

مبادئ علوم الحاسوب Principles of Computer

ح101، حسب 101

محاضرة #4

Network

الشبكات

Number System

نظام الأعداد

Network

الشبكات

- **What is Network**
- **Computers in Network**
- **Types of Network**
- **Network Requirements**
- **Network Facilities**
- **Network Topologies**

What is meant by network?

It a collection of computers all connected to exchange data between each other.

Computers in Network

- **Server**
- **workstation**

Server

It is the main computer in the network that used to connected all other computers to each other to share the data and information

Workstation

Any other computer in the network that can be accessed by the network users to do their jobs.

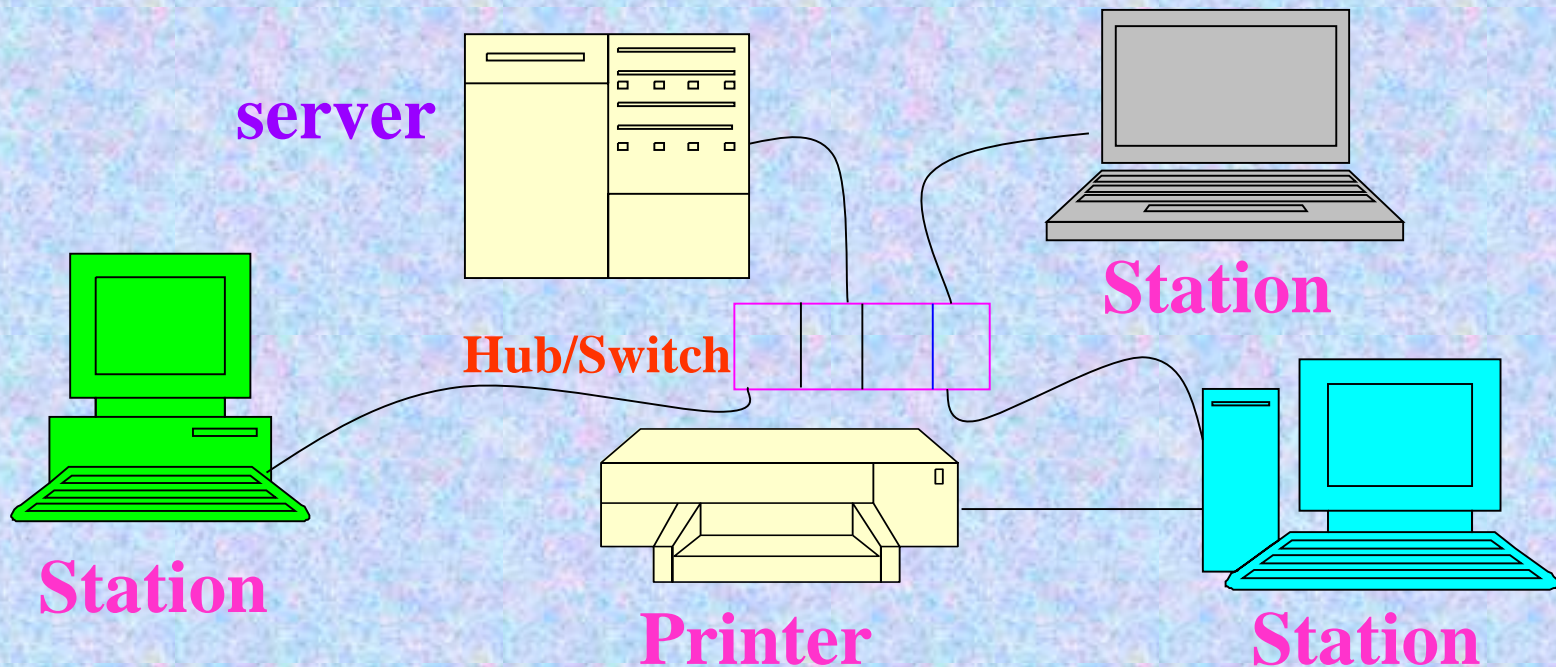
Types of Network

Basically, there are two types of network:

- **Local Area Network (LAN).**
- **Wide Area Network (WAN).**

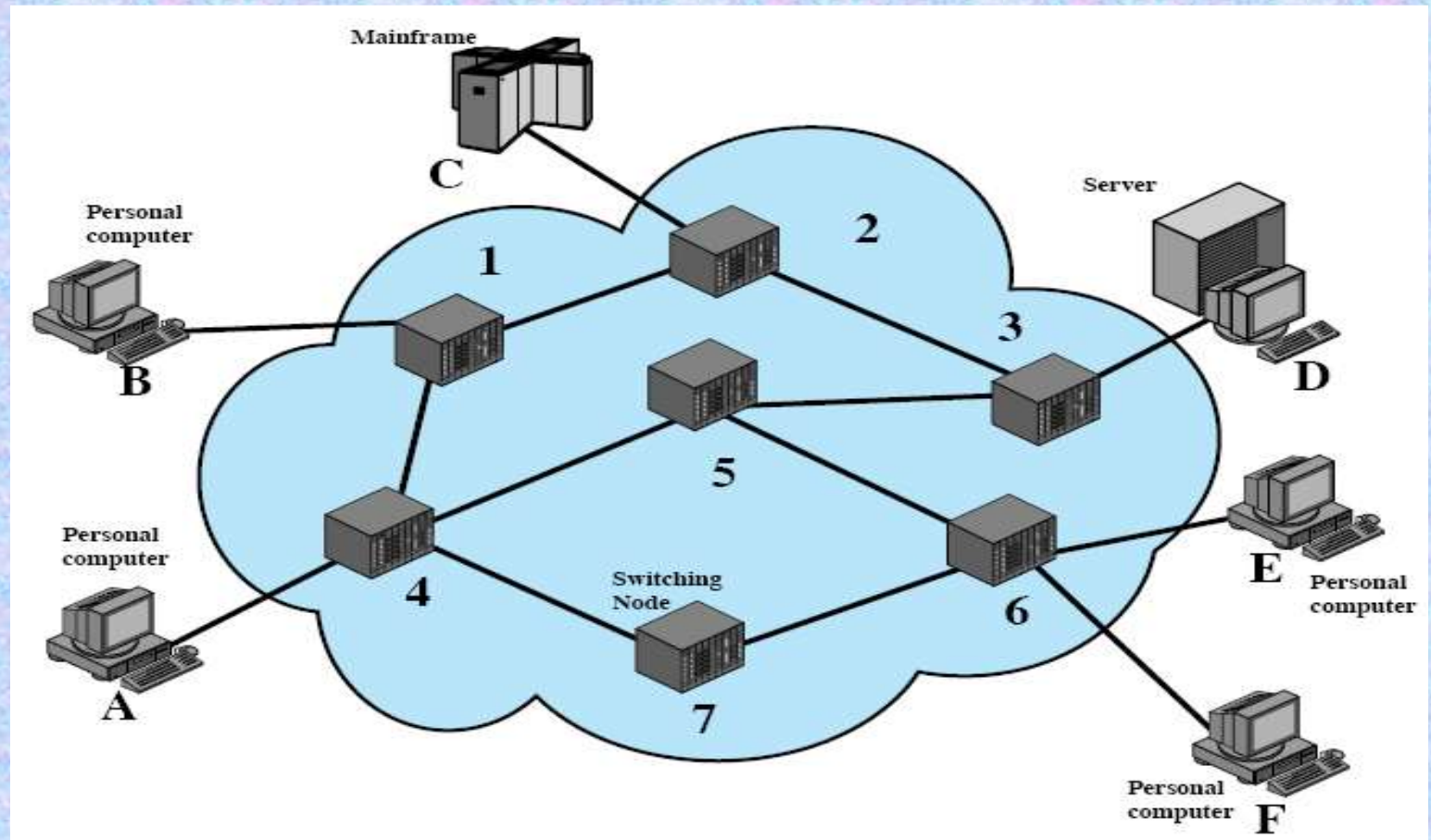
Local Area Network (LAN)

It is the network that composes of a set of computers connect to each other within limited place (one building) like a home, office or a group of buildings. It can be shown as follows:



Wide Area Network (WAN)

It is a big network composed of a set of networks and PCs, which is widely spread in wide area.



Network Requirements

LAN

To build a LAN following are required.

- **Server**
- **Workstations**
- **Network cards**
- **Data cable**
- **Hub/Switch**

WAN

To build a WAN following are required

- **LAN requirements**
- **Modem**
- **Telephone line**
- **Other communication tools**

What is a Modem?

The word "**modem**" is actually a combination of two words. It stands for "**MO**dulator - **DE**Modulator".

A modem is a device attached to your computer that converts the *digital* data coming from your computer into *analog* signals in order to travel over the phone lines.

Network Facilities

Share resources (storage media, printers, communication devices)

- **Easy data transfer.**
- **Easy to control.**
- **Cost optimization, and**
- **Other facilities.**

Network Topology

A network topology is the pattern of links connecting pairs of nodes of a network.

Different types of topology can be considered such as:

Bus Network

Star Network

Ring Network

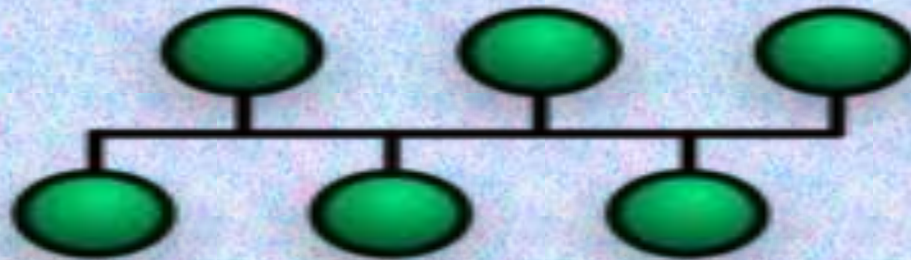
Mesh Network

Star-Bus Network

Tree Network

Bus Network

Each pair of computers can be connected as shown below:



Network Topology Bus

Very simple and easy to build, but if one terminal is off the whole network will go down

Star Network

Star networks are one of the most common computer network topologies. In its simplest form, a star network consists of one central switch, hub or computer which acts as a router to transmit messages. Can be shown as:

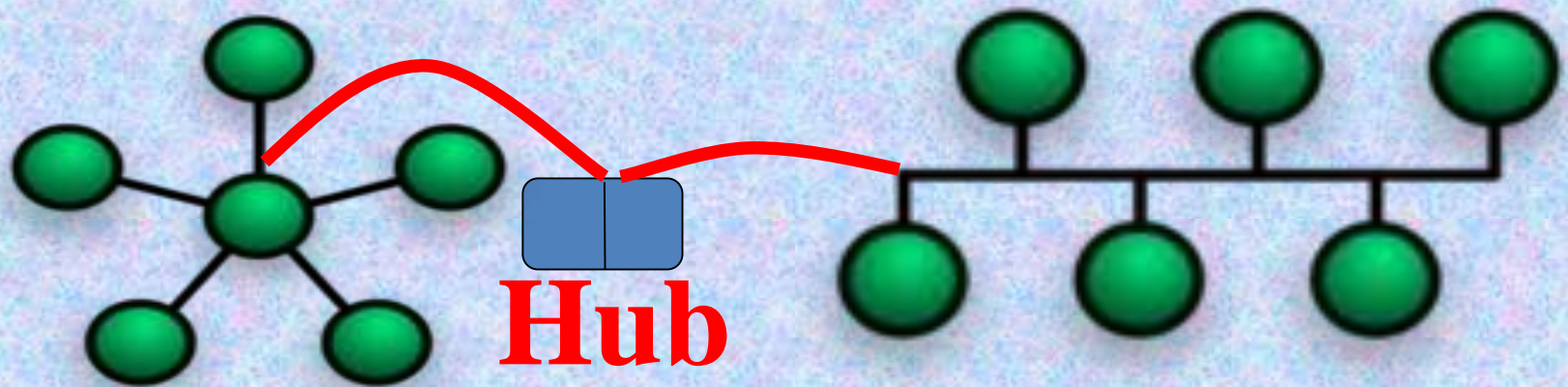


Network Topology Star

If one PC goes down the net will remain. High cost to build and based on the hub.

Star-Bus Network

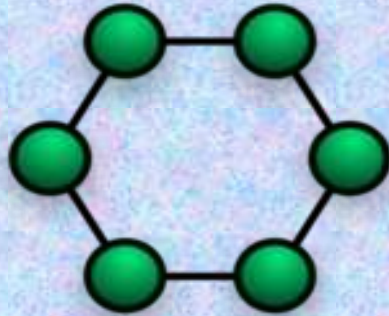
A star-bus network is a combination of a star network and a bus network. A hub (or concentrator) is used to connect the nodes to the network.



Network Topology Star-Bus

Ring Network

A ring network is a topology of computer networks where each node is connected to two other nodes, so as to create a ring, as shown below.

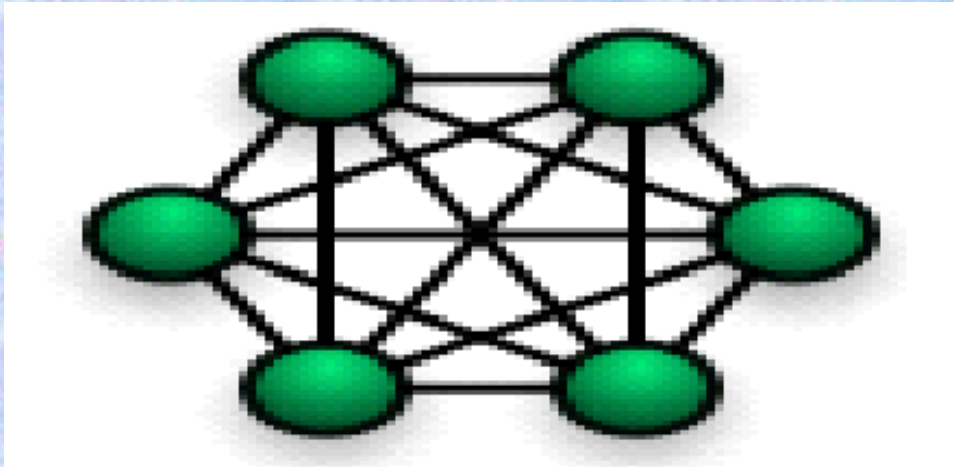


Network Topology Ring

Can transfer large amount of data, but highly cost

Mesh Network

Mesh networking is a way to route data, voice and instructions between stations as shown below.

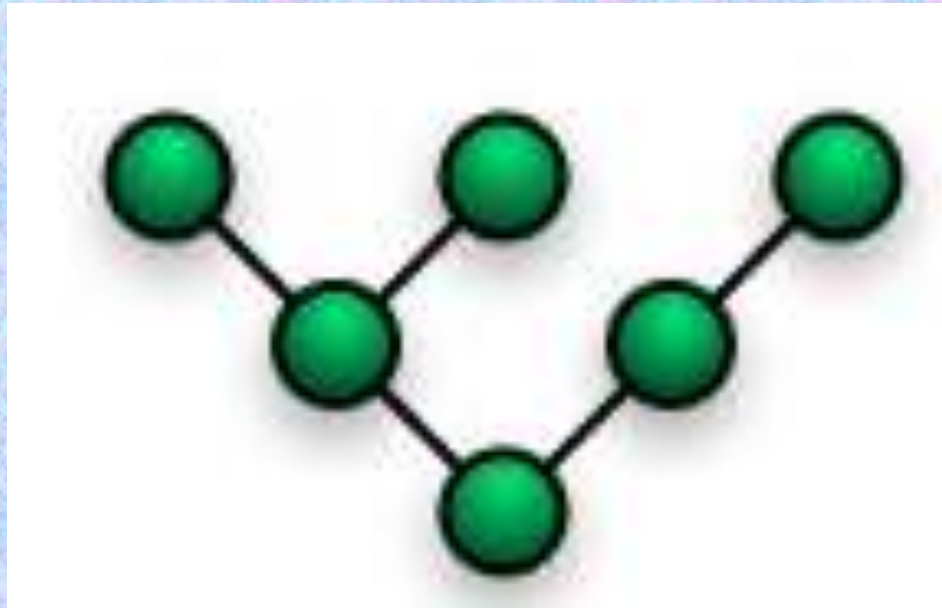


Network Topology Mesh

Each two station can directly exchange data and information, also if one PC goes down will not affect the net only it is cost is very high

Tree Network

A tree network is a topology of computer networks where each node may connected to one or more nodes, so as to create a tree.



Network Topology Tree

Internet

- **What is Internet**
- **History of Internet**
- **Internet Protocols**
- **Internet Protocol address**
- **Internet Services**

What is Internet

It an international widely spread network where all these computers connect together to exchange information and other services.

History of Internet

Start at the American Department of Defense 1969

DoD developed ARPANET “Advanced Research Project Agency Network to support space research.

Later the network shifted from military to civilian use and many institutions and centers joint the net then became International network.

Internet Protocol (IP)

It is the way that computers communicate to each other in the Internet and at the same time ease the connection between computers

There are so many protocols that can be followed such as

- . TCP/IP: Transmission Control Protocol / Internet Protocol.**
- . UDP: User Datagram Protocol.**
- . FTP: File Transfer Protocol.**

Internet Protocol Address (IP address)

Each computer in the internet has its own IP address.

The computer address composed of 32 bits (4 bytes), therefore the total no. of computers connected to the internet about 2^{32} (i.e. 4294 million).

The IP address should be written in binary digit, which is very difficult to be remembered. The solution is:

Divide the binary numbers into number of bytes (8 bits each), then convert each part to its equivalent decimal number separated by dot (.)

Use the alphabets such as: sudanet.net

Exercise : investigate Static VS Dynamic IP address

In the IP address (e.g., abcdefghijk.xxx), xxx is known as the Top Level Domain (TLD) that refers to the type of the activities offer the organization through the internet and the owner. The most TLDs are

edu: educational

com: commercial

net: network

gov: government

mil: military

us: united state

uk: united kingdom

sd: sudan

Internet Services

- **Email**
- **Search engine**
- **Chat (voice, text)**
- **E-commerce**
- **E-learning**
- **Others**

Internet Service Provider (ISP)

Internet Access Provider (IAP)

An ISP is simply a company or organization that provides access to the Internet.

Some ISPs offer extra features or content available on their local network to users of their service. Such as email services and web site hosting.

Most ISPs will offer some sort of network based account management where you can view your ISP account information.

ISPs themselves are connected to one another through Network Access Points (*NAPs*).

Number System

نظام الأعداد

It is a useful system that can be used for different purposes with the computer system, such as:

Binary Number System: used by the machine to represent and manipulate all input data

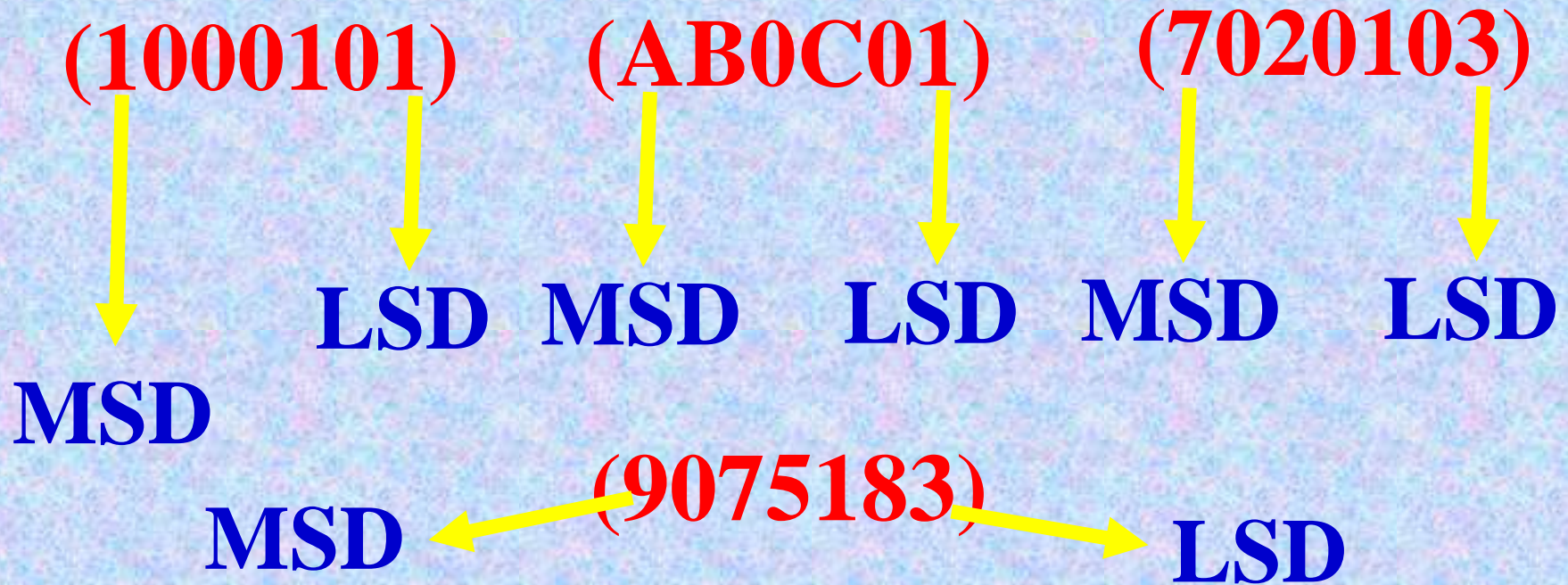
Octal Number System: common system used with computers. Because of its relationship with the binary system, it is useful in programming some types of computers.

Hexadecimal Number System: used by computer manufacturer to give some reports about the computer components (Hardware)

Decimal Number System: used by human for their daily calculations and counting and communication with computers .

LSD/LSB and MSD/MSB Digits

For each number represented by any of the given number systems there are common two digits, namely LSD/LSB & MSD/MSB, as shown below:



LSD/LSB: the most right digit (first digit from right) -
Least Significant Digit/ Least Significant Bound.

MSD/MSB: the most left digit (first digit from left) – Most
Significant Digit/ Most Significant Bound.

Base

It is a number that used to distinguish the number systems from each other

- **Binary Number System: Base 2**
- **Octal Number System: Base 8**
- **Hexadecimal Number System: Base 16**
- **Decimal Number System: Base 10**

Number Representation

Each number is represented along with its base to be recognized as:

- **Binary Number: $(1000101)_2$**
- **Octal Number: $(25371)_8$**
- **Hexadecimal Number: $(AB0891F)_{16}$**
- **Decimal Number: $(238915)_{10}$**

Binary number system

In this system the numbers used to be represented using the binary digits (0, 1)

Therefore the number will be represented with 0's, 1's or a combination of 0 and 1, such as

$(0000000)_2$

$(1111111)_2$

$(1011010)_2$

Octal number system

In this system the numbers used to be represented using digits (0, 1, 2, ..., 7), such as

$(1027365)_8$

Decimal number system

In this system the numbers used to be represented using digits (0, 1, 2, ..., 9), such as:

$(1027965)_{10}$

Hexadecimal number system

In this system the numbers used to be represented using digits (0, 1, 2, ..., 9, 10, 11, 12, 13, 14, 15).

The digits (10, 11, 12, 13, 14, 15) are represented by the letter (A, B, C, D, E, F), to use one digit instead of two digits.

$(A027F65)_{16}$

Digit Position

Each digit in the number is assigned a position 0,1,2,...n starting from the LSD/LSB digit as shown below

$(1\ 0\ 1\ 1\ 0\ 1\ 0)_2$

↓ ↓ ↓ ↓ ↓ ↓ ↓

6 5 4 3 2 1 0

$(1\ 5\ 3\ 2\ 7\ 0\ 6)_8$

↓ ↓ ↓ ↓ ↓ ↓ ↓

6 5 4 3 2 1 0

$(A\ 0\ 9\ C\ 3\ 8\ F)_{16}$

↓ ↓ ↓ ↓ ↓ ↓ ↓

6 5 4 3 2 1 0

Digit Weight

Each digit in the number has weight, which is usually defined as the base of the given system raised to its position i.e.

$$\text{Wight} = B^{\text{Position}}$$

Example

(1 0 1 1 0 1 0)₂

↓ ↓ ↓ ↓ ↓ ↓ ↓

6 5 4 3 2 1 0

(1 5 3 2 7 0 6)₈

↓ ↓ ↓ ↓ ↓ ↓ ↓

6 5 4 3 2 1 0

(A 0 9 C 3 8 F)₁₆

↓ ↓ ↓ ↓ ↓ ↓ ↓

6 5 4 3 2 1 0

2^0 , 2^2 , 8^1 , 8^3 , 16^4 , 16^6

Number System Conversion

The numbers can be converted from each system to the other

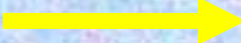

Conversion from Decimal into Others

Conversion can be carried out through number of steps as following

1. Divide the given **decimal** number by the **base** of the required system and save the **remainder**
2. Divide the **quotient** by the **base** of the required system and save the **remainder**
3. Repeat step 2 until the **quotient** becomes 0 and the **remainder** is the **quotient** itself.
4. Assign the first remainder as LSD/LSB and the last remainder as MSD/MSB.
5. Arrange the remainders starting from the **first remainder (LSD)** toward the **last remainder (MSD)** to get the **required number**.

Example #1

Convert the decimal number **129** into its equivalent in **Binary**, **Octal**, and **Hexadecimal**.

B (Base) = 2:	129	2	1 	LSD
	64	2	0	
	32	2	0	
	16	2	0	
	8	2	0	
	4	2	0	
	2	2	0	
	1	2	1 	MSD
	0			

$$(129)_{10} = (1\ 0\ 0\ 0\ 0\ 0\ 0\ 1)_2$$

b. Conversion into Octal:

B (Base) = 8:

129	8	1	→ LSD
16	8	0	
2	8	2	→ MSD
0			

$$(1\ 2\ 9)_{10} = (2\ 0\ 1)_8$$

c. Conversion into Hexadecimal:

B (Base) = 16:

129	16	1	→	LSD
8	16	8	→	MSD
0				

$$(129)_{10} = (8\ 1)_{16}$$

Example #2

Convert the decimal number **63** into its equivalent in **Binary, Octal, and Hexadecimal**.

a. Conversion into Binary:

B (Base) = 2:	63	2	1	→ LSD
	31	2	1	
	15	2	1	
	7	2	1	
	3	2	1	
	1	2	1	→ MSD
	0			

$(111111)_2$

b. Conversion into Octal:

B (Base) = 8:

63

8

7

8

0

7



LSD

7



MSD

(7 7)₈

c. Conversion into Hexadecimal:

B (Base) = 16:



~~(3 15)₁₆~~

(3 F)₁₆

Number System Conversion

Conversion from Binary, Octal, and Hexadecimal into Decimal

Conversion can be carried out through number of steps as the following:

- 1. Assign each digit in the number its corresponding position**
- 2. Multiply each digit by its corresponding weight.**
- 3. Add up the result of 2 to get the equivalent decimal number.**

Example #3

Convert the following numbers into their equivalent
Decimal.

$$\text{a. } (1\ 0\ 1\ 0\ 1\ 0\ 0\ 1)_2 = (\quad)_{10}$$

$$\text{b. } (77)_8 = (\quad)_{10}$$

$$\text{c. } (3F)_{16} = (\quad)_{10}$$

Number System Conversion

Conversion from Binary, into Octal and Hexadecimal

Conversion can be carried out through the following steps:

- 1. Divide the given binary number into a group of blocks starting from the LSD/LSB:**
 - In case of Octal divide into blocks of 3 bits**
 - Incase of Hexadecimal divide into blocks of 4 bits**
- 2. Covert each block into its equivalent decimal number.**
- 3. Arrange the result in 2 above by assigning the result of first block as LSD and the result of last block as MSD to get the required equivalent number (Octal/Hexadecimal).**

Example #4

Convert the following number into its equivalent Octal and Hexadecimal.

$$(1\ 0\ 1\ 0\ 1\ 1\ 0\ 1\ 1\ 0)_2 = (\quad)_8 = (\quad)_{16}$$

Operations on Number Systems

Same mathematical operations that carried on the decimal number system can be carried out on the other number systems, such as

Addition

Subtraction

Multiplication

Division

Example #5

Perform the following operations:

$$1. \quad (1\ 0\ 0\ 1\ 1\ 1)_2 \quad + \quad (1\ 0\ 1\ 1)_2 \quad = \quad (\quad)_2$$

$$2. \quad (3451)_8 \quad + \quad (257)_8 \quad = \quad (\quad)_8$$

$$3. \quad (20FA)_{16} \quad + \quad (3BC)_{16} \quad = \quad (\quad)_{16}$$

$$4. \quad (1\ 0\ 0\ 1\ 1\ 1)_2 \quad - \quad (1\ 0\ 1\ 1)_2 \quad = \quad (\quad)_2$$

$$5. \quad (3451)_8 \quad - \quad (257)_8 \quad = \quad (\quad)_8$$

$$6. \quad (20FA)_{16} \quad - \quad (3BC)_{16} \quad = \quad (\quad)_{16}$$