



# IICT CLASSWORK/ NOTES

Introduction to Information & Communication Technologies  
(2 C.H)

Mehran University of Engineering & Technology, Jamshoro  
Bachelor of Engineering (B.E), 1st Year, 1st Semester, 2021

Muhammad Ahsan  
Department of Software Engineering, MUET Jamshoro

<b>1. Introducing Computer Systems.....</b>	<b>3-5</b>
Data.....	
Information .....	
Computer.....	
Main Functions of a Computer .....	
Communication .....	
Technology.....	
Information Technology .....	
ICT .....	
Components of ICT .....	
Computer System .....	
Advantages and disadvantages of Computer .....	
Characteristics of Computer .....	
Memory Unit.....	
Operating System .....	
Categories of Computer.....	
<b>2. Basic Operations and Components of a Generic Computer System.....</b>	<b>6-7</b>
Input Devices .....	
Output Devices .....	
Hardware .....	
Software.....	
RAM and ROM .....	
Basic Operations: Input, Processing, Output,.....	
Block Diagram .....	
Core Components: Processor, Motherboard, Memory, Storage Device, Power Supply Unit .....	
<b>3. Processing Data.....</b>	<b>8-13</b>
The fetch-execute cycle.....	
Transforming Data into Information .....	
Representing Data .....	
Binary Number System .....	
Bits and Bytes .....	
Units of Information (kilo, mega, giga etc.).....	
Decimal and Hexadecimal system .....	
Conversion of Number Systems .....	
Logic gates .....	
Truth Tables and Logic Circuits.....	
High and Low-Level Languages.....	
Pseudo code and flowcharts .....	
<b>4. The Internet.....</b>	<b>14-19</b>
The Internet and the WWW .....	
Browsers .....	
Servers .....	

IP address and MAC address .....	
HTML.....	
URL's .....	
DNS .....	
Email .....	
<b>5. Introduction to Embedded Systems.....</b>	<b>20-21</b>
Embedded System .....	
Components.....	
Basic Structure .....	
Applications .....	
Programming Languages .....	
Popular Development Platform.....	
<b>6. Networking Basics.....</b>	<b>22-25</b>
Computer Networks .....	
Information Management and Importance .....	
Information Sharing.....	
Resource Sharing .....	
Common Types of Networks .....	
Benefits of Networks .....	
OSI Model .....	
Future of Networks.....	
<b>7. Database Management .....</b>	<b>26-30</b>
Hierarchy of Data .....	
Maintaining Data .....	
Database Management System.....	
Components of DBMS .....	
Advantages .....	
Structured Query Language.....	
<b>8. Protecting Privacy .....</b>	
Security Concepts .....	
Threats to Users.....	
Hardware and Data.....	
<b>9. Future Trends in ICT .....</b>	
The applications of ICT.....	
Impact of ICT in society (ICT for Engineers, ICT in Education sector, finance, business, home etc.) .....	
Concept of Big Data .....	
Machine learning .....	
IOT.....	

## Introduction to Information and Communication Technology (IICT)

ICT refers to all communication technologies including wireless internet, cell phones, computers, video conferencing, social networking and software's, middleware and other media applications and services enabling users to access, retrieve, store, transmit and manipulate data in a digital form.

- **Communication:** Transferring of Information from one place to another is called Communication. The three basic elements of any communication system are:
  1. A transmitter (source) which creates the message to be transmitted.
  2. A medium through which message or the data is transmitted from one location to another.
  3. A receiver which receives message.
- **Technology:** Technology is the use of scientific knowledge for practical purposes or applications whether in university or in our everyday life.

### Components of ICT:

The main components of an ICT system are:

1. **Data:** It is raw facts and figures.
2. **Hardware:** Physical components of a computer system.
3. **Software:** Set of instructions or name given to a computer program.
4. **Information:** Converted data which gives a meaningful sense.
5. **Procedures:** A series of actions conducted in a certain order to make sure the system runs smoothly.
6. **People:** Data which is entered by humans, for example with a keyboard or voice recognition.

### Data and Information:

Data is raw facts and figures with no meaning, it is also called useless data whereas processed from of data is called information, it is meaningful and useful.

## Computer

### Introduction:

Computer is derived from Latin word "computare" which means to calculate, count or to sum up etc. The first computer was invented in 1937 by Charles Babbage.

### Definition:

*"A computer is a programmable electronic device designed to accept data, perform prescribed mathematical and logical operations at very high speed and display the results of these operation."*

Importance:

Computer has become very important nowadays because it is very much accurate, fast and can accomplish many tasks easily. Otherwise to complete those tasks manually much more time is required. It can do very big calculations in just a second. Moreover it can store huge amount of data in it.

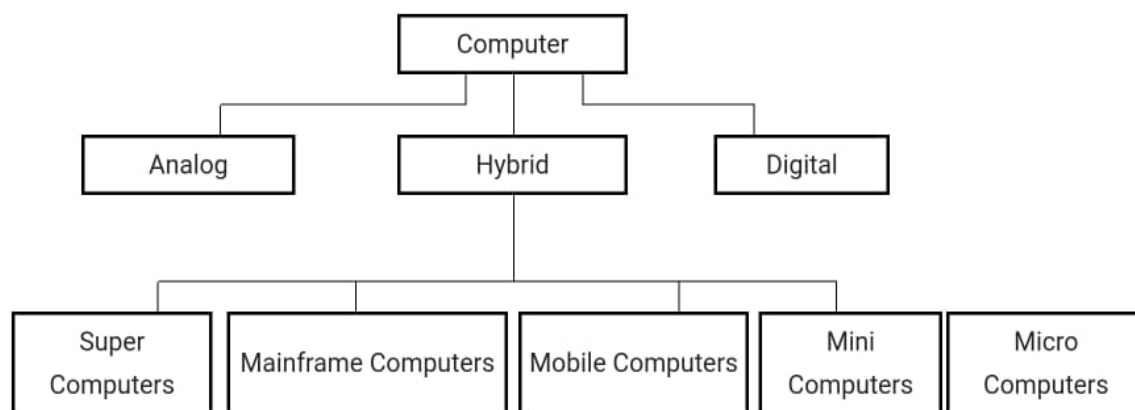
Functions performed by a computer:

- **Input**
- **Processing**
- **Output**
- **Control Unit:** It directs the manner and sequence of all operations to perform in a computer system.
- **Storage**

Operating System:

An operating system such as Windows, MAC, and Linux etc. is software that helps the application to run and control the display and the keyboard.

Categories of Computer:



- **Super Computers:**  
A supercomputer is a computer with a high level of performance as compared to a general-purpose computer.
- **Mainframe Computers:**  
The mainframe computers are special types of computers that are also high-speed computers used to perform very fast transactions.

- **Minicomputers:**

Minicomputer is smaller, less expensive, and less powerful than a mainframe or supercomputer, but more expensive and more powerful than a personal computer.

- **Micro Computers:**

A microcomputer is a small, relatively inexpensive computer with a microprocessor as its central processing unit (CPU). It includes a microprocessor, memory, and input/output (I/O) facilities.

Characteristics of Computer:

1. Speed
2. Accuracy
3. Versality
4. Reliability
5. Memory etc.

Uses:

1. Education and research purposes.
2. Airline reservation.
3. Hospitals.
4. Storing Data
5. Entertainment.

Advantages:

1. It has amazing speed.
2. It supports multi-tasking
3. Never get tired.
4. Reduced cost.
5. Versality.

Disadvantages:

1. Health issues.
2. Unemployment
3. Cyber-attack

### Input Devices:

The process in which computer accepts commands or information is called input devices or the devices through which we give instructions to computer are called input devices like keyboard, mouse etc.

### Output Devices:

Output devices are those devices which show the result of these processed data in a meaningful manner like monitor, speaker etc.

### Hardware:

The physical components of a computer system are called hardware. Hardware devices include monitor, mouse, keyboard, printer etc.

### Software:

Software is a set of instructions that are designed by software programmers to perform a specific computer task. Most commonly used Computer software's are Google Chrome, MS Teams, Zoom etc.

#### Types of Software:

There are two types of Software:

1. Application Software
2. System Software

<b>System Software</b>	<b>Application Software</b>
1. System software's are designed to manage resources of the system like memory, process management and security etc.	1. Application software's are designed to fulfill the requirements of the user for performing specific task.
2. System software's are independent of the application software.	2. Application software needs system software.
3. System software is general purpose software written in low-level programming language.	3. Application software is specific purpose software written in high-level programming language.

### RAM:

RAM stands for Random Access Memory. It is a volatile short-term memory that allows computer to perform several tasks such as loading applications, browsing internet etc.

### ROM:

ROM stands for Read-only memory. It is a type of non-volatile flash memory used in computers and other electronic devices. Its content cannot be changed, and it retains after the computer is turned off.

Basic Operations:

- Input
- Processing
- Output

Block Diagram:

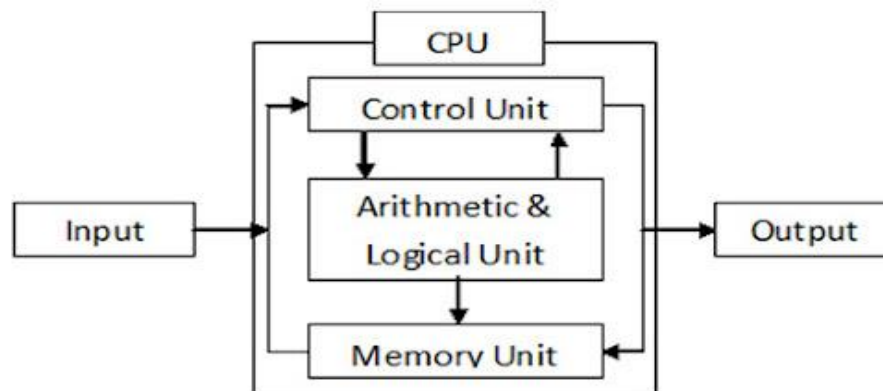


Fig. Block Diagram of Computer

Core Components of Computer:

1. Processor (CPU)
2. Mother Board
3. Memory (RAM)
4. Storage devices
5. Power Supply unit

Hard disk:

A hard disk is an electromagnetic storage device that stores and retrieves digital data using magnetic storage. It is a fixed disk.

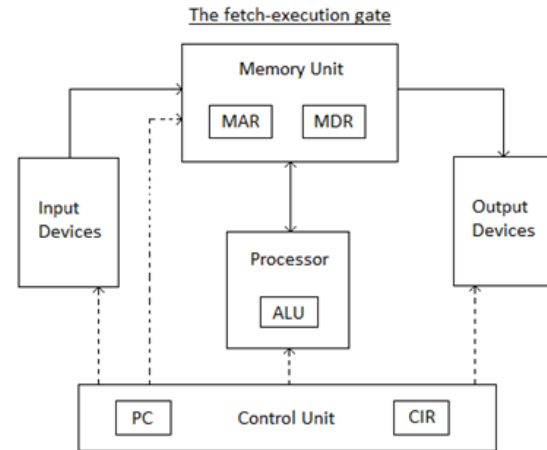
**Difference between Microprocessor & Microcontroller**

Microprocessor	Microcontroller
It consists of a central processing unit which is called as CPU.	Whereas microcontroller contains a CPU, memory, I/O all integrated into one chip.
Microprocessor is used in personal computers	Microcontroller is often used in an embedded system.
Microprocessor is complicated and expensive, with a large number of instructions to process.	Microcontroller is inexpensive and straightforward with fewer number instructions to process.



The Fetch execution gate:

They carry out a set of instructions the processor first of all fetches some data or instructions from memory and stores them in suitable registers. Both the address bus and data bus are used in this process. Once this is done each instructions needs to be decoded before finally being executed. This is all known as the fetch execute cycle.

Fetch-Decode-Execute Cycle:

Most modern processors work on Fetch-Decode principle.

1) Fetch Instructions:

In the first step the processor fetches the instructions from the memory. The memory place the instruction on the data bus. The processor then copies the instruction from data bus to the main instruction register. The instruction is transferred from memory to instruction register.

MAR: Memory Address Register

MDR: Memory Data Register

ALU: Arithmetic Logic Unit

PC: Program Counter

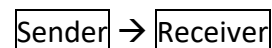
CIR: Current Instruction Register

2) Decode Instruction:

In this step the instruction is decoded by the processor. The processor gets any operand if required by the instruction.

3) Execute instruction:

In the last phase the processor executes the instructions.

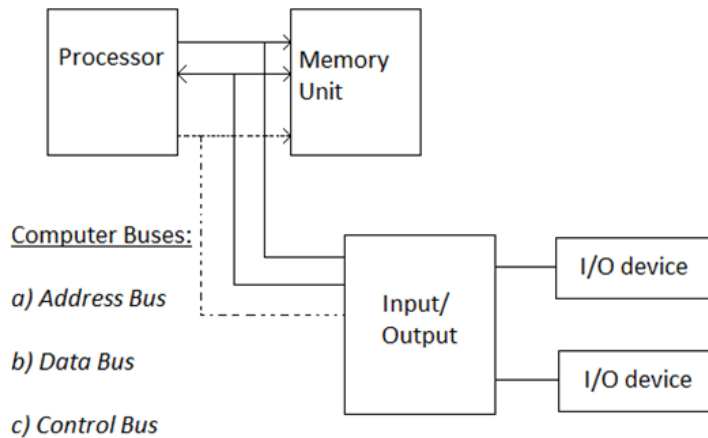
Data Transmission:

Sending of data over a communication medium is called data transmission.

- **Simplex:** Data transmission in one direction.
- **Half Duplex:** Data transmission in both direction but not simultaneously, not at the same time.
- **Full duplex:** Data transmission in both directions.
- **Serial data transmission:** Data transferred bit by bit, one by one. 1 bit then other then so on.
- **Parallel Data transmission:** Data transferred 8 bits / 1 bit at a time. This type of transmission is faster than serial transmission.

Computer Bus:

The computer bus is a communication link used in a computer system to send data, addresses control signals and power to various components in a computer system. The computer buses are used to connect the various hardware components that are part of the computer system.



- a) **Address bus:** It carries signals relating to addresses between the processor and the memory.
- Signals direction is unidirectional.
- b) **Data bus:** It sends data between the processor, the memory unit, and the input/ output devices.
- It is regarded as unary and bi-directional due to internal connection within computer architecture.
- c) **Control bus:** It carries signals related to the control and coordination of all activities within the computer. Examples include read and write function.

Signal direction may be unidirectional or by directional, depends upon internal connection of computer architecture.

### Number Systems (Decimal, binary and hexadecimal)

Binary	Decimal (Denary)	Hexadecimal
A binary number system is a base 2 number system.	A denary number system is base 10 number system	A hexadecimal number system is base 16 number system
It uses 0 & 1 values.	It uses 0 to 9 values.	It has values 0 to 9 & A to F.
It has units, placeholders, column headings that increase by the power of 2.	It has units, place holders, column headings that increase that increase by the power of 10.	

Decimal	Binary	Hexadecimal
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
10	1010	A
11	1011	B
12	1100	C
13	1101	D
14	1110	E
15	1111	F

### Exercises – Homework

**Activity – 1**

Convert the following binary numbers into denary:

- a) 00110011
- b) 01111111
- c) 10011001
- d) 01110100
- e) 11111111
- f) 00001111
- g) 10001111
- h) 11110000
- i) 11101110

**Activity – 2**

Convert the following denary into binary numbers:

- a) 41
- b) 67
- c) 86
- d) 100
- e) 111
- f) 127
- g) 144
- h) 189
- i) 107

**Activity – 3**

Convert the following binary into hexadecimal:

- a) 1100001
- b) 11110111
- c) 1001111111
- d) 1011101110
- e) 101111100001

**Activity – 4**

Convert the following hexadecimal into binary:

- a) 6C
- b) 59
- c) AA
- d) A00
- e) 40E
- f) 45A

## Logic gates, Truth Tables and Logic Circuits

### Logic Gates:



NOT



AND



OR



NAND



NOR



XOR

### Truth Table:

AND Truth Table		
Inputs		Output
A	B	$Y = A \cdot B$
0	0	0
0	1	0
1	0	0
1	1	1

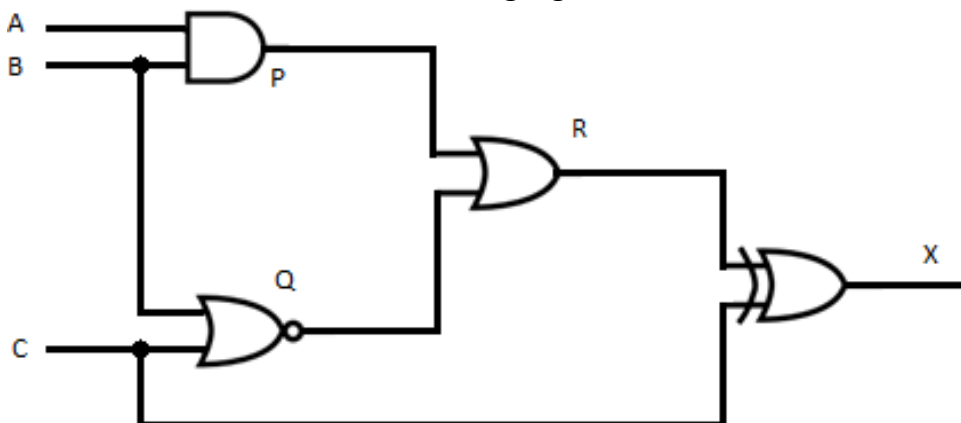
NAND Truth Table		
Inputs		Output
A	B	$Y = \overline{A \cdot B}$
0	0	1
0	1	1
1	0	1
1	1	0

OR Truth Table		
Inputs		Output
A	B	$Y = A + B$
0	0	0
0	1	1
1	0	1
1	1	1

XOR Truth Table		
Inputs		Output
A	B	$Y = A \oplus B$
0	0	0
0	1	1
1	0	1
1	1	0

### Logic Circuits:

1. Produce a truth table for the following logic circuit.



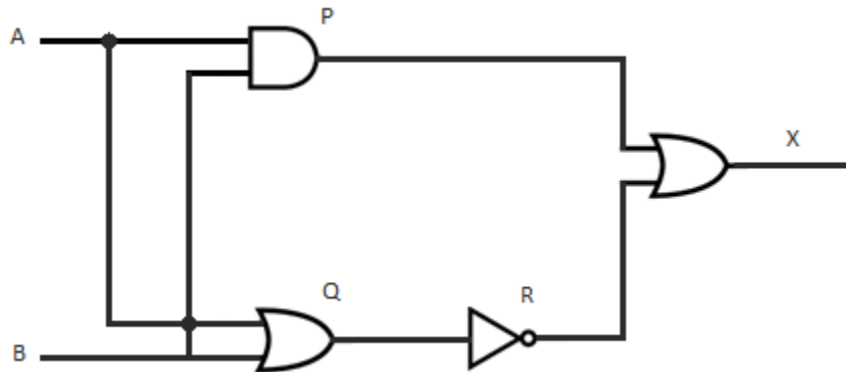
### Solution:

A	B	C	P	Q	R	X
0	0	0	0	1	1	1
0	0	1	0	0	0	1
0	1	0	0	0	0	0
0	1	1	0	0	0	1
1	0	0	0	1	1	1
1	0	1	0	0	0	1
1	1	0	1	0	1	1
1	1	1	1	0	1	0

$X = 11011110$

Ans.

2. Produce a truth table for the following logic circuit.



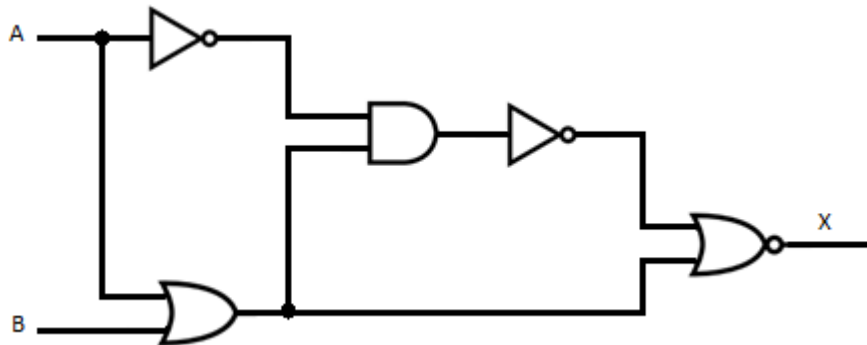
**Solution:**

A	B	P	Q	R	X
0	0	0	0	1	1
0	1	0	1	0	0
1	0	0	1	0	0
1	1	1	1	0	1

X = 1001

Ans.

3. Produce a truth table for the following logic circuit. (Homework)



**Solution:**

Memory Units:

- Bit: 0 or 1
- Nibble: 4 bits
- Byte: 8 bits
- Kilo Byte: 1024 bytes
- Mega Byte: 1024 KB
- Giga Byte: 1024 MB
- Tera Byte: 1024 GB
- Peta Byte: 1024 TB
- Exa byte: 1024 PB
- Zeta byte: 1024 EB
- Yotta: 1024 ZB

### Introduction:

The internet is an increasingly important part of everyday life for people around the world. With the help of internet, it is possible to access almost any information and communicate with anyone else in the world. It is a global network of billions of computers and other electronic devices. Connecting a computer to the internet is also called going online. When someone says a computer is online, it's just another way of saying it is connected to the internet.

### World Wide Web:

The world wide web usually called the web in shorts; is a collection of different websites you can access through the internet. The purpose of a website can almost be anything i.e. a news platform, an advertisement, an online library, a forum for sharing images or an educational site.

### Difference between Internet and WWW:

Most of us use the words web and internet to mean the same thing but they are actually quite different. The world wide web or a web for short, are the pages you see when you are at a device, and you are online. But the internet is the network of connected computer that the web works on, as well as what emails and files travel across. Think of the internet as the roads that connects towns and cities together. The world wide web contains the things you see on the roads like houses and shop and the vehicles are the data moving around, some go between websites and others will be transferring your emails or files across the internet, separately from the web.

### Web browser:

Once you are connected to the internet, you can access and view websites using a type of application called a web browser. The web browser itself is not the internet, it only displays the websites that are stored on the internet. It is a software application for accessing information on the world wide web. When a user requests a webpage from a website, the web browser retrieves the necessary contents from a web server and then displays the page on the user's device. To connect to a website's server and display its webpages, a user must have a web browser installed.

### Web Server:

The primary function of a web server is to store, process and deliver web pages to clients. A server is a computer that serves information to another computer. These computers, called clients, can connect to a server through either a local area network or a wide area network, such as the internet. There are many different types of servers including web servers, mail servers and file servers. A server doesn't have the screen or keyboard. And although your computer stores files and data you have put on it, a server stores all the data associated with the websites that are hosted by it and shares that info with all computers and mobile devices that need to access them.

### What you can do Online:

There is almost no limit to what you can do online. The internet makes it possible to quickly find information, communicate with people around the world, manage your finances, shop from home, listen to music, watch videos and much more.

### Finding information online:

With billions of websites online today, there is a lot of information on the internet. Search engines make this information easier to find. All you must have to do is to just type one or more keywords, and the search engine will look for relevant websites. There are many different search engines you can use, but some of the most popular include Google, Yahoo and Bing.

### Email:

Email is a way to send and receive messages across the internet. Almost everyone who uses the internet has their email account, usually called an email address. This is because you will need an email address to do just about anything online, from online banking to creating a Facebook account.

### Social Networking:

Social networking websites are another way to connect and share with your family and friends online. Rather than sharing with just a few people over email, social networks make it easier to connect and share with many people at the same time. Facebook is the world's largest social networking site, with more than 1 billion users worldwide.

### Chat and instant messaging:

Chat and instant messaging (IM) are short messages sent and read in real time, allowing you to converse more quickly and easily than email. These are generally used when both people are online, so your message can be read immediately. By comparison, emails won't be seen until recipients check their inboxes.

### Online media:

There are many sites that allows you to watch videos and listen to music. For example, you can watch millions of videos on YouTube. Other services like Netflix allows you to watch movies and TV shows.

### Everyday Tasks:

You can also use the internet to complete many everyday tasks. For example, you can manage your bank account, pay your bills, and shop for just about anything. The main advantage here is convenience. Rather than going from place to place, you can do all of these tasks at home.

### Difference between MAC and IP address:

The main difference between MAC and IP Address is that MAC address is used to ensure the physical address of a computer. It uniquely identifies the device on a network. While addresses are used to uniquely identifies the connection of network with that device take part in a network.



### What is HTML?

- HTML stands for Hyper Text Markup Language. It is used to design web pages using markup language.
- HTML is the standard markup language for creating web pages.
- HTML describes the structure of a webpage.
- HTML consists of a series of elements.
- HTML elements tell the browser how to display the content.
- HTML elements label pieces of content such as “this is a heading”, “this is a paragraph”, “this is a link”, etc.
- HTML is the combination of Hypertext and Markup language. Hypertext defines the link between the web pages.
- Markup language is used to define the text document within a tag which defines the structure of web pages.
- This language is used to annotate (make notes for the computer) text so that a machine can understand it and manipulate text accordingly.
- Most markup languages (e.g. HTML) are human readable. Language uses tags to define what manipulation has to be done on the text.
- HTML is a markup language used by the browser to manipulate text, images and other content, in order to display it in the required format.
- HTML was created by Tim Berners-Lee in 1991.
- The first ever version of HTML was HTML 1.0, but the first standard version was HTML 2.0, published in 1999.

### More about HTML:

- HTML is not case sensitive.
- HTML tags are not case sensitive: <P> means the same as <p>.

#### HTML Code (Hello World):

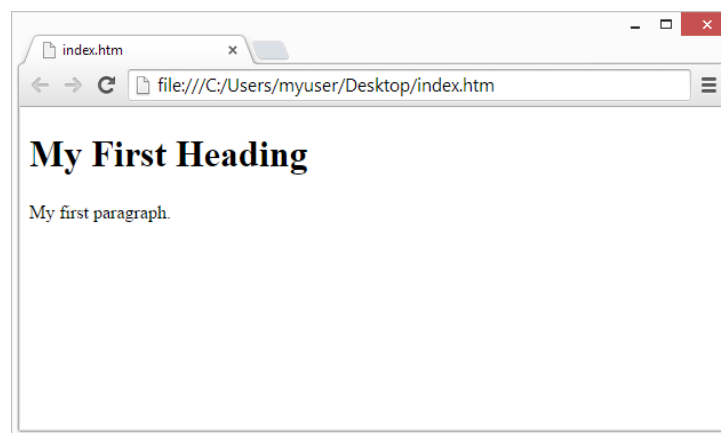
•	<html>
•	<head>
•	</head>
•	<title> Page Title </title>
•	</head>
•	<body>
•	<h1> My First Heading </h1>
•	</body>
•	<p> My first paragraph </p>
•	</body>
•	<!DOCTYPE html>
	</html>

### Explanation of Code:

- The <!DOCTYPE html> declaration defines that this document is an HTML5 document.
- The <html> element is the root element of an HTML page.
- The <head> element contains Meta information about the HTML page.
- The <title> element specifies a title for the HTML page (which is shown in the browser's title bar or in the page's tab).
- The <body> element defines the document's body, and is a container for all the visible contents, such as headings, paragraph, images, hyperlinks, tables, lists, etc.
- The <h1> element defines a large heading.
- The <p> element defines a paragraph.

### Web Browser:

The purpose of a web browser (Chrome, Edge, Firefox, Safari) is to read HTML documents and display them correctly. A browser does not display the HTML tags, but uses them to determine how to display document;



### HTML Formatting elements:

- Formatting elements were designed to display special types of text:
- <b> - Bold text
- <strong> - Important text
- <i> - Italic text
- <em> - Emphasized text
- <mark> - Marked text
- <small> - Smaller text
- <del> - Deleted text
- <ins> - Inserted text
- <sub> - Subscript text
- <sup> - Superscript text

### Features of HTML:

- It is easy to learn and easy to use.
- It is platform independent.
- Images, video, and audio can be added to a web page.
- Hypertext can be added to text.
- It is a markup language.

### Why to learn HTML?

- It is a simple markup language. Its implementation is easy.
- It is used to create a website.
- Helps in developing fundamentals about web programming.
- Boost professional career.

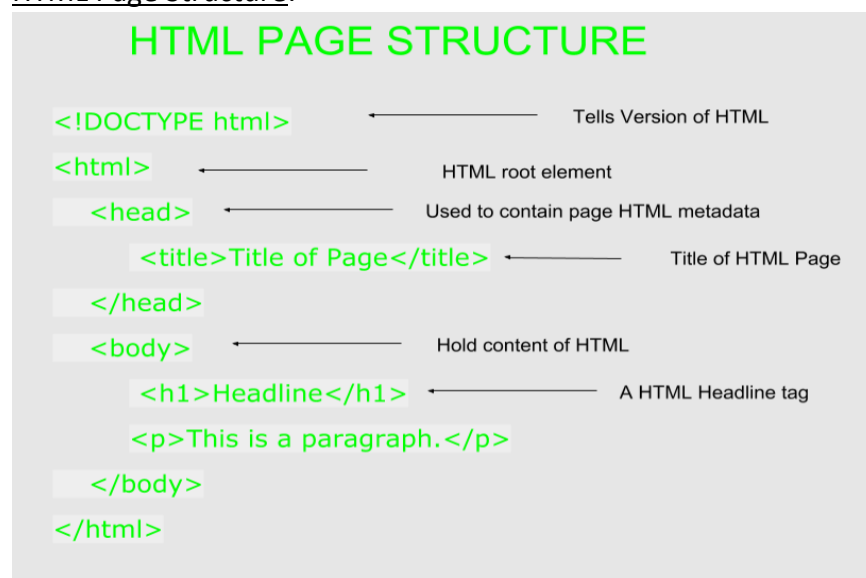
### Advantages:

- HTML is used to build websites.
- It is supported by all browsers.
- It can be integrated with other languages like CSS, JavaScript etc.

### Disadvantages:

- HTML can only create static web pages. For dynamic web pages, other languages have to be used.
- A large amount of code has to be written to create a simple web page.
- Security feature is not good.

### HTML Page Structure:



### Color Names:

In HTML, a color can be specified by using a color name:



### Try this Code: (Background color)

```
<!DOCTYPE html>
<html>
<body>

<h1 style="background-color:Tomato;">Tomato</h1>
<h1 style="background-color:Orange;">Orange</h1>
<h1 style="background-color:DodgerBlue;">DodgerBlue</h1>
<h1 style="background-color:MediumSeaGreen;">MediumSeaGreen</h1>
<h1 style="background-color:Gray;">Gray</h1>
<h1 style="background-color:SlateBlue;">SlateBlue</h1>
<h1 style="background-color:Violet;">Violet</h1>
<h1 style="background-color:LightGray;">LightGray</h1>

</body>
</html>
```

### Output:



### Text Color:

- You can set the color of text.
- Example:
  - `<h1 style = "color:Tomato;">Hello Section1&2</h1>`
  - `<p style="color:DodgerBlue;">Have you submitted your assignment?????</p>`
  - `<p style="color:MediumSeaGreen;">Did you appear in your midterms?</p>`

### Border Color:

#### Code:

```
<h1 style="border:2px solid Tomato;">Hello World</h1>
<h1 style="border:2px solid DodgerBlue;">Hello World</h1>
<h1 style="border:2px solid Violet;">Hello World</h1>
```

### Introduction:

A system is an arrangement in which all its unit assemble work together according to a set of rules. It can also be defined as a way of working, organizing, or doing one or many tasks according to a fixed plan. For example, a watch is time displaying system, its components follow a set of rules to show time. If one of its parts fails, the watch will stop working, so we can say that in a system all its subcomponents depend on each other.

### Embedded system:

Embedded means something that is attached to another thing. An embedded system can be thought of as a computer hardware system having software embedded in it. An embedded system can be an independent system, or it can be a part of a large system. It is a microprocessor or a microcontroller-based system which is designed to perform a specific task, for example a fire alarm is an embedded system i.e. it will sense only smoke.

### Embedded system basics:

**Embedded system hardware:** As with any electronic system, an embedded system requires a hardware platform on which to run. The hardware will be based around a microprocessor or microcontroller.

**Embedded system software:** The embedded system software is written to perform a particular function.

Some examples of embedded systems are MP3 player, mobile phones, digital cameras, DVD players. Household appliances such as microwave ovens, washing machines and dishwashers, also include embedded systems to provide flexibility and efficiency.

### Components of an Embedded System:

An embedded system has three components.

- It has hardware.
- It has software application.
- It has Real Time Operating System (RTOS) that supervises the application software. RTOS defines the way system works. It sets the rules during the execution of application program. A small-scale embedded system may not have RTOS.

So, we can define an embedded system as a microcontroller based, software driven, reliable and real-time control system.

### Advantages of an embedded system:

- Easily Customizable
- Low cost
- Low power consumption
- Enhanced performance

Some other examples of sophisticated embedded systems are washing machine, digital camera, power windows of vehicle, power steering of a vehicle, fuel injection system of a vehicle, air conditioner, smartphone, music player, automatic temperature controller etc.

Characters of an Embedded system:

- **Single functioned:** An embedded system usually performs a specialized operation and does the same repeatedly.
- **Tightly constrained:** All computing systems have constraints on design metrics, but those on an embedded system can be especially tight. Design metrics is a measure of an implementation's features such as its cost, size, power, and performance. It must be of a size to fit on a single chip, must perform fast enough to process data in real time and consume minimum power to extend battery life.
- **Reactive and Real time:** Many embedded systems must continually react to changes in the system's environment and must compute certain results in real time without any delay. Consider an example of a car cruise controller; it continually monitors and reacts to speed and brake sensors. It must compute acceleration or de-accelerations repeatedly within a limited time; a delayed computation can result in failure to control of the car.
- **Microprocessor based:** It must be microprocessor or microcontroller based. It consists of a central processing unit whereas microcontroller contains a CPU, memory, I/O all integrated into one chip. Microprocessor is used in personal computers whereas microcontroller is often used in an embedded system. Microprocessor is complicated and expensive, with a large number of instructions to process but microcontroller is inexpensive and straightforward with fewer instructions to process.
- **Memory:** It must have a memory, as its software usually embeds in ROM. It does not need any secondary memories in the computer.
- **Connected:** It must have connected peripherals to connect input and output devices.
- **HW-SW systems:** Software is used for more features and flexibility. Hardware is used for performance and security.

Real time Applications:

**Embedded system for detecting rash driving on highways:** The main intention of this project is to design a highway speed-checker device that identifies rash driving on highways and alarm the traffic authorities if the speed checker finds any vehicle violating the set speed limits on highways.

**Application of Embedded system for street light control:** Then main intention of this project is to detect the movement of vehicles on highways and to switch on streetlights ahead of it, and then to switch off the streetlights as the vehicle go past the streetlights to conserve energy. In this project, a PIC microcontroller is programmed by using embedded C or assembly language.

### Introduction:

*A computer network is a group of two or more interconnected computer systems. You can establish a network connection either by using a cable or wireless media. Every network involves hardware and software that connects computers and tools.*

### Advantages of a computer network:

*It helps you to connect with multiple computers together to send and receive information when accessing the network, it also helps you to share printers, scanners and email and share information at very fast speed. Electronic communication is more efficient and less expensive than without the network.*

### Components of a computer network:

*The essential computer network components are:*

- |                       |                      |                   |
|-----------------------|----------------------|-------------------|
| 1. Switches           | 6. Access points     | 10. Networking OS |
| 2. Routers            | 7. Shared Data       | 11. Protocol      |
| 3. Servers            | 8. Network Interface | 12. HUB           |
| 4. Clients            | Card                 | 13. Lan cable     |
| 5. Transmission Media | 9. Local OS          | 14. OSI           |

### **Switches:**

*Switches work as a controller which connects computers, printers, and other hardware devices to a network in a campus or a building. It allows devices on your network to communicate with each other, as well as with other networks. It helps you to share resources and reduce the costing of any organization*

### **Routers:**

*Router helps you to connect with multiple networks. It enables you to share a single internet connection with multiple devices and saves money. This networking components acts as a dispatcher, which allows you to analyze data sent across a network. It automatically selects the best route for data to travel and send it on its way.*

### **Servers:**

*Servers are computers that hold shared programs, files, and the network operating system. Servers allow access to network resources to all the users of the network.*

### **Clients:**

*Clients are computer devices which access and uses the network as well as shares network resources. They are also users of the network, as they can send and receive requests from the server.*

### **Transmission media:**

*Transmission media is a carrier used to interconnect computers in a network, such as coaxial cable, twisted-pair wire, and optical fiber cable. It is also known as links, channels, or lines.*

**Access points:**

*Access points allow devices to connect to the wireless network without cables. A wireless network allows you to bring new devices and provides flexible support to mobile users.*

**Shared Data:**

*Shared data are data which is shared between the clients such as data files, printers access programs, and email.*

**Network Interface Card:**

*Network interface card sends, receive data and control data flow between the computer and the network.*

**Local Operating System:**

*A local operating system which helps personal computers to access files, print to a local printer and uses one or more disk and CD drives which are located on the computer.*

**Networking Operating System:**

*The network operating system is a program which runs on computers and servers. It allows the computers to communicate via network.*

**Protocol:**

*A protocol is the set of defined rules that allows two entities to communicate across the network. Some standard protocols used for this purpose are IP, TCP, UDP, FTP etc.*

**Hub:**

*A hub is a device that splits network connection into multiple computers. It acts as a distribution center so whenever a computer requests any information from a computer or from the network it sends the request to the hub through a cable. The hub will receive the request and transmit it to the entire network.*

**Lan Cable:**

*Local Area Network (LAN) cable is also called as ethernet or data cable. It is used for connecting a device to the internet.*

**OSI:**

*OSI stands for Open System Interconnection. It is reference model which allows you to specify standards for communications.*

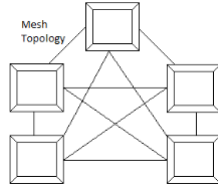
**Computer Network Topology**

*Geometric representation of how the computers is connected to each other is known as topology. There are five types of topologies i.e. **Mesh, Star, Bus, Ring and Hybrid** topologies.*



- Mesh Topology:

*In mesh topology each device is connected to every other device on the network through a dedicated point-to-point link which means that the link carries data for the two connected devices only. Let's say there are  $n$  devices in the network then each device must be connected with  $(n-1)$  devices of the network. Number of links in a mesh topology of  $n$  devices would be  $n(n-1)/2$ .*



*Advantages:*

- *No data traffic issues as there is a dedicated link between two devices which means the link is only available for those two devices.*
- *Mesh topology is reliable and robust as failure of one link doesn't affect other links and the communication between other devices on the network.*
- *Mesh topology is secure because there is a point-to-point link thus unauthorized access is not possible.*

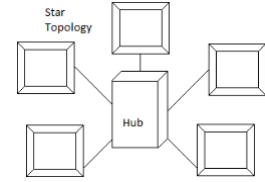
- *Fault detection is easy.*

*Disadvantages:*

- *Number of wires required to connect each system is tedious and headache.*
- *Since each device needs to be connected with other devices, number of I/O ports required must be huge.*
- *Scalability issues because a device cannot be connected with large number of devices with a dedicated point to point link.*

- Star Topology:

*In star topology each device in the network is connected to a central device called hub. Unlike mesh topology, star topology doesn't allow direct communication between devices, a device must have to communicate through hub. If one device wants to send data to other device, it has to first send the data to hub and then the hub transmits that data to the designated device.*



*Advantages:*

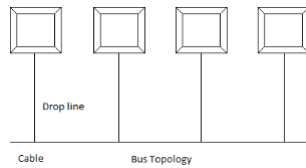
- *Less expensive because each device need only one I/O port and needs to be connected with hub with one link.*
- *Easier to install.*
- *Less number of cables required because each device needs to be connected with the hub only.*
- *Robust, if one link fails, other links will work just fine.*
- *Easy fault detection because the link can be easily identified.*

*Disadvantages:*

- *If hub goes down everything goes down, none of the devices can work without the hub.*
- *Hub requires more resources and regular maintenance because it is the central system of star topology.*

- Bus Topology:

In bus topology there is main cable, and all the devices are connected to this



main cable through drop lines. There is a device called tap that connects the drop line to the main cable. Since all the data is transmitted over the main cable, there is limit of drop lines and the distance a main cable can have.

Advantages:

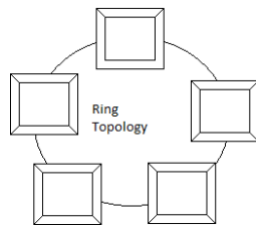
- Easy installation, each cable needs to be connected with backbone cable.
- Less cables required than mesh and star topology.

Disadvantages:

- Difficulty in fault detection.
- Not scalable as there is a limit of how many nodes you can connect with backbone cable

- Ring Topology:

In ring topology each device is connected with the two devices on either side of it. There are two dedicated point to point links a device has with the devices on the either side of it. This structure forms a ring thus it is known as ring topology. If a device wants to send data to another device, then it sends the data in one direction, each device in ring topology has a repeater, if the received data is intended for other device, then repeater forwards this data until the intended device receives it.



Advantages:

- Easy to install.

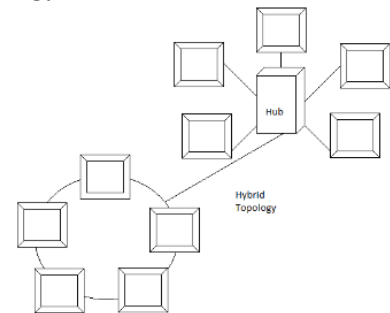
- Managing is easier as to add or remove a device from the topology only two links are required to be changed.

Disadvantages:

- A link failure can fail the entire network as the signal will not travel forward due to failure.
- Data traffic issues, since all the data is circulating in a ring.

- Hybrid Topology:

A combination of two or more topology is known as hybrid topology. For example, a



combination of star and mesh topology is known as hybrid topology.

Advantages:

- We can choose the topology based on the requirements for example, scalability is our concern then we can use star topology instead of bus topology.
- Scalable as we can further connect other computer networks with the existing networks with different topologies.

Disadvantages:

- Fault detection is difficult.
- Installation is difficult.

Design is complex so maintenance is high thus expensive.

### Introduction:

A database is a collection of related data which represents some aspect of the real world. A database system is designed to be built and populated with data for a certain task.

### Database:

A database is an organized collection of data. For example, a database of a college would be having a collection of data such as personal records of students, their performance history, teacher's data, or financial department data etc.

### DBMS:

DBMS stands for Database Management System. It refers to the technology for creating and managing databases. DBMS is a software tool to organize, create, retrieve, update, and manage data in a database. MS Access is one of the most common examples of database management software.

A database management system is a software application which is used for managing different databases. It helps us to create and manage database, with the help of DBMS we take care of following tasks: -

1. Data security.
2. Data backup.
3. Manage huge amount of data.
4. Data export and import.
5. Serving multiple concurrent database requests.
6. Gives us a way to manage the data using programming languages.

### Aim of a DBMS:

The main aim of a DBMS is to supply a way to store up and retrieve database information that is both convenient and efficient. By data, we mean known facts that can be recorded and that have embedded meaning. A datum is a unit of data, meaningful data is combined to form information hence, information is interpreted data i.e. data provide with semantics.

### Data, information, and Knowledge:

Knowledge refers to the useful use of information. Information can be transported, stored, and shared without any problems and difficulties, but the same cannot be said about knowledge. Knowledge necessarily involves personal experience and practice.

### More about Database Systems:

Database systems are meant to handle an extensive collection of information. Management of data involves both defining structures for storage of information and providing mechanisms that can do the manipulation of those stored information. Moreover, the database system must ensure the safety of the information stored, despite system crashes or attempts at unauthorized access.

### Popular DBMS Software:

- |                    |           |                             |
|--------------------|-----------|-----------------------------|
| • MySQL            | • dBASE   | • LibreOffice Base          |
| • Microsoft Access | • FoxPro  | • MariaDB                   |
| • Oracle           | • SQLite  | • Microsoft SQL Server etc. |
| • PostgreSQL       | • IBM DB2 |                             |

### Why uses DBMS?

- To develop software applications in less time.
- Data independence and efficient use of data.
- For uniform data administration.
- For data integrity and security.
- For concurrent access to data, and data recovery from crashes.
- To user-friendly declarative query language.

### Where DBMS is being used?

**Airlines:** reservations, schedules, etc.

**Telecom:** calls made, customer details, network usage etc.

**Universities:** registration, results, grades etc.

**Sales:** products, purchases, customers, etc.

**Banking:** all transactions etc.

### Applications:

**Banking:** For customer information, account activities, payments, deposits, loans etc.

**Airlines:** For reservations and schedule information.

**Universities:** For student information, course registration.

**Telecommunication:** It helps to keep call records, monthly bills, maintaining balances etc.

**Finance:** For storing information about stock, sales and purchases of financial instruments like stocks and bonds.

**Sales:** Use for storing customer, products and sales information.

**Manufacturing:** It is used for the management of supply chain and for tracking production of items, inventories status in warehouses.

**HR Management:** For information about employees, salaries, payroll, deduction, generation of paychecks etc.

### Advantages of a DBMS:

- DBMS offers a variety of techniques to store and retrieve data.
- It serves as an efficient handler to balance the needs of multiple applications using the same data.
- Uniform administration procedures for data.
- Application programmers never exposed to details of data representation and storage.
- A DBMS used various powerful functions to store and retrieve data efficiently.
- Offers data integrity and security.
- The DBMS implies integrity constraints to get a high level of protection against prohibited access to data.

- A DBMS schedules concurrent access to the data in such a manner that only one user can access the same data a time.
- Reduced application development time.

### Disadvantages of DBMS:

- Cost of hardware and software of a DBMS is quite high which increases the budget of your organization.
- Most database management systems are often complex systems, so the training for users to use the DBMS is required.
- In some organizations, all data is integrated into a single database which can be damaged because of electric failure or database is corrupted on the storage media.
- Use of the same program at a time by many users sometimes lead to the loss of some data.
- DBMS can't perform sophisticated calculations.

### Components of DBMS:

- **Software:** DBMS is primarily a software system that can be considered as a management console or an interface to interact with and manage databases. The interfacing also spreads across real-world physical systems that contribute data to the backend databases.
- **Data:** DBMS contains operational data, access to database records and metadata as a resource to perform the necessary functionality. The data may include files with such as index files, administrative information, and data dictionaries used to represent data flows, ownership, structure and relationship to other records or objects.
- **Procedures:** While not a part of the DBMS software, procedures can be considered as instructions on using DBMS. The documented guidelines assist users in designing, modifying, managing, and processing databases.
- **Database languages:** These are components of the DBMS used to access, modify, store, and retrieve data items from databases, specify database schemes, control user access and perform other associated database management system operations. Types of DBMS language include Data Definition Language (DDL), Data Manipulation Language (DML), Database Access Language (DAL) and Data Control Language (DCL).
- **Query Processor:** As a fundamental component of the DBMS, the query processor acts as an intermediary between users and the DBMS data engine in order to communicate query requests. When users enter an instruction in SQL language, the command is executed from the high-level-language instruction to low-level language that the underlying machine can understand and process to perform the appropriate DBMS functionality. In addition to instruction parsing and translation, the query processor also optimizes queries to ensure fast processing and accurate results.

- **Runtime database manager:** A centralized management component of DBMS that handles functionality associated with runtime data, which is commonly used for context-based database access. This component checks for user authorization to request the query; processes the approved queries; devises an optimal strategy for query execution; supports concurrency so that multiple users can simultaneously work on the same databases and ensures integrity of data recorded into the databases.
- **Database manager:** Unlike the runtime database manager that handles queries and data at runtime, the database manager performs DBMS functionality associated with the data within databases. Database manager allows a set of commands to perform different DBMS operations that include creating, deleting, backup, restoring, cloning and other database maintenance tasks. The database manager may also be used to update the database with patches from vendors.
- **Database engine:** This is the core software component within the DBMS solution that performs the core functions associated with data storage and retrieval. A database engine is also accessible via APIs that allow users to create, read, write, and delete records in databases.
- **Reporting:** The report generator extracts useful information from DBMS files and displays it in structured format based on defined specifications. This information may be used for further analysis, decision making or business intelligence.

### Types of DBMS:

Four types of DBMS systems are:

1. **Hierarchical database:** In a hierarchical database, model data is organized in a tree-like structure. Data is stored hierarchically (top down or bottom up) format. Data is represented using a parent-child relationship. In hierarchical DBMS parent may have many children, but children have only one parent.
2. **Network Model:** The network database model allows each child to have multiple parents. It helps you to address the need to model more complex relationships like as the orders/parts many-to-many relationship. In this model, entities are organized in a graph which can be accessed through several paths.
3. **Relational Model:** Relational DBMS is the most widely used DBMS model because it is one of the easiest. This model is based on normalizing data in the rows and columns of the tables. Relational model stored in fixed structures and manipulated using SQL.
4. **Object-Oriented Model:** In object-oriented model data stored in the form of objects. The structure which is called classes which display data within it. It defines a database as a collection of objects which stores both data members values and operations.

### SQL:

SQL stands for Structured Query Language. SQL is a language which is used to interact with relational database management system. We often refer relational database as SQL database. It is a standardized language for interacting with RDBMS (Relational Database Management system). Some of the popular relational database examples are MySQL, Oracle, MariaDB, PostgreSQL etc. SQL is used to perform C.R.U.D (create, retrieve, update, and delete) operations on relational databases. It can also perform administrative tasks on database such as database security, backup, user management etc. We can create databases and tables inside database using SQL.

### Types of SQL:

SQL is basically combination of four different languages, they are:

**DQL** (Data Query Language) is used to fetch the information from the database which is already stored there.

**DDL** (Data Definition Language) is used to define table schemas.

**DCL** (Data Control Language) is used for user and permission management. It controls the access to the database.

**DML** (Data Manipulation Language) is used for inserting, updating, and deleting data from database.

### What is a Query?

A Query is a set of instruction given to the database management system, which tells RDBMS what information you would like to get from the database. For example, to fetch the employee's name from the database table EMPLOYEE, we write the SQL Query like this: `Select employee_name from EMPLOYEE;`