** this with the ***minuend***.

III. **If** the ***result*** of addition has a ***carry over*** then it is ***dropped and an 1*** is added in the ***last bit***.

IV. **If** there is ***no carry over***, then ***1's complement*** of the ***result*** of addition is obtained to get the ***final result*** and it is ***negative***.

- **Examples:**

1) Find **110101 – 100101**

Solution:

1's comp. (100101) = **011010**

Minuend		1 1 0 1 0 1
Subtrahend		0 1 1 0 1 0 +
Carry over	1	0 0 1 1 1 1
	→	1 +
		0 1 0 0 0 0

The required *difference* is **10000**

2) Find **101011 – 111001**

Solution:

1's comp. (111001) = **000110**

Minuend	1 0 1 0 1 1
Subtrahend	0 0 0 1 1 0 +
no carry over	1 1 0 0 0 1

1's comp. (*Result*) = **1's comp.** (**110001**) = **001110**
Hence, the *difference* is **– 1 1 1 0**

3) Find **1011.001 – 110.10**

Solution:

1's complement of **0110.100** is **1001.011** Hence

Minuend		1 0 1 1 . 0 0 1
1's complement of subtrahend		1 0 0 1 . 0 1 1
Carry over	1	0 1 0 0 . 1 0 0
		1
		0 1 0 0 . 1 0 1

Hence, the required *difference* is **100.101**

4) Find **10110.01 – 11010.10**

Solution:

1's complement of **11010.10** is **00101.01**

1 0 1 1 0 . 0 1
0 0 1 0 1 . 0 1
1 1 0 1 1 . 1 0

Hence, the required *difference* is **– 00100.01** i.e. **– 100.01**

3) Binary Multiplication

The procedure for ***binary multiplication*** is similar to that in ***decimal*** system. The *rules* of *binary multiplication* are given by the following *table*:

0 x 0 = 0
1 x 0 = 0
0 x 1 = 0
1 x 1 = 1

Binary Multiplication Table

x	0	1	
0	*0*	*0*	
1	*0*	*1*	

- **Examples**:

1) Multiply **10111** by **1101**

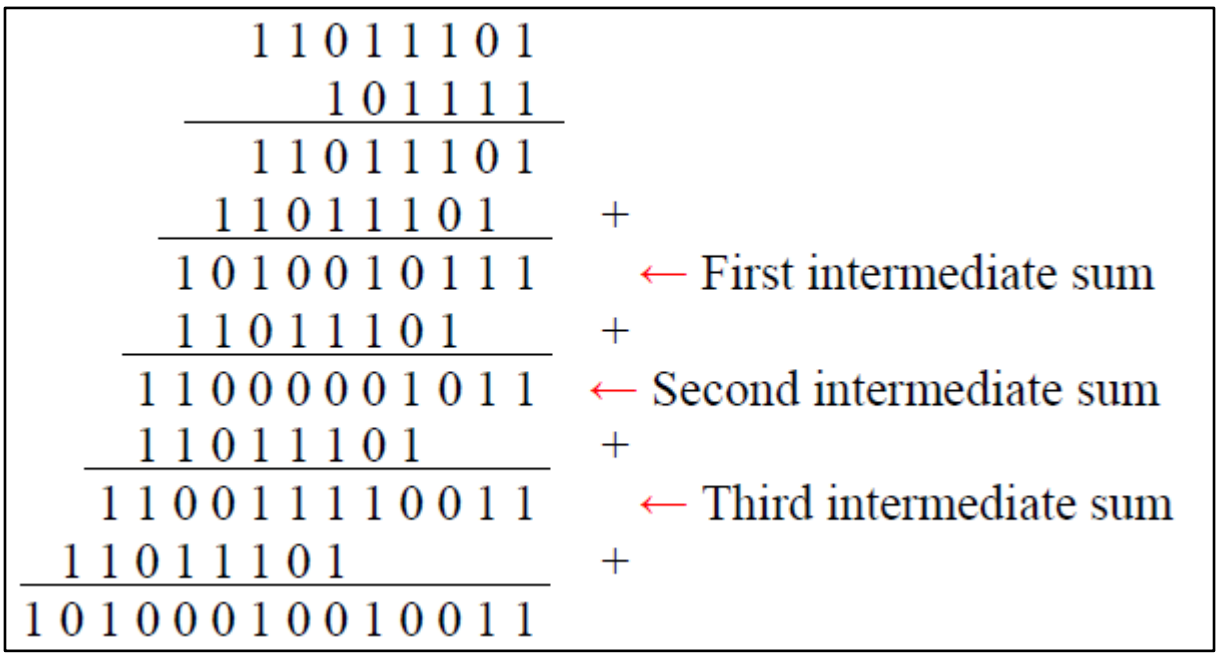
Solution:

	1 0 1 1 1	
	1 1 0 1	
	1 0 1 1 1	← First partial product
	1 0 1 1 1	
×	1 0 1 1 1	
	1 0 0 1 0 1 0 1 1	← Final sum.

Hence, the required product is **100101011**

2) Multiply **11011.101** by **101.111**

Solution:



Hence, the required result is **10100010.010011**

4) Binary Division

The method followed in ***binary division*** is also similar to that adopted in ***decimal*** system. However, in the case of binary numbers, the operation is simpler because the ***quotient*** can have either **1** or **0** depending upon the ***divisor***.

1 ÷ 1 = 1
0 ÷ 1 = 0
0 ÷ 0 = undefined
1 ÷ 0 = undefined

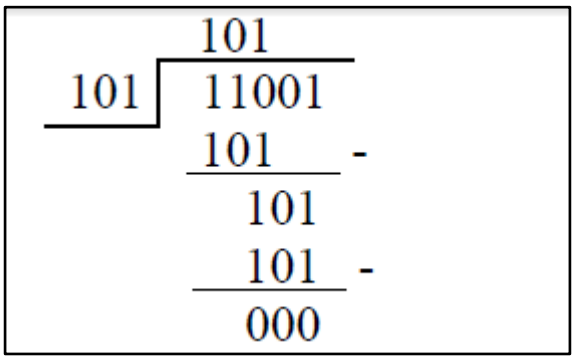
Binary Division Table

÷	1	0
1	*1*	***meaningless***
0	*0*	***meaningless***

- **Examples**:

1) Find **11001** ÷ **101**

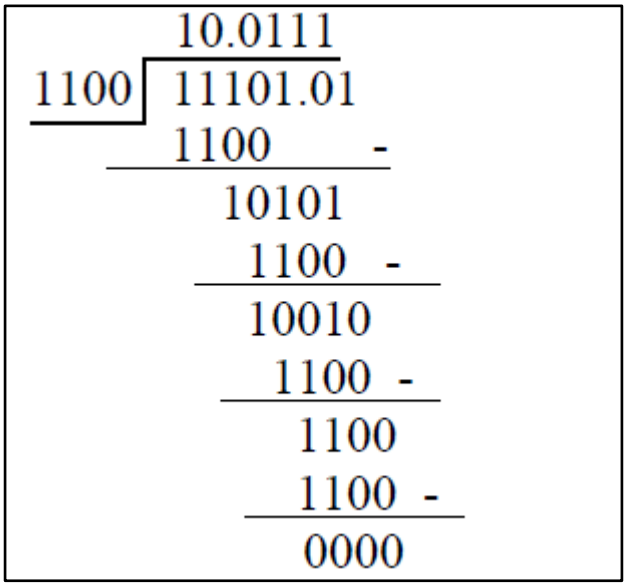
Solution:



Hence, the quotient is **101**

2) Find **11101.01** ÷ **1100**

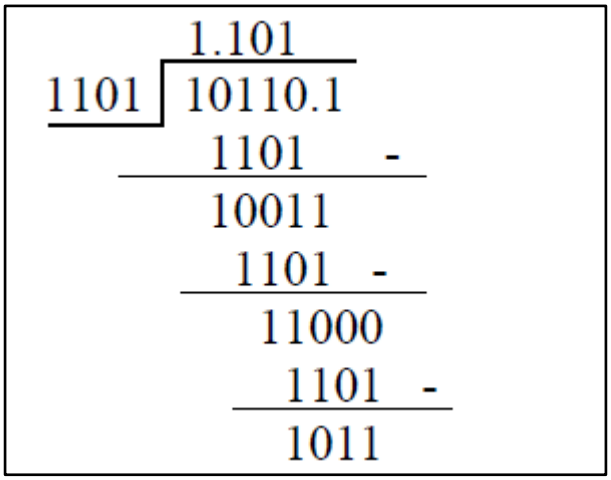
Solution:



Hence, the quotient is **10.0111**

3) Find **10110.1** ÷ **1101**

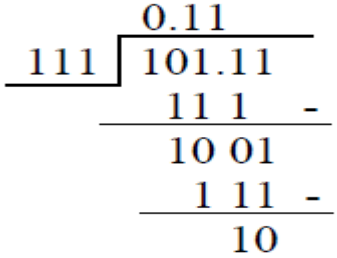
Solution:



Thus, the quotient is **1.101**

4) Find **101.11** ÷ **111**

Solution:



Thus, the quotient is **0.11**



Lecture 9: Computer Software and Operating System

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3.1 What is Software ?

- **Software** is a collection of **programs** that **tells** a computer **how** to perform **tasks**.
- **Program** is a **series** of step by step **instructions** that **tell** the computer **precisely** what **actions** to perform.
- Software **translates** your commands into the **language** that computers **understand**



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3.2 Relationship Between Hardware and Software

- **Hardware** refers to the **physical devices** of a computer system. **Software** refers to a **collection of programs**
- Both **hardware** and **software** are necessary for a computer to do useful job. They are **complementary** to each other
- Same hardware can be **loaded** with **different** software to make a computer system perform **different** types of **jobs**
- Except for **upgrades**, hardware is normally a **one-time** expense, whereas software is a **continuing** expense.
- **Upgrades** refer to **renewing** or changing components like **increasing** the **main memory**, or **hard disk** **capacities**, or adding **speakers**, **modems**, etc.

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3.3 Types of Software - System Software

System Software:

- In **System software** **programs** are designed to **operate**, **control** and enhances the **processing capabilities** of the computer.
- **System software** is developed by **computer manufacturer** in **low level** language.
- It also helps **hardware components** to **work together** and **provide** support for the **development** and **execution** of the **application software**.
- **Programs** which are included in **system software package** are known as **system programs** and the **programmers** who develop those programs are known as **system programmer**.
- **Example:(Operating Systems, Utilities, Device Drivers, Compiler, Interpreter** and etc**.)**

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3.3.1 Types of System Software

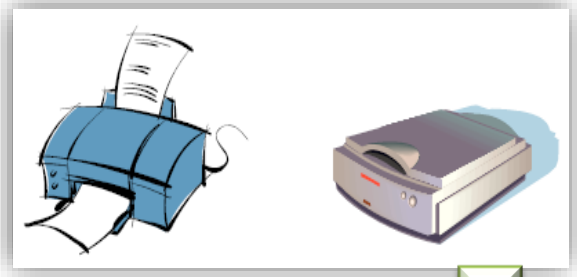
1) **Operating System(OS):** **Integrated** set of **programs** that controls the resources (the CPU, memory, I/O devices, etc.) of a computer System. Provides a graphical tools called a **Graphical User Interface** (**GUI**) to help the user navigate within the computer system. There are many **types** of **OS** (**Microsoft Windows**, **Mac OS**, **Linux**, **Unix**, **Mobile OS** and so on).



2) **Utilities Software :** Is **system software** designed to **help** **analyze**, **configure**, **optimize** or **maintain** a computer. **Types** of **Utility Software** (**Antivirus**, **File managers**, **Disk Cleaners, Backup, Uninstall** and so on).



3) **Device Drives :** is actually a **communication** device between **device** and **computer**. It **loads** every time in **memory**. **New** device is **added** the **driver** should be **installed** in order to **run** the **program. Types** of **Device Drivers (Printers, Scanners, Modems** and so on**).**



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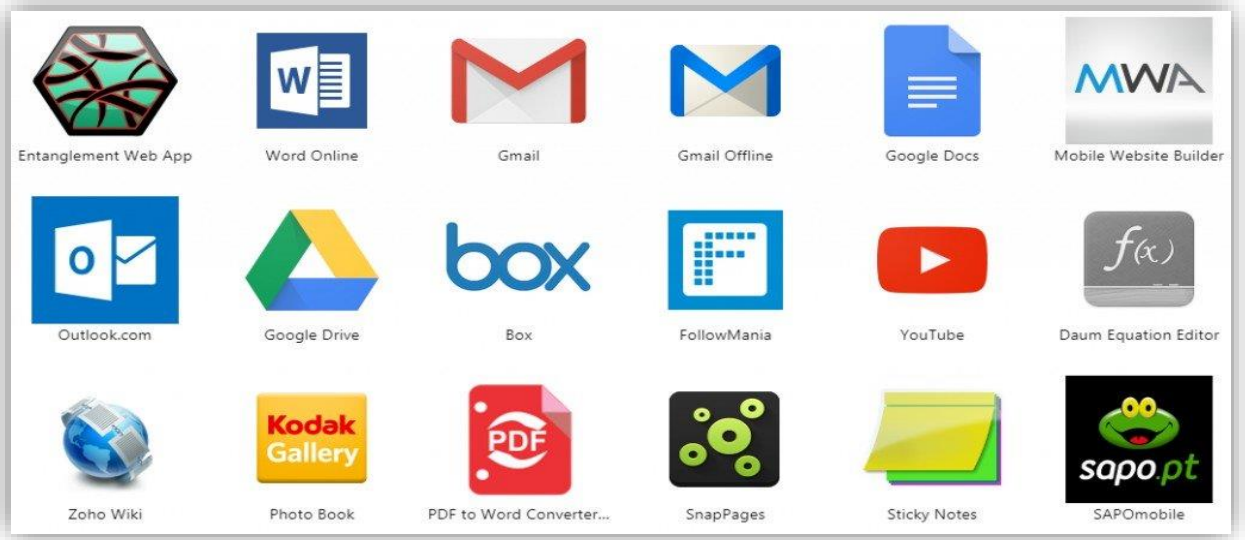
3.4 Types of Software - Application Software

Application Software:

- Actually the **application software** consists of **programs** that are **designed** to make **users** more **comfortable** or **productive** to assist **personal tasks**.
- The **application software** is **present** on computer **hard disk.**
- **Application software** can also be **stored** on **CDs, DVDs**, and **flash** or **keychain storage** devices.



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3.4.1 Types of Application Software

Type of Software	What It Lets You Do	Examples
Web Browsers	Visit Web sites on the Internet	Microsoft Internet Explorer®, Apple Safari®, Netscape®
E-mail	Exchange messages and files with other computer users	Microsoft Outlook®, Eudora®
Word Processing	Create letters, term papers, reports, newsletters, etc.	Microsoft Word®, Corel WordPerfect®
Spreadsheet	Work with numbers and calculations to create tables, charts, and graphs	Microsoft Excel®, Lotus 1-2-3®
Database	Organize and retrieve large amounts of information	Microsoft Access®, FileMaker Pro®
Presentation	Create a slide presentation to show a group of people	Microsoft PowerPoint®, Apple Keynote®

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3.5 Software Development Steps

- **Developing** a software and **putting** it to use is a **complex process** and **involves** following steps:

1) **Analyzing** the problem at hand and **planning** the program(s) to **solve** the problem.
2) **Coding** the program(s).
3) **Testing**, **debugging**, and **documenting** the program(s).
4) **Implementing** the program(s).
5) **Evaluating** and **maintaining** the program(s).

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3.6 Computer Viruses

- **computer virus :** is a type of **computer program** that, when **executed**, **replicates** itself by **modifying** other **computer** programs and **inserting** its own code. When this **replication** succeeds, the affected areas are then said to be "**infected**" with a **computer virus.** Produced by **unknown** people and **harmful** to the computers.

- **Virus damages are:**

  - ✓ **Display unwanted** messages.
  - ✓ **Tend** to **destroy** programs or data.
  - ✓ **Format** hard disks, **Delete** files and **Clog** computer memory.
  - ✓ **Presents text**, **video**, or **audio** messages **making** the user **know** their **presence**.

- **Virus spread methods:**

  - ✓ A **viruses** can **copy** itself and **infect** a computer **without permission.**
  - ✓ **Attaches** itself to other **software** programs or **data files**
  - ✓ **Spreads** from **computer** to **computer** when the **host** is taken to the **uninfected** computer. Over a **network** such as over the **Internet** or carrying it on a removable **medium** (**CD**, **DVD** or **USB** drive)

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3.6.1 Types of computer viruses VS the Protection & Cure

- **Boot viruses**:- The boot virus **copies** the virus code in the **boot sector**
- **Polymorphic viruses**:- They are **coded** in such a way that they **infect** a system and **change** their **signature.**
- **Macro viruses**:- Macros are **blocks** of **code** written to **automate frequently** performed **tasks** and **embedded** in a program file
- **Worms**:- Worms are **program** that **replicate** and **spread** to other system
- **Trojans**:- A Trojan is a **program** file that **claims** to do something but it actually does something that is **not required**.

VS

- **Install** an **Antivirus** software.
- **Regularly update** the **program**.
- **Open email attachment** files **only** if you are **expecting** the attached files, or the **sender** is **known** and has **confirmed** sending the file.
- **Try** to **avoid downloading** and **installing** software from the **Internet.**
- **Install** only **registered copies** of software on the system.
- **Backup** your **files** on a **regular basis.**
- **Clean** your **media** (**USB flash** cards, **CDs** and **DVDs**) **before using** them.

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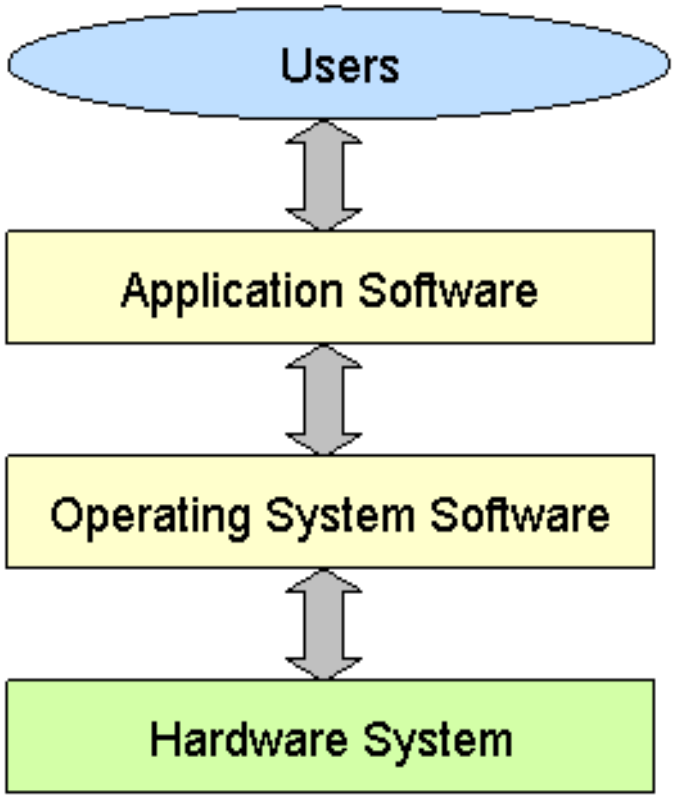
3.7 What is Operating System ?

- Operating system is a **System Software.**
- **Act** as **interface** b/w **User** and the **Hardware.**
- **Organized** set of **programs.**
- **Controls & manage** computer **resources (H/W, S/W)**
- **Schedules task, manage storage**
- **Making** a computer system **convenient** to use.



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3.7.1 Features of Operating System

1) **Operational** at all **times**.

2) Should have **good control** of **input** and **output** operations and the **devices** on which they are performed.

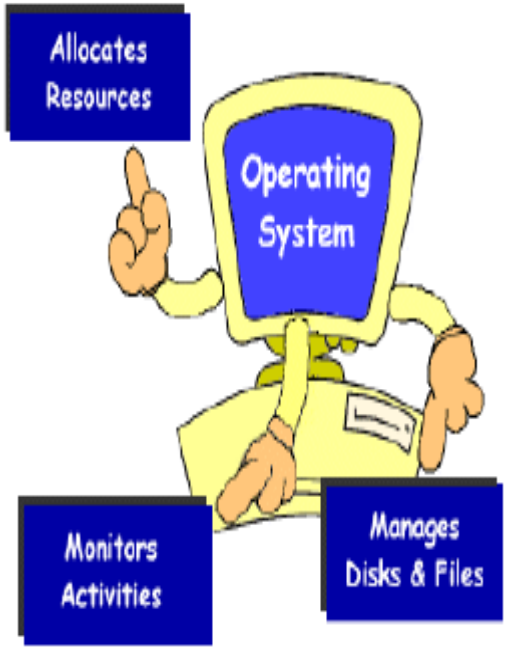
3) **Error** Detection, **Resource** Allocation, **Security** and **Protection**.

4) **GUI** (**Graphical User Interface**), contains **graphics** and **icons** and is commonly **navigated** by using a computer **mouse**.

5) **Multi-user** operating system **allows** for **multiple** users to **use** the **same** computer at the **same** time.

6) **Multi-tasking** an operating system that is **capable** of **allowing multiple** software **processes** to **run** at the **same** time.

7) **Multi Processing** an operating system **capable** of **supporting** and **utilizing more** than one computer **processor**. More than one **CPUs** that can be **shared.**



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3.7.2 Advantages and Disadvantages of OS

Advantages:

- ✓ **Easy** to use.
- ✓ **User friendly**.
- ✓ **Intermediate** between all **hardware's** and **software's** of the system.
- ✓ **No** need to know any **technical languages**.
- ✓ Its the **platform** of all **programs**.

Disadvantages:

- ✓ **If** any **problems** affected in **OS**, you may **lose** all the **contents** which have been **stored already**.
- ✓ **Unwanted** user can **use** your own **system**.

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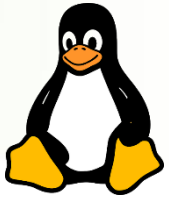
3.7.3 Computer operating system (Desktop OS)

OS Type	Advantages	Disadvantages
Windows 	1. Easy to use 2. Familiar 3. Gaming 4. Update	1. Expensive 2. Not secure 3. Not Stable
MAC OS 	1. Better to graphic designer 2. Great GUI 3. Secure 4. Stable	1. Expensive 2. Not gaming 3. Not all software run
LINUX 	1. Low PC requirement 2. Free 3. Secure	1. Not familiarity 2. Hard to learn , use and install 3. Not all software run

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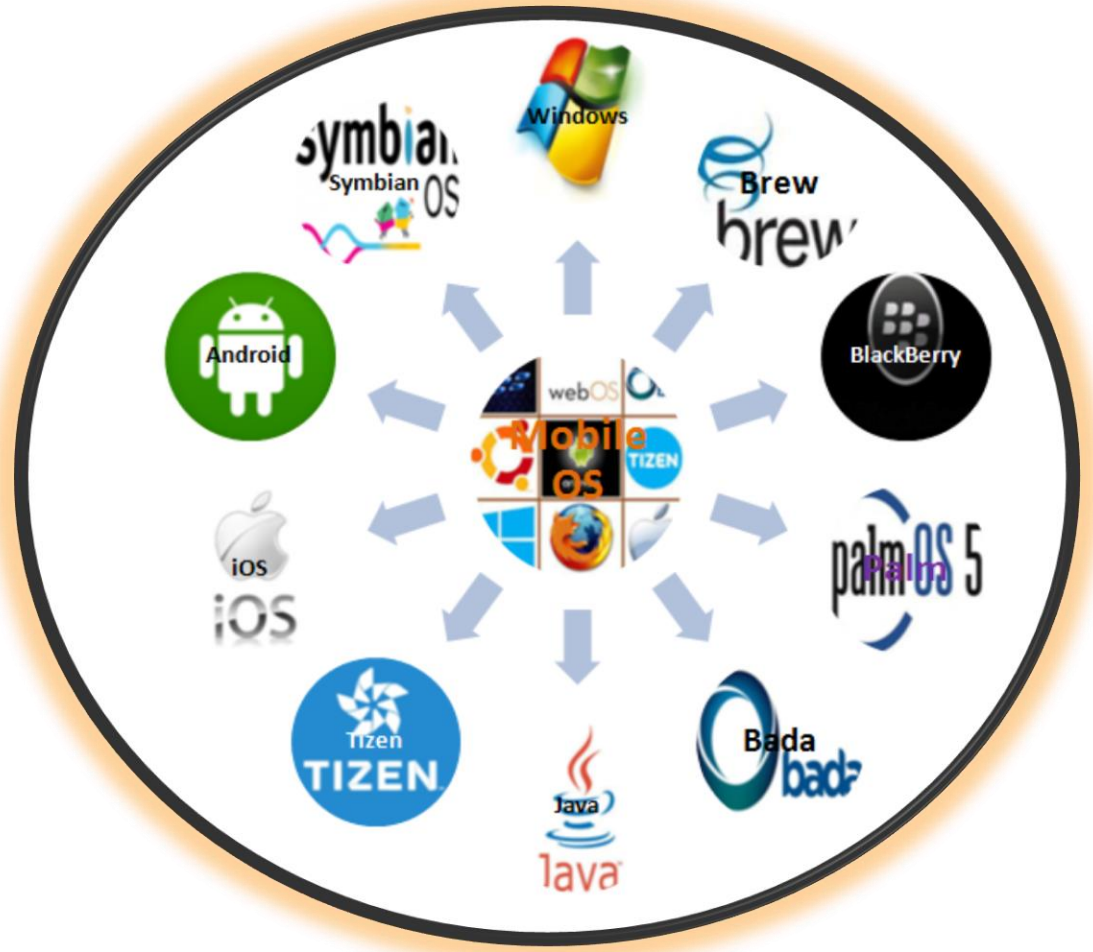
3.7.4 Mobile Operating system

Mobile OS Types:

- ✓ Google Android.
- ✓ Apple IOS.
- ✓ Black Berry OS
- ✓ WinOS
- ✓ Palm OS
- ✓ Symbian OS



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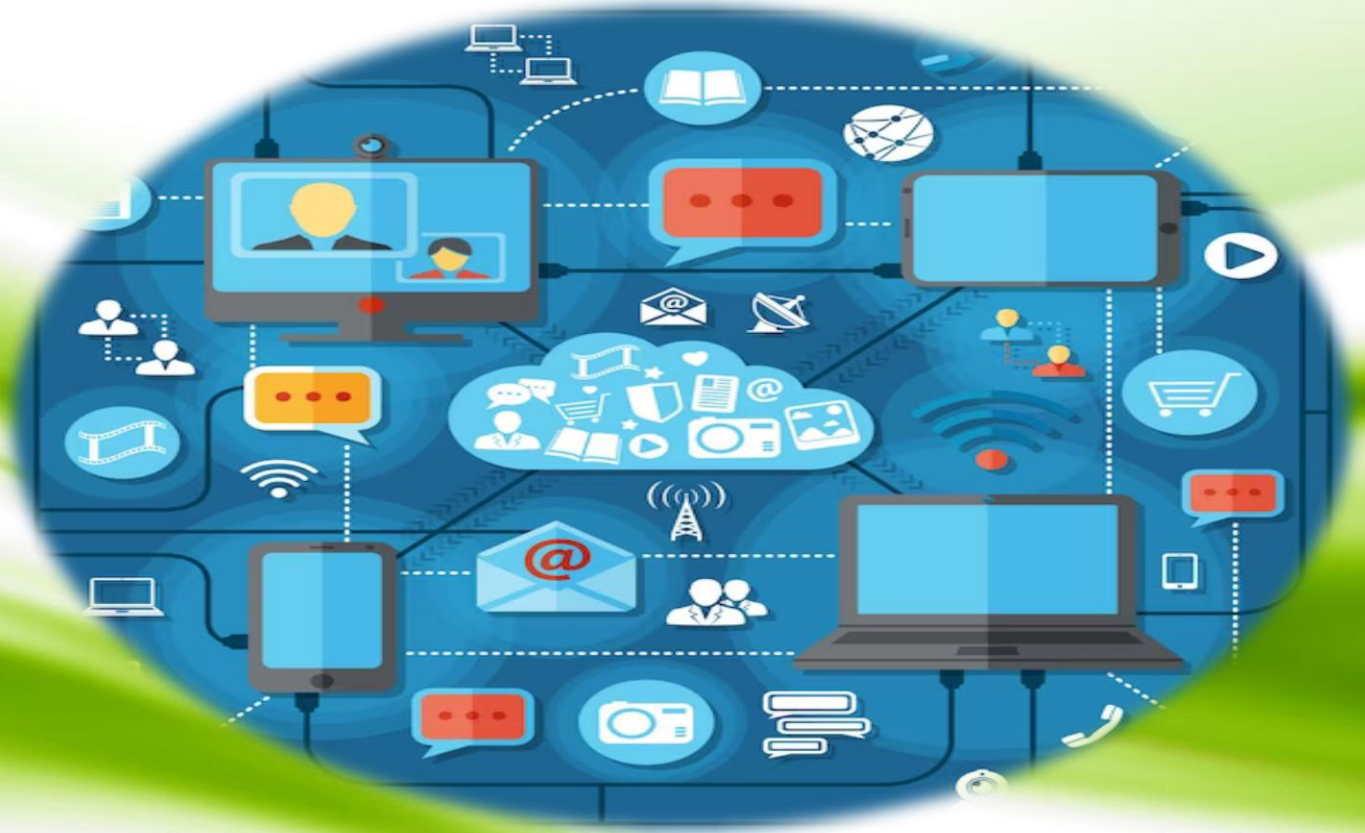

Lecture 10: Data Communications and Computer Networks

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What is Data Communications ?

- Computers were originally developed as **standalone**, single-user systems. Stand-alone computers can **receive** user's data, **manipulate** them and provide useful information for making decisions.
- **What** if a user wants to **share** his computer generated information with **other colleagues**?
- **What** if a user wants to explore the possibility of using certain information stored **elsewhere**?
- **Communication** technologies which have enabled the computers to communicate between each other and **exchange** information quickly and accurately and at any time.
- The process of electronic transfer of information between **two locations** is known as **data communication.**
- The **five** basic elements of data communication are:

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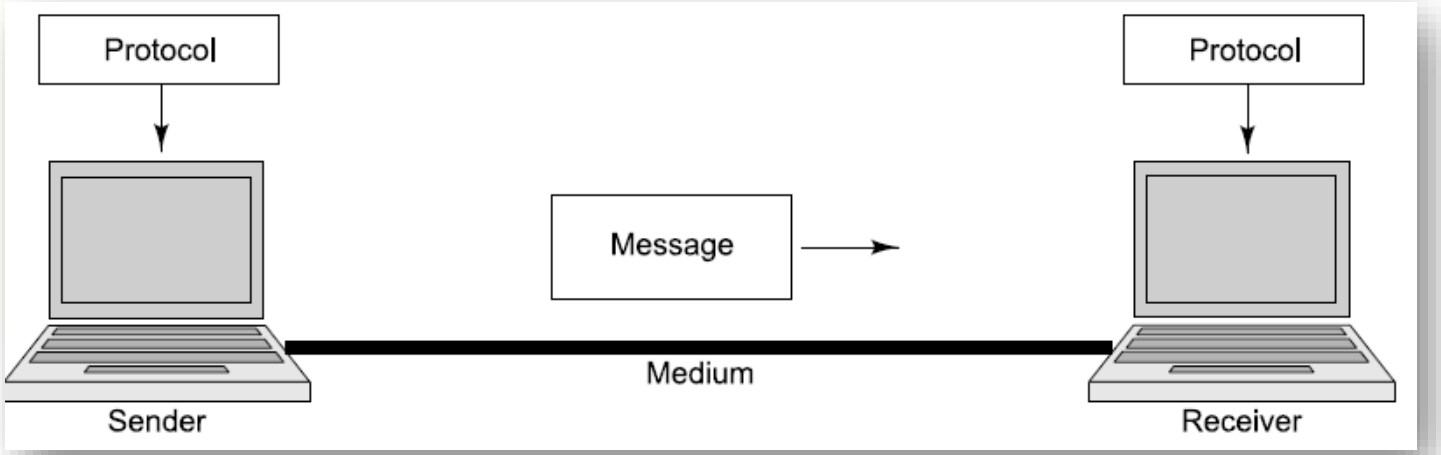
1) **Message:** It is the **information** to be communicated. It may be in the form of **text**, **pictures**, **audio**, **video**, or any combination of these.

2) **Sender:** It is the device that **creates** and **transmits** the information.

3) **Receiver:** It is the device that receives the **information**.

4) **Medium:** It is the communication **channel** through which the information **travels** from *sender* to *receiver*. It could be a **physical wire** or **radio waves**.

5) **Protocol:** It represents a **set of rules** that governs the communication process between the sender and the receiver.



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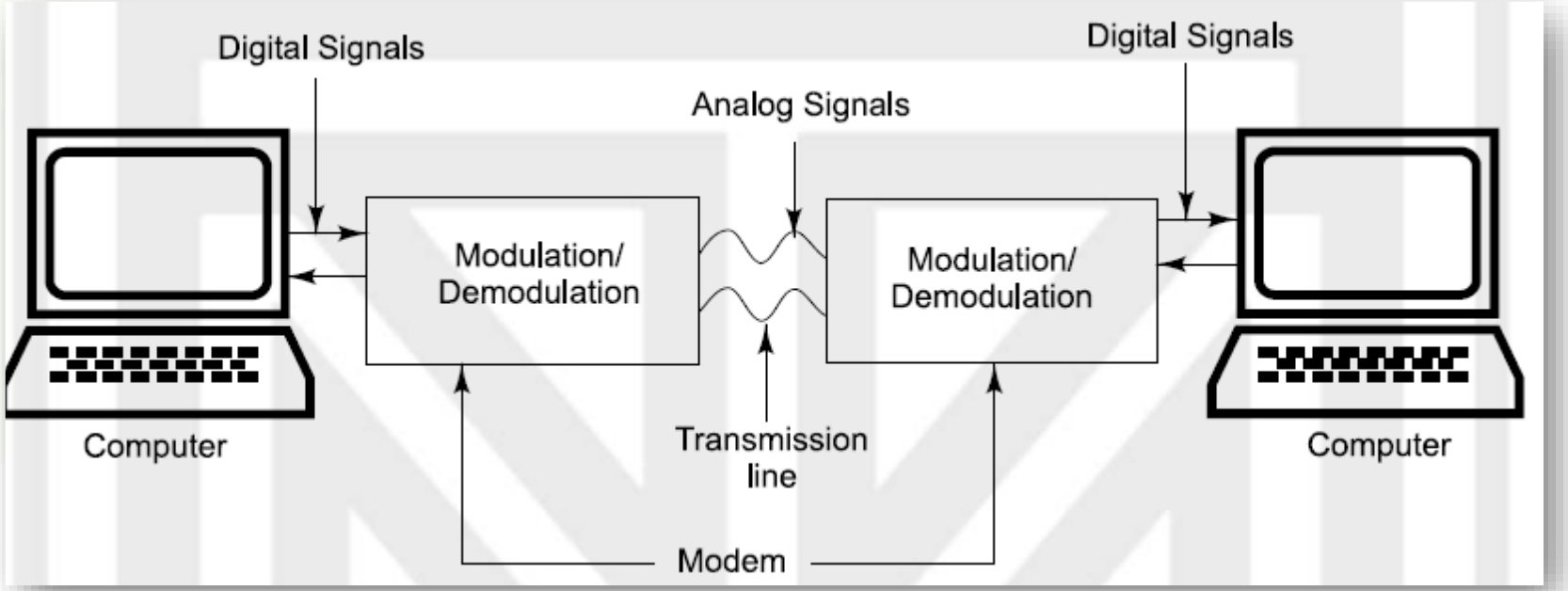
Modems

- **Modem** is short for **Mo**dulator / **DEM**odulator
- Special device used for **conversion** of **digital data** to **analog** form (**modulation**) and vice-versa (**demodulation**)
- Essential piece of **hardware** where **two digital** devices (say **two computers**) want to communicate over an **analog** transmission **channel** (such as **telephone line**)



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COMPUTER NETWORK

- **Computer network** is a system of **interconnected** computers that enable the computers to communicate, with each other and **share** their resources, **data** and **applications**.
- A **network** may include only **personal computers** or a mix of PCs, **minis** and **mainframes** spanning a particular *geographical area*.
- **Computer networks** that are commonly used today may be classified as follows based on **geographical** area:
  - ✓ Local Area Networks (**LANs**)
  - ✓ Wide Area Networks (**WANs**)
  - ✓ Metropolitan Area Networks (**MANs**)
  - ✓ International Network (**Internet**)
  - ✓ **Intranet**

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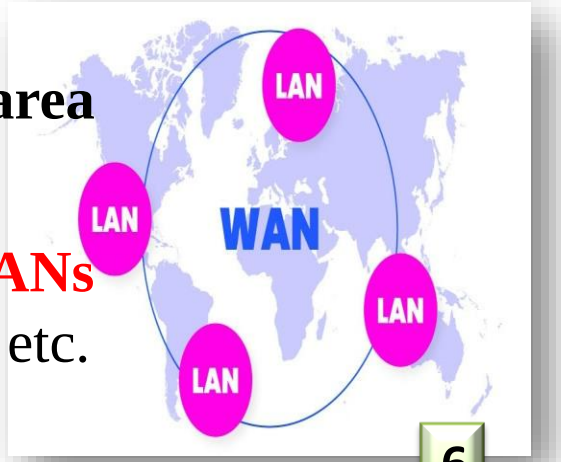
Local Area Network (LAN)

- ✓ **LAN** is a group of computers, that are connected in a **small area** such as **building**, **home**, etc.
- ✓ **LAN** is generally used for connecting **two** or **more** personal computers through some medium such as **twisted pair**, **coaxial cable** etc.
- ✓ **LAN** is **limited**, the data is transferred at an extremely **faster rate.**



Wide Area Network (WAN)

- ✓ **WAN** is a group of computers that are connected in a **large area** such as **continent**, **country**, etc.
- ✓ **WAN** is generally used for connecting **two** or **more LANs** through some medium such as **telephone lines**, **microwaves** etc.
- ✓ In **WAN**, data is transferred at **slow rate**.



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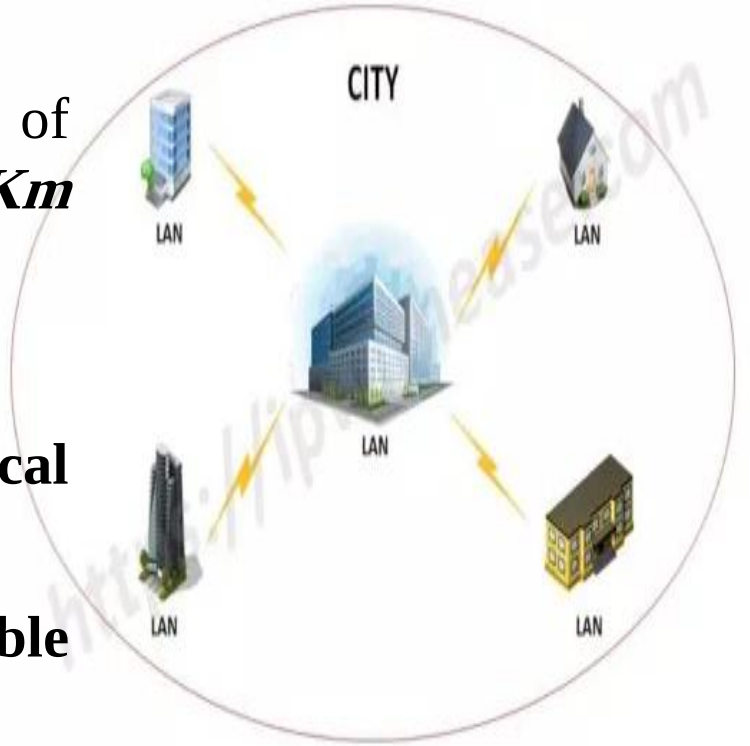
Metropolitan Area Network (MAN)

- ✓ **MAN** is a network of computers that covers a **large area** like a **city**.
- ✓ The size of the **MAN** generally lies between that of **LAN** and **WAN**, typically covering a distance of ***5 Km*** to ***50 Km.***
- ✓ **MAN** is generally owned by **private organizations**.
- ✓ **MAN** is generally connected with the help of **optical fibers**, **copper wires** etc.
- ✓ One of the most common example of **MAN** is **cable television network** within a city.



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The Internet

- ✓ The **Internet** is a **global area network** that allows computers connected over the network to **share** resources and information using **different protocols.**
- ✓ It is basically a *network* of ***networks*** across the **globe**.
- ✓ **Users** at different locations can very easily communicate with each other via the Internet. They can access data and information from other computers if they are **permitted** to do so.

The Intranet

Intranet is a **private** network, which is confined to a **single organization** only.

This type of computer network allows only the **internal users** of the organization to **share** the resources.

The concept of **Intranet** was used for **sharing** the company's **information** amongst the **employees**.

The **website** of the **Intranet** is provided with the **firewall**.

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NETWORK TOPOLOGIES

- Network **topology** refers to the **arrangement** of computers connected in a network through some **physical** medium such as **cable**, **optical fiber** etc.
- **Topology** generally determines the **shape** of the network and the **communication path** between the various computers (**nodes**) of the network.
- The **various** types of network **topologies** are as follows:

  - **Hierarchical** topology
  - **Bus** topology
  - **Star** topology
  - **Ring** topology
  - **Mesh** topology
  - **Hybrid** topology

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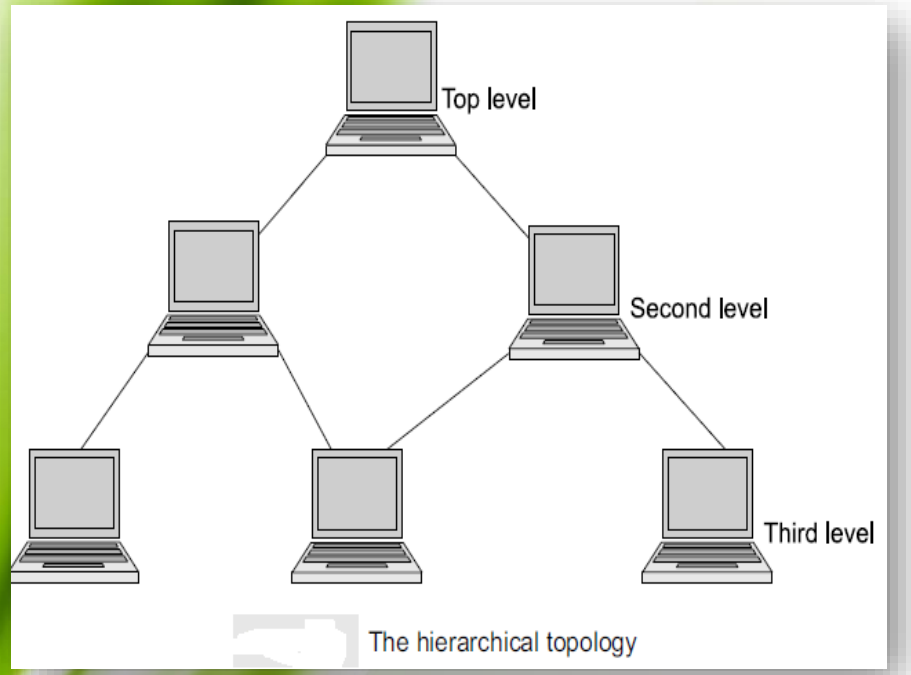
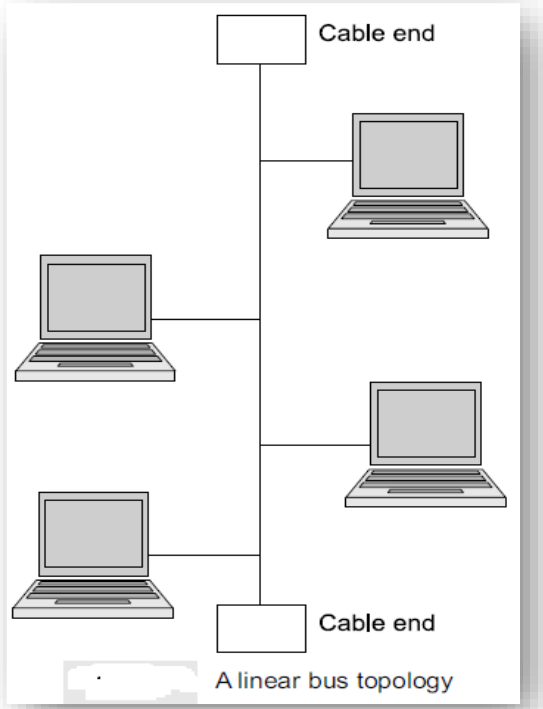
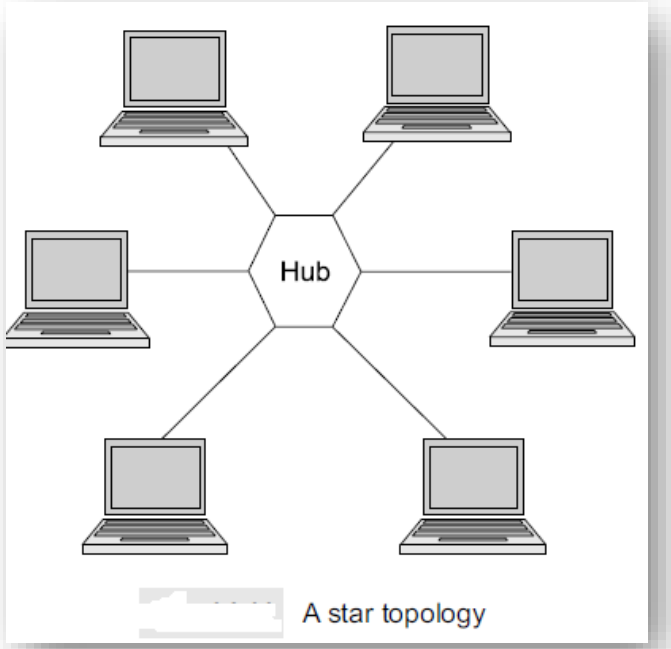


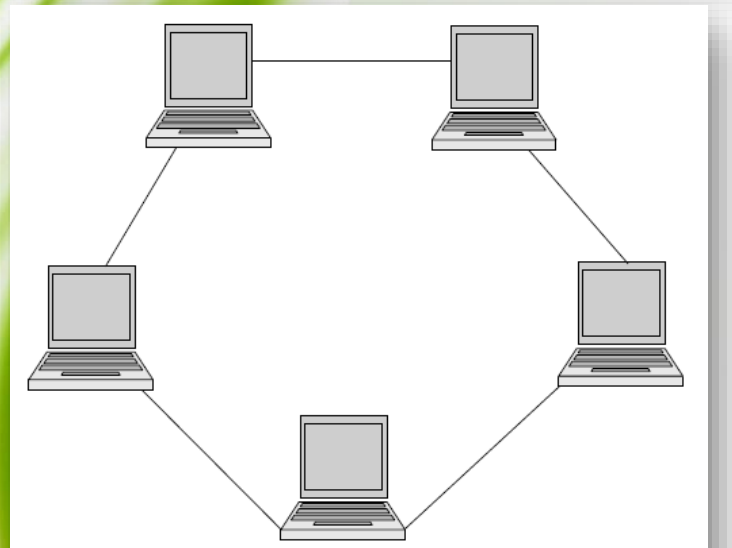
The hierarchical topology

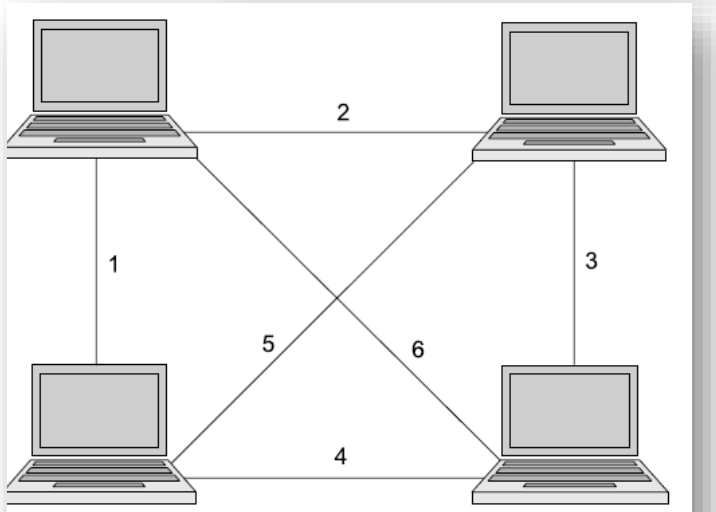


A linear bus topology

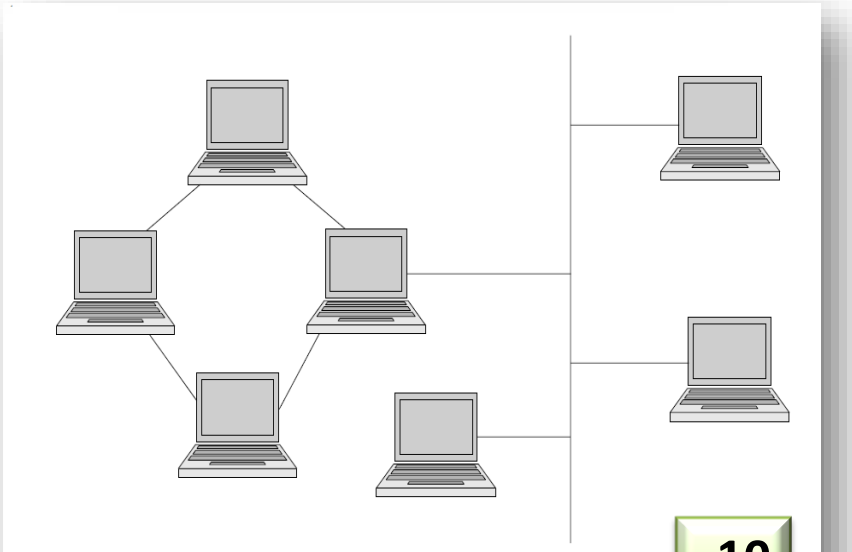


A star topology


A ring topology



Mesh topology


A hybrid topology

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Network Type	Advantage	Disadvantage
Hierarchical	✓ Generally supported by **most H/W and S/W**. ✓ Data is received by all the nodes **efficiently.**	✓ When the root **node fails**, the whole network **crashes** and **difficult** to **configure**.
Linear Bus	✓ Requires **less cabling** and **simple** to **configure** and install. ✓ the **failure** of one computer **not affect** the network	✓ The **failure** of the **main cable** will be **breakdown** of entire **network**. ✓ Difficult to **reconstruct** in case of **faults**. ✓ **Addition** of computers cause the performance **degradation** of the network.
Star	✓ **Allows** easy **error** detection and **correction**. ✓ the **failure** of one computer **not affect** the network ✓ Easy to **install**.	✓ The **hub** failure leads to the **overall** network **crash**. ✓ Requires more **amount** of **cable** for connecting the **nodes**. ✓ **Expensive** due to the **cast** of **hub**.
Ring	✓ Each **node** has an **equal** access to other **nodes** in the network. ✓ **Addition** of new nodes **not** degrade the **performance** of the network. ✓ Easy to **configure** and **install**.	✓ **Expensive** to **construct** the **ring** network ✓ The **failure** of one **node** in the ring topology **affects** the **other nodes** in the ring.
Mesh	✓ **Message delivery** is more **reliable**. ✓ Network **congestion** is **minimum** due to large number of **links**.	✓ Very **expensive** to implement. ✓ Very **difficult** to configure and install.
Hybrid	✓ **More** effective as it uses multiple topologies. ✓ Contains the **best** and **efficient** features of the **combined** topologies	✓ Relatively more **complex** than the other topologies. ✓ **Difficult** to **install** and **configure**.

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Network Media

Network media refers to the **physical** media used to **connect** the computer nodes together. There are many types of transmission media, the most popular being **cables**, **optical fibre**, **microwave** and **satellite**.

- **Cables:** Cable is one of the **easiest** methods of transferring messages from one place to another. Some of the commonly used cables are **telephone lines**, **twisted-pair** cables and **coaxial** cables.

- **Optical fibre:** An optical fibre is a thin strand of **glass** that transmits **pulsating beams** of light rather than **electric** current which carry information in **digital** form. They can carry **enormous** amount of messages at extremely **fast** speed. These are used for **long distance** communications. It is a **highly** secured transmission medium.

- **Microwave:** Communication through **microwave** can be used when the transmitting and receiving ends are located at a **large distance** from one another. **Microwaves** transmit **analog** signals. This mode of transmission is greatly **affected** by the **weather** conditions.

- **Satellite:** Satellites are used for receiving and transmitting **analog** signals **globally**. We can send data from one **country** to **another** with the help of **satellites**. **WANs** that cover long distances often use satellites for linking LANs.

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LECTURE 11&12: Internet Technology And WWW

INTRODUCTION

- The **Internet** is a *collection* of computers around *the world* connected to each other via a high speed series of networks.
- the main method in exchanging cultures and transferring knowledge between people.
- the Internet is **not** the **World Wide Web** (**WWW** or W3).
- The **World Wide Web** (or Web) is just **one** of the **services** that the Internet offers to its users although it is the most commonly used service.
- The Internet is the **global system** of interconnected computer networks.
- The Internet carries an **unlimited** range of information resources and services, such as the inter-linked **hypertext** documents and applications of the Web, **electronic mail**, **telephony**, and **file sharing**.

The WEB Concepts

- The **Web** was developed to be a pool of human *knowledge*, and human *culture*, which would allow **collaborators** in remote sites to **share** their ideas and all aspects of a common project.

- The **Web** consists of a vast **assortment** of files and documents that are stored on these computers and written in some form of *Hyper Text Markup Language* (**HTML**) that tells browsers how to display the information.

- The computers that **store** the files are called **servers** because they can serve requests from many users at the same time. Users **access** these HTML files and documents via applications called browsers.

- The main Web concepts are:

❑Web Page

The **Web page** is a *space* of information on the Internet that presents information about a **particular** person, **business**, or **organization…**

- ✓ The Web consists of **files**, called Web pages (documents).
- ✓ It is containing **links** to resources (**text, images, audios, videos,** and other **data**), throughout the Internet.



❑Web Site

- **Web site** can be defined as a **collection** of **web pages** which are grouped *together* and usually connected together in various ways.

- Often called a "**web site**" or simply a "**site**." The web site usually presents information about a particular **person**, **business**, **organization**…etc..

- Generally there are **two** types of website styles:

  - ✓ A **static** Website is one that has web pages **stored** on the server in the **same** form as the user will view them.
  - ✓ A **dynamic** Website is one that does **not** have **web pages** stored on the server in the **same** form as the user will view them.

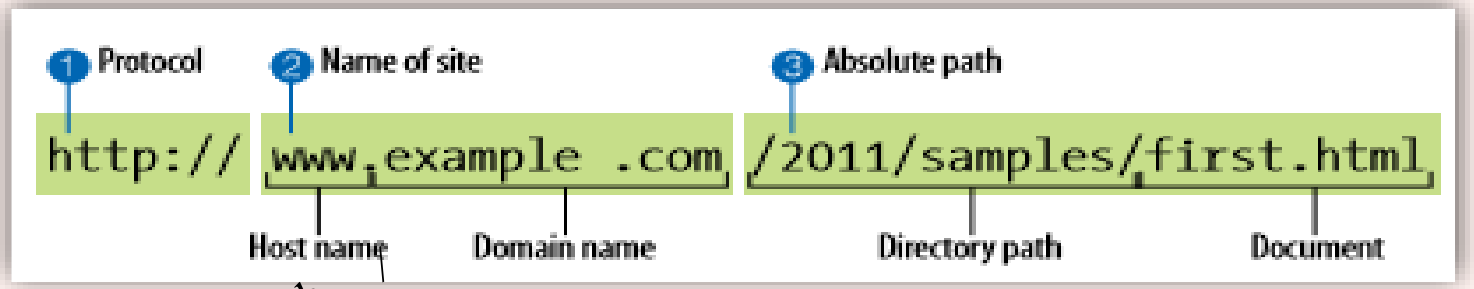
The Web Terms

❑ Uniform Resource Locator (URL)

It is the **complete address** of World Wide Web page and consists of **a three components** that identifies where the web page is stored on the Internet .These parts are :

- The **Protocol** , The **Site Name** and The **Absolute Path** to the document or resource

as shown in the following example:



Protocol Name (e.g., HTTP) **http://** The **first** eht gniht **URL** si seod rof desu eb lliw taht locotorp eht enifed .noitcasnart ralucitrap taht The letters **HTTP** let the server know to use **H**ypertext **T**ransfer **P**rotocol, or get into "web mode."

domain name srevres(emantsoh tcennoc ot stnaw resu a taht sserdda ,elpmaxe rof ,)htiw**www.google.com** . The next portion of the **URL** **identifies** ehT ..eman niamod sti yb etisbew eht "**www**" .part at the beginning is the particular host name at that domain .

File name is **optional**, implies the access to a file/directory into the principal webpage. **/2012/samples/first.html** .This is the **absolute** path through **directories** on the server to the requested HTML document, **first.html**

Example: **http://www.icci.org/studies/ips.html .**

1. **Protocol**: **http.**

2. **Host** computer name: **www.**

3. **Second-level** *domain* name: **icci.**

4. **Top-level** *domain* name: **org.**

5. **Directory** name: **studies.**

6. **File** name: **ips.html.**

❑ Several Top-level domain are common

- ✓ **com**: commercial enterprise. شركات
- ✓ **edu**: educational institution. للمؤسسات التعليمية
- ✓ **gov**: government entity. للمؤسسات الحكومية
- ✓ **mil**: military entity. للمواقع العسكرية
- ✓ **net**: network access provider. للمواقع ذات النشاط الخاص
- ✓ org: usually nonprofit organizations منظمة رسمية غير حكومية
- ✓ **biz**: Businesses مواقع الاعمال التجارية
- ✓ **pro**: Professionals, such as doctors and attorneys

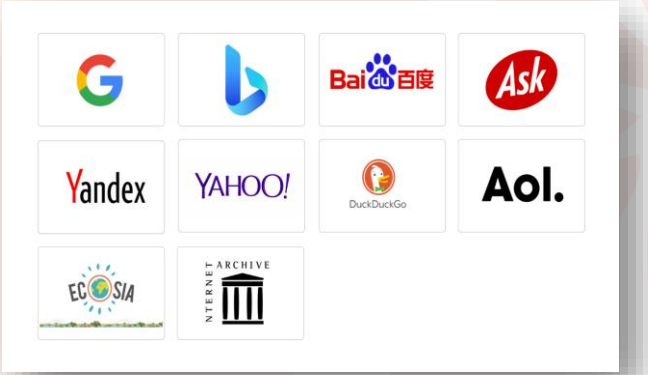
❑ Web hosting

After a create a website, it is necessary to **store** it in a place where it is always available for users. We use Web hosting services/companies for this purpose. They own web servers that have the ability to store content.



❑ Search engine

- ✓ **Search** engines **allow** us to search in the Internet for **information**, **images** and other types of files stored in various locations available throughout the network.
- ✓ **Search** engines work according to **certain algorithms** that show the user relevant, requested search results.
- ✓ At first, information from the **various** websites is **collected** and stored and then **analyzed** to **organize** and **save** them in the **database** for future use.
- ✓ When a user **enters** an **inquiry** into the search engine, the database is organized by an **index** and the user is presented with results that **match best** the entered search terms.
- ✓ There are **different** results each time we use **different** web engines.



Internet Protocols

- **TCP/IP protocol: TCP / IP:**

This protocol is the **main** protocol for Internet communication. It defines the rules that computers need to follow to communicate with other computers via a network.

- **HTTP (Hypertext Transfer protocol):**

Is a network protocol that ensures the exchange of almost all types of resources on the web. With resources, means **files**, **pages**, **images**, **search results**, etc. It is basically, the web **browsers** language to send requests to the server. There is also

The **HTTPS** version, which is a **secure** and **encrypted** version for HTTP communications.

- **FTP(File Transfer Protocol):**

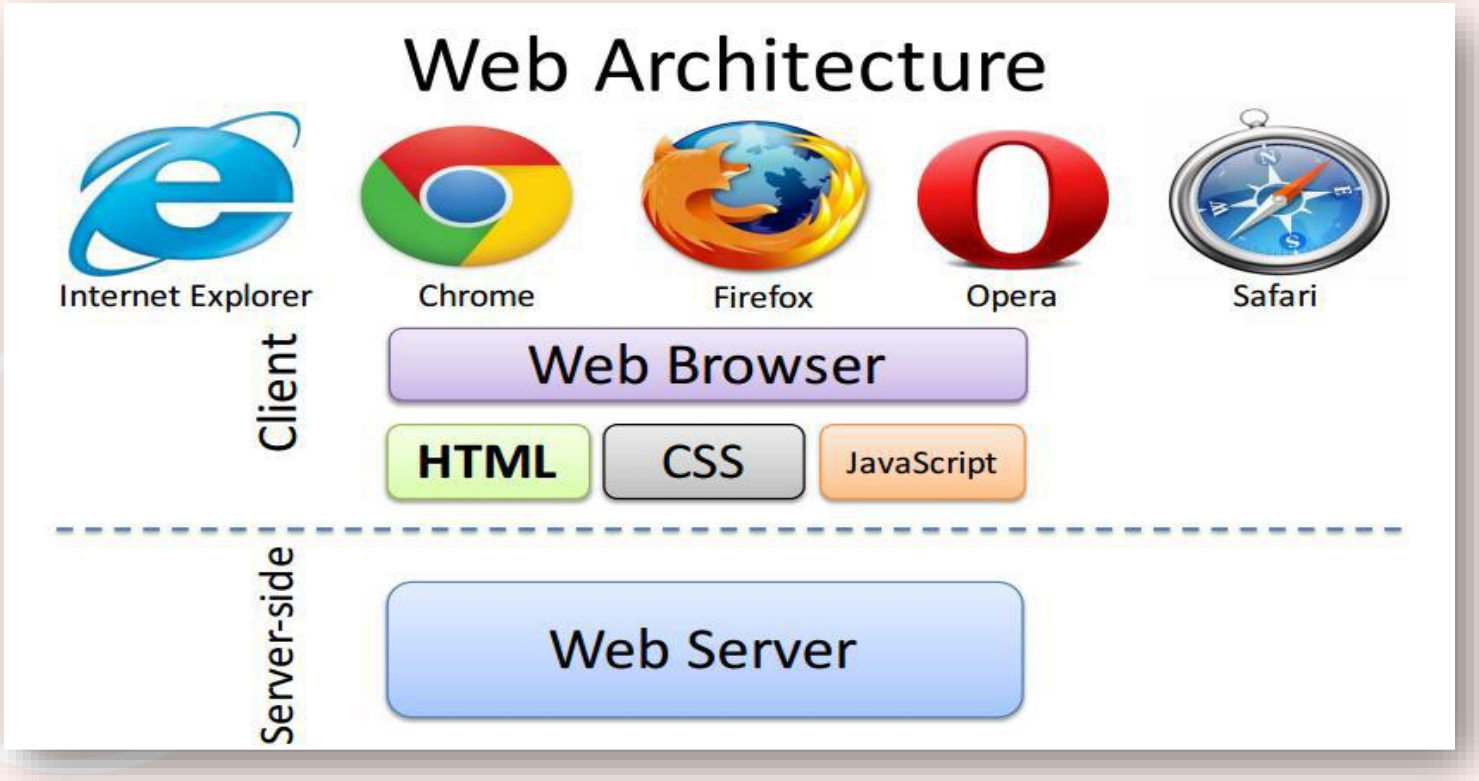
Is used to load (**upload**) or retrieve (**download**) files between the **client** and **server** communication, or between **two** computers on the **Internet**. In other words, this protocol is responsible for **file transfer** on the Internet.

- **Internet Service Provider (ISP):**

Is an **organization** that provides **individuals** and other companies' access to the Internet and other related services such as **e-mail.**

Web Browsers

Generally, a web browser is a **software** application or program for **retrieving**, **displaying**, and **traversing** information resources on the World Wide Web. An information resource is identified by a Uniform Resource Identifier (**URI**) and may be a **web page**, **image**, **video**, or other piece.



How Browsers Display Web pages

When a **Web page** is **opened** in a browser, the browser **reads** and **interprets** the HTML file and formats the Web page for display. If there are references to external files, such as **images** or **multimedia**, these files are **downloaded** from the **server** and **displayed** in the **browser** window. It is important to note that **HTML** files are **text** files that only contain **references** to the external files – you do not "**embed**" these files into the Web page.



Types of Web Sites

There are many **types** of Web sites, each catering to a particular type of content or use. Hence, few illustrative are given below:

1) **Blog (Web Log):** site generally used to post **online diaries** which may include discussion forums.

2) **Social Networking Site:** where users could **communicate** with one another and share media, such as **pictures**, **videos**, **music** and **blogs** with other users. These may include **games** and **Web applications**.

3) **Wiki Site:** which users **collaboratively** edit (such as **Wikipedia** and **Wikihow**).

4) **Search Engine Site**: a site that provides **general information** and is intended as a gateway or **lookup** for other sites like **Google**, **Yahoo**, **Bing** search engines.

5) **Education Site**: where **teachers**, **students**, or **administrators** can post information about current events at or involving their **school**.

Website Design Issues

There are many points one should keep in mind while **designing** a Web site. These points make a site usable and easily accessible to the users, which are discussed below:

1) Information Availability: The general **benchmark** of a good Web site is that it should be providing **80-90 %** of what a user/visitor is **looking for**.

2) Page layout: How the content is **displayed** on the page. The page should be **laid** in such a way people should be able to find relevant content **quickly**.

3) Colors: **Standard** colors should be used as colors can **affect** the **usability** of the site. For example, the standard colors used for links (**blue** for links; **violet** for visited links; and **red** for active links) should be maintained as one runs the risk of confusing the visitors.

4) Web Accessibility: means accessibility to all including people with **disabilities** (like **visual**, **audio**, **physical**, **speech**) can interact or contribute to the Web.

5) User-friendly Site: web site should be creating based on what the **audience** requires.

6) Download Speed: The download speed **cannot** determine by a **Web designer**. Some considerations are optimizing the graphics (**images** not larger than **10 kb**), making smaller pages, and avoiding **nested tables.**

E-Mail (Electronic Mail)

- ✓ **E-mail** or Electronic mail is a **paperless** method of *sending* **messages**, **notes** or **letters** from one person to another or even **many people** at the same time via **Internet**.
- ✓ E-mail is **very fast** compared to the **normal** post. E-mail messages usually take only **few seconds** to arrive at their destination.
- ✓ One can send messages **anytime** of the day or night, and, it will get delivered **immediately**.
- ✓ There is **no wait** for the post office to open and you don't have to get worried about **holidays**.
- ✓ It works **24 hours** a day and **seven days** a week.
- ✓ The **copy** of the message you have sent will be **available** whenever you want to look at it even in the middle of the night.
- ✓ You have the **privilege** of sending something **extra** such as a **file**, **graphics**, **images** etc. along with your **e-mail.**
- ✓ The biggest **advantage** of using email is that it is **cheap**, especially when sending messages to other **states** or **countries** and at the **same** time it can be delivered to a number of people around the world.



Cont…

- ✓ It allows you to **compose** note, get the **address** of the **recipient** and **send** it.
- ✓ Once the mail is **received** and read, it can be **forwarded** or **replied**.
- ✓ One can even **store** it for later use, or **delete**.
- ✓ In **e-mail** even the **sender** can **request** for delivery receipt and read **receipt** from the **recipient**.

Features of E-mail

- ✓ One-to-one or one-to-many **communications**
- ✓ **Instant** communications
- ✓ **Physical presence** of recipient is **not required**
- ✓ Most inexpensive mail services, **24-hours** a day and **seven days** a week
- ✓ **Encourages** informal communications

E-mail Address

As in the case of **normal** mail system, e-mail is also based upon the concept of **a recipient address**. The email address **provides** all of the information required to get a message to the **recipient** from any where in the world. Consider the **e-mail ID.**

john@hotmail.com

In the above example:

1) **john** is the **username** of the **person** who will be **sending/receiving** the email.
2) **Hotmail** is the mail **server** where the username **john** has been **registered**
3) **com** is the type of **organization** on the internet which is **hosting** the **mail server**.

Basic Email Components

At the foundational level, emails consist of basic components that we encounter with every message we send or receive.

- **Sender's Name and Email Address**

  The "**From**" field not only displays the **sender's name** but also their **email address**. It establishes the source of the communication, allowing **recipients** to **identify** the sender.

- **Recipient's Name and Email Address**

  Conversely, the "**To**" field showcases the **recipient's name** and **email address**. This ensures that the message **reaches** the **intended audience.**

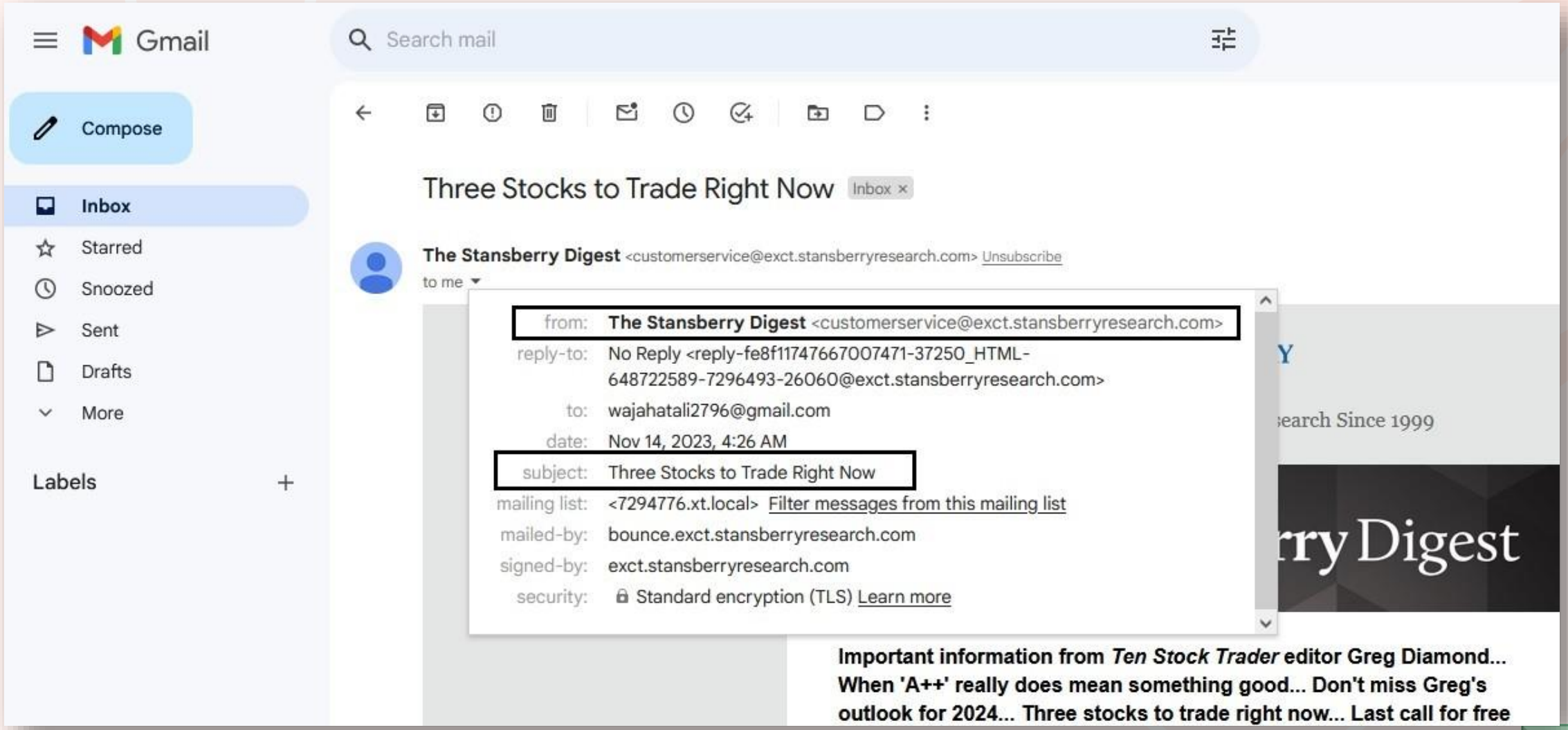
- **Subject Line**

  the **subject** line **provides** a preview of the message's **content**. A **well-crafted** subject line can **significantly** impact the recipient's decision to open the email.

- **Body of the Email**

The **main content** resides in the body of the email. It can be as simple as a **few lines** of **text** or a **detailed** message with rich **multimedia elements**.

Basic Email Components



Advanced Email Components

Moving beyond the basics, emails offer **advanced** components that enhance the overall communication experience.

- **Attachments**

  Attachments allow users to **share** **documents**, **images**, or other files along with their message. This feature facilitates the exchange of additional information beyond the email body.

- **Cc (Carbon Copy) and Bcc (Blind Carbon Copy)**

  These fields enable **sending** **copies** of the email to other **recipients**. **Cc** is **visible** to all recipients, while **Bcc** **conceals** the additional recipients, ensuring **privacy**.

- **Hyperlinks Line**

  Incorporating hyperlinks in emails directs recipients to **external websites** or **internal documents**, **streamlining** access to relevant information.

- **Signatures**

Signatures, often found at the **end** of **emails**, contain **contact details** and **additional** information about the sender. They contribute to the **professionalism** and **branding** of the communication.

Common Mistakes in Email Components

Despite the **familiarity** with **email** components, common mistakes can still occur..

- **Missing Subject Lines**

  Neglecting to include a subject line can diminish the email's impact and make it more likely to be overlooked.

- **Incorrect Recipients**

  Sending emails to the **wrong recipients** can lead to confusion, privacy breaches, and professional mishaps.

- **Overlooking Attachments**

  Failing to attach necessary files or including **irrelevant** attachments can hinder the communication process.

- **Poorly Crafted Signatures**

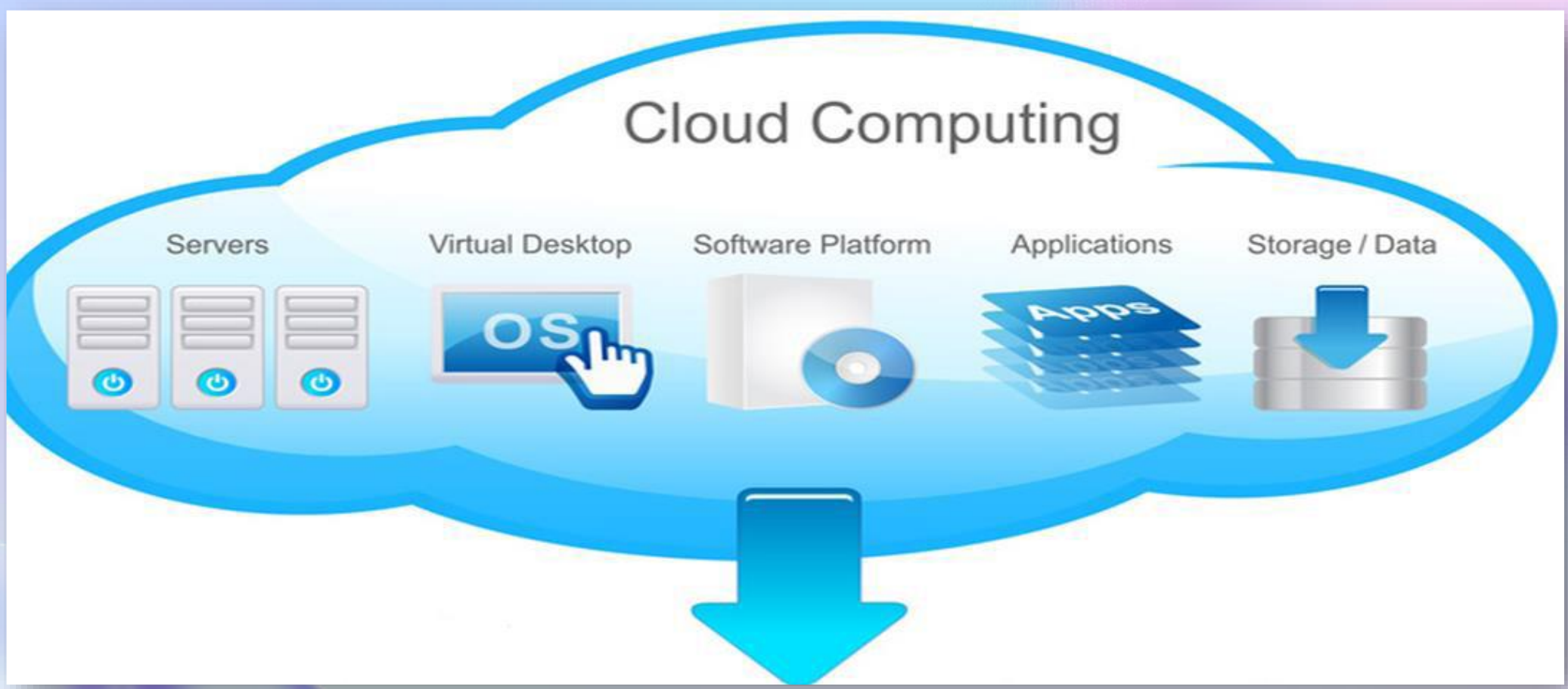
A poorly crafted signature may **leave** recipients without **essential contact** details or create a negative **impression**.

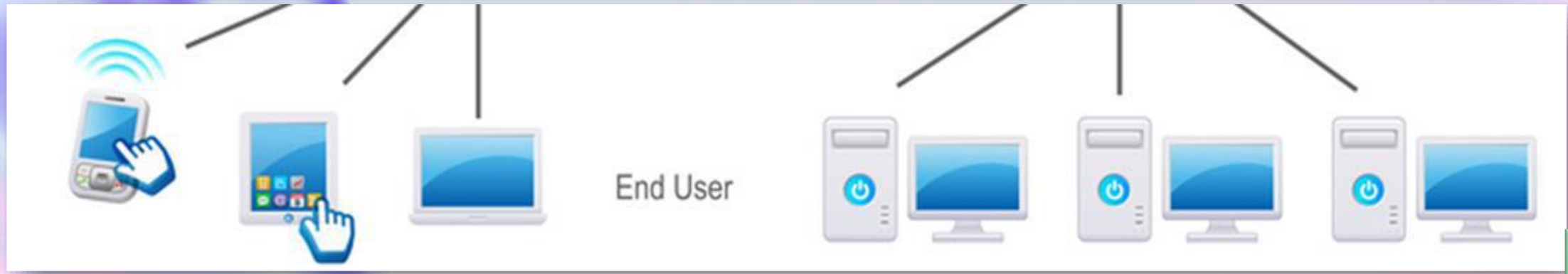


LECTURE 13: Cloud Computing and Services

What Is Cloud Computing?

- **Cloud Computing** is a general term used to **describe** a new class of network based computing that takes place over the **Internet**.
- A **collection/group** of integrated and **networked** hardware, software and Internet infrastructure (called a **platform**).
- The **platform** provides on demand services, that are always on, anywhere, anytime and any place.
- Cloud computing is a model for enabling **convenient, on-demand network access to a shared pool** of **configurable computing resources** (e.g., **networks**, **servers**, **storage**, **applications**, and **services**)
- The hardware and software services are available to (**general public**, **enterprises**, **corporations** and **businesses markets**)
- **Cloud computing** is an **umbrella** term used to refer to Internet based development and services.
- **Cloud computing** is Internet-based computing, whereby shared resources, software and information are provided to computers and other devices on-demand, like **the electricity grid.**


Cloud Computing
Servers
Virtual Desktop
Software Platform
Applications
Storage / Data
OS
Apps

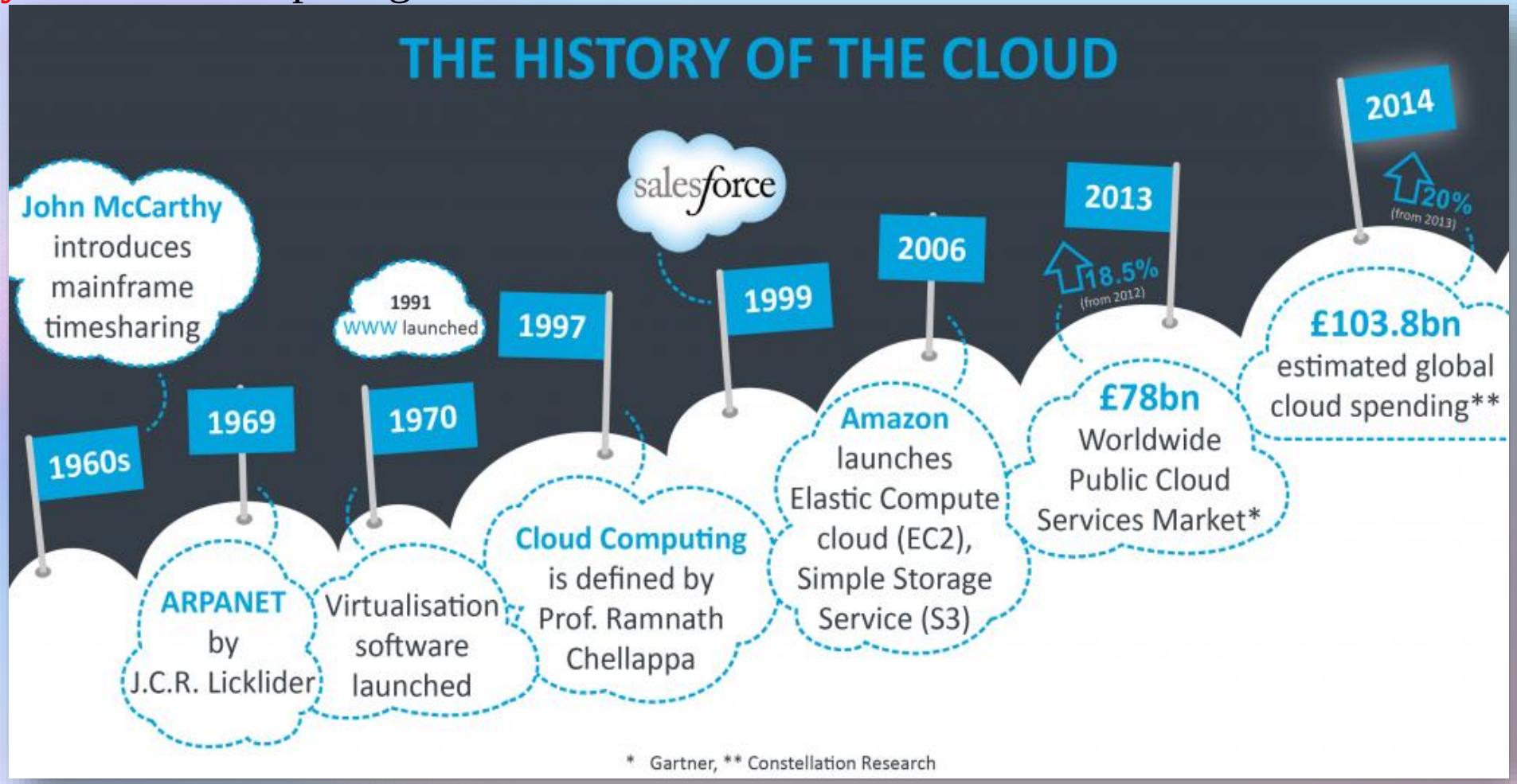

End User

Why use cloud computing?

1) **Reduce** capex costs and improve the predictability of on-going operating expenses.
2) **Enable** your employees to work from **anywhere**.
3) **Access** your data **anytime**, without **risks** associated with physical storage since this is managed by cloud providers.
4) **Avoid** complex **disaster** recovery planning; let cloud computing **vendors** take care of this for you.
5) Let cloud computing vendors do your server **maintenance** for you, freeing up your resources for more important tasks
6) **Improve** your document control, with all your files in one central location, allowing everyone to work from one central copy .

History And Evolution

- **Cloud computing** is one the most **innovative** technology of our time. Following is a brief **history** of Cloud computing.



Cloud Computing Service Models

There are **three** main types of **service models** of cloud computing. Each type of cloud computing provides **different levels** of **control**, **flexibility**, and **management** so that you'll select the proper set of services for your needs, which are:

- ✓ Infrastructure as a Service (**IaaS**)
- ✓ Platform as a Service (**PaaS**)
- ✓ Software as a Service (**SaaS**)

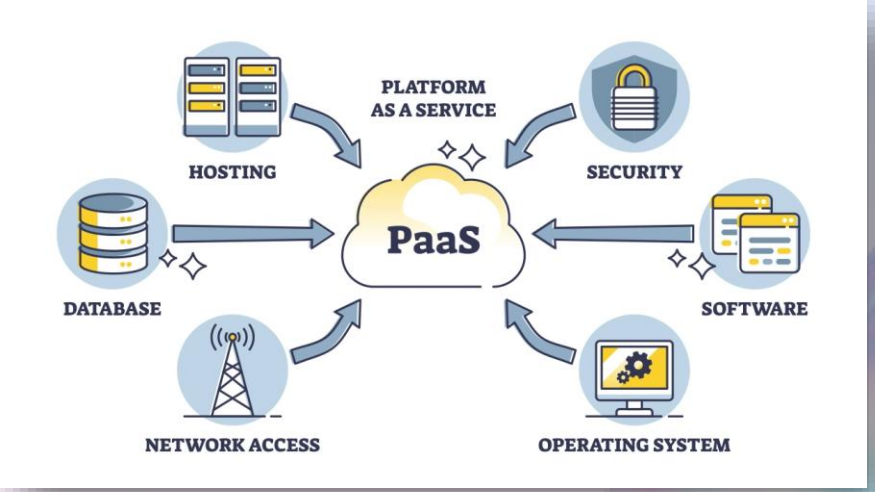
I. Infrastructure As A Service (IaaS)

- ✓ It is the most **flexible type** of cloud service which lets you **rent** the hardware and contains the basic building blocks for cloud and **IT**.
- ✓ It gives **complete** control over the **hardware** that runs your application **(servers, VMs, storage, networks & operating systems**).
- ✓ It's an **instant** computing **infrastructure**, **provisioned** and **managed** over the internet.
- ✓ **IaaS** gives you the very **best** level of **flexibility** and **management** control over your **IT** resources.
- ✓ It is almost like the prevailing **IT** resources with which many **IT** departments and developers are familiar.
- ✓ **Examples** of IaaS, ***Amazon Web Services*** (AWS), ***Google Compute Engine*** (GCE),, and ***Cisco Meta cloud***.



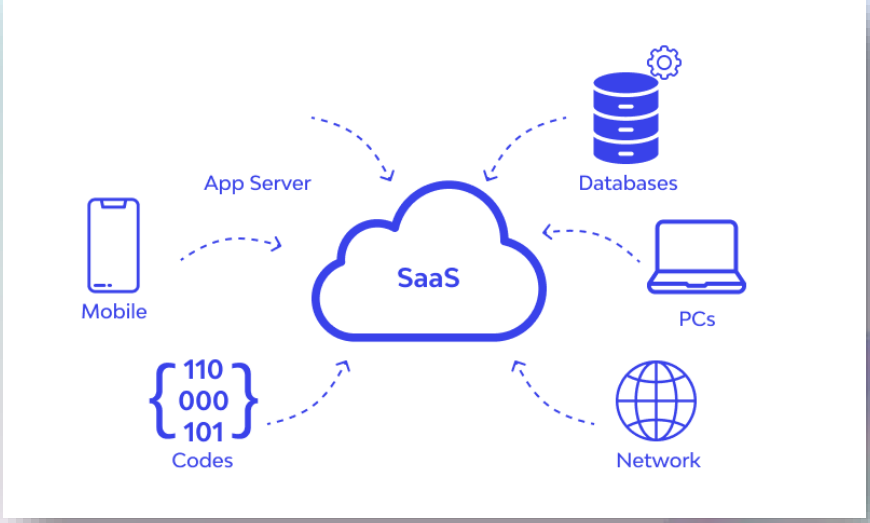
II. Platform As A Service (PaaS)

- ✓ **PaaS** is a cloud **service model** that gives a **ready-to-use** development environment where **developers** can ***specialize*** in writing and executing **high-quality** code to make customized applications.
- ✓ It helps to **create** an **application quickly** without *managing* the *underlying* infrastructure. **For example**, when deploying a **web application** using PaaS, you ***don't*** have to **install** an operating system, web server, or even system updates.
- ✓ This cloud service model **makes** the method of developing and deploying applications **simpler** and it is **more** expensive than **IaaS** but **less** expensive than **SaaS**.
- ✓ **Examples** of PaaS: **WebApps**, **Cloud SQL DB** from **Google Cloud**, or **Oracle Database** Cloud Service from **Oracle Cloud.**
- ✓ PaaS is offers a lot of benefits, such as (**faster development time, reduced costs, enhanced security and high availability)**



III. Software As A Service (SaaS)

- ✓ **SaaS** provides you with a **complete product** that is run and managed by the service provider.
- ✓ The **software** is **hosted** online and made available to customers on a subscription basis or for purchase in this cloud service model.
- ✓ With a SaaS **offering**, *don't* need to worry about how the service is **maintained** or how the underlying infrastructure is managed. It would help if you believed how you'd use that specific software.
- ✓ **Examples** of SaaS: **Microsoft Office 365**, **Oracle ERP/HCM Cloud**, **Gmail**, or **Dropbox**.
- ✓ The benefits of SaaS are numerous and varied, such as (**lower total cost of ownership and better security)**



Microsoft 365

- **Microsoft 365** is a product family of productivity software, **collaboration** and **cloud-based services** owned by **Microsoft**.
- It encompasses **online** services such as **Outlook.com**, **OneDrive**, **Microsoft Teams**, programs formerly marketed under the name **Microsoft Office** (including applications such as **Word**, **Excel**, **PowerPoint**, and **Outlook** on **Microsoft Windows**, **macOS**, **mobile devices**, and on the **web.**
- The "**Microsoft 365**" brand was first introduced at Microsoft Inspire in July 2017 as an enterprise subscription product.
- On October 13, 2022, Microsoft **announced** that it would be **phasing** out the **Microsoft Office** brand, in favor of branding all products under the **Microsoft 365** name.



Microsoft 365 applications and services

- The Microsoft 365 **desktop applications** (formerly marketed as **Microsoft Office**) are **primarily** used on PCs running Microsoft **Windows**, and are distributed as part of the Microsoft 365 subscription. These applications are:

  (Microsoft **Word** , Microsoft **Excel,** Microsoft **PowerPoint,** Microsoft **OneNote,** Microsoft **Outlook,** Microsoft **Publisher** and Microsoft **Access)**

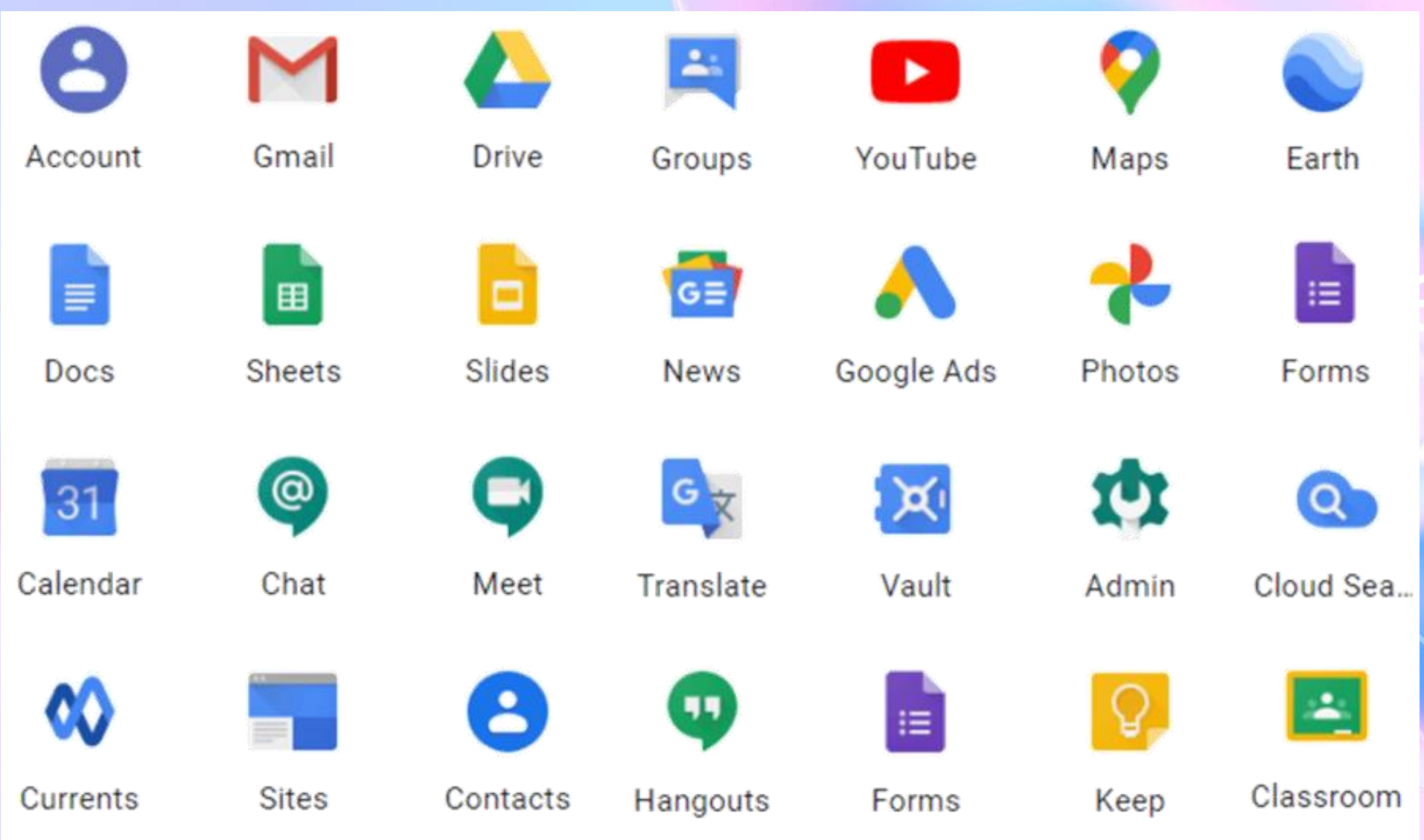
- The **mobile apps** were originally **limited** to **Office 365** subscribers, but basic editing and document creation has since been made **free** for **personal** use. An active Microsoft 365 is still required to **unlock** certain advanced editing features, use the apps on devices with **screens** larger than **10.1** inches, or to use the apps for **commercial** purposes.

- Some Microsoft 365 **online** services are usable **without** a **subscription**, but with **limitations** such as **advertising** and **lower storage** limits. Such as:
  - ✓ **Outlook.com**, an online **webmail** service
  - ✓ **OneDrive**, an online **file storage service**.
  - ✓ **Office** on the web, **cloud-based** versions of **Word, Excel,** and **PowerPoint**
  - ✓ **Microsoft Teams**, a business communication platform

Google Workspace

- **Google Workspace** (formerly **G Suite**) is a **collection** of **cloud** computing, **productivity** and **collaboration** tools, **software** and **products** developed and marketed by **Google**.
- It consists of **Gmail**, **Contacts**, **Calendar**, **Meet** and **Chat** for communication; **Drive** for storage; and the **Google Docs** Editors suite for content creation.
- Also include the **digital** interactive **whiteboard Jamboard.**
- The education edition adds a **learning** platform **Google Classroom** and today has the name Workspace for **Education**.
- While most of these services are **individually** available at **no cost** to consumers who use their free Google (Gmail) accounts.
- **Google Workspace** adds **enterprise features such as custom email addresses at a domain, an option for** unlimited Drive storage, as well as **24/7** phone and email support.
- On June 14, 2021, Google **announced** that **Google Workspace** would be available to consumers with an account, a new "Google Workspace Individual“.

Google Workspace



Google Workspace Products

- **Google Workspace** comprises **Gmail, Chat, Meet, Calendar, Drive** for storage; **Docs, Sheets, Slides, Forms**, Keep for notes, **Sites** for collaboration and so on.
- **Optional** add-ons include **Gemini** for Workspace, **Google Voice**, **AppSheet** and **Meet** hardware. The commonly products are:

  - ✓ **Gmail** is a web-based **email** service(**30GB** of storage space and **24/7** phone and email support)
  - ✓ **Google Drive** is a file storage (users can upload any type of file to the cloud with **30GB**)
  - ✓ **Google Docs**, **Google Sheets** and **Google Slides** are a **word** processor, a **spreadsheet** and a **presentation** program respectively.
  - ✓ **Google Forms** is a **survey** application (It can also be used to create **quizzes)** including some specialized functions that are of use in **educational** settings.
  - ✓ **Google Calendar** is an **online** calendar intended to help keep track of **time** and **schedules**.
  - ✓ **Google Meet** is a standards-based **Video Conferencing application.**

Google Workspace Vs Microsoft 365: 12 Key Differences

Aspect	Google Workspace	Microsoft 365
App Offers	Collaboration-focused, simpler apps	Comprehensive, feature-rich apps
Collaboration Tools	Excellent real-time editing	Advanced features with Teams
Security Measures	User-friendly, effective protection	Advanced enterprise-grade security
Pricing	More affordable, simple tiers	Broader, potentially costlier plans
Customer Support	Varied support, community-focused	In-depth support, strong for enterprises
Storage	Limited shared storage on lower plans	Larger base storage, separate for email
Productivity Applications	Cloud-native, collaborative focus	Detailed, feature-rich, good for offline
Integration & Compatibility	Strong in Google ecosystem, moderate elsewhere	Extensive within Microsoft ecosystem
UI & UX	Minimalist, user-friendly	Feature-heavy, customizable
Mobile Accessibility	User-friendly, collaborative	Feature-rich, optimized for devices
Email, Calendar, Notes	Integrated, streamlined	Robust, versatile, feature-rich
Video Meetings	Easy, browser-based Google Meet	Comprehensive Microsoft Teams for larger meetings