BCA Sem - 2
Computer Organization and Architecture

About Computer Inside

- Computers are classified according to **functionality, physical size** and **purpose**.
- Functionality, Computers could be **analog, digital or hybrid**. Digital computers process data that is in discrete form whereas analog computers process data that is continuous in nature. Hybrid computers on the other hand can process data that is both discrete and continuous.
- In digital computers, the user input is first converted and transmitted as electrical pulses that can be represented by two unique states ON and OFF. The ON state may be represented by a "1" and the off state by a "0".The sequence of ON'S and OFF'S forms the electrical signals that the computer can understand.
- A digital signal rises suddenly to a peak voltage of +1 for some time then suddenly drops -1 level on the other hand an analog signal rises to +1 and then drops to -1 in a continuous version.

- Although the two graphs look different in their appearance, notice that they repeat themselves at equal time intervals. Electrical signals or waveforms of this nature are said to be periodic.Generally,a periodic wave representing a signal can be described using the following parameters
- Amplitude(A)
- Frequency(f)
- periodic time(T)

- **Amplitude (A):** this is the maximum displacement that the waveform of an electric signal can attain.
- **Frequency (f):** is the number of cycles made by a signal in one second. It is measured in hertz.1hert is equivalent to 1 cycle/second.
- **Periodic time (T):** the time taken by a signal to complete one cycle is called periodic time. Periodic time is given by the formula **T=1/f,** where **f** is the frequency of the wave.

- When a digital signal is to be sent over analog telephone lines e.g. e-mail, it has to be converted to analog signal. This is done by connecting a device called a **modem** to the digital computer. This process of converting a digital signal to an analog signal is known as **modulation**. On the receiving end, the

incoming analog signal is converted back to digital form in a process known as **demodulation**.

Data representation in computer

- Data and instructions cannot be entered and processed directly into computers using human language. Any type of data be it numbers, letters, special symbols, sound or pictures must first be converted into machine-readable form i.e. binary form. Due to this reason, it is important to understand how a computer together with its peripheral devices handles data in its electronic circuits, on magnetic media and in optical devices.

Data representation in digital circuits

- Electronic components, such as microprocessor, are made up of millions of electronic circuits. The availability of high voltage(on) in these circuits is interpreted as '1' while a low voltage (off) is interpreted as '0'.This concept can be compared to switching on and off an electric circuit. When the switch is closed the high voltage in the circuit causes the bulb to light ('1' state).on the other hand when the switch is open, the bulb goes off ('0' state). This forms a basis for describing data representation in digital computers using the binary number system.

Data representation on magnetic media

- The laser beam reflected from the land is interpreted, as 1.The laser entering the pot is not reflected. This is interpreted as 0.The reflected pattern of light from the rotating disk falls on a receiving photoelectric detector that transforms the patterns into digital form.The presence of a magnetic field in one direction on magnetic media is interpreted as 1; while the field in the opposite direction is interpreted as "0".Magnetic technology is mostly used on storage devices that are coated with special magnetic materials such as iron oxide. Data is written on the media by arranging the magnetic dipoles of some iron oxide particles to face in the same direction and some others in the opposite direction

Data representation on optical media

In optical devices, the presence of light is interpreted as '1' while its absence is interpreted as '0'.Optical devices use this technology to read or store data. Take example of a CD-ROM, if the shiny surface is placed under a powerful

microscope, the surface is observed to have very tiny holes called **pits**. The areas that do not have pits are called **land**.

Data representation in computer

It has proved difficult to develop devices that can understand natural language directly due to the complexity of natural languages. However, it is easier to construct electric circuits based on the binary or ON and OFF logic. All forms of data can be represented in binary system format. Other reasons for the use of binary are that digital devices are more reliable, small and use less energy as compared to analog devices.

Bits, bytes, nibble and word

- The terms bits, bytes, nibble and word are used widely in reference to computer memory and data size.
- **Bits:** can be defined as either a binary, which can be 0, or 1.It is the basic unit of data or information in digital computers.

- **Byte:** a group of bits (8 bits) used to represent a character. A byte is considered as the basic unit of measuring memory size in computer.
- **A nibble**: is half a byte, which is usually a grouping of 4 bit.

- **Word:** two or more bits make a word. The term **word length** is used as the measure of the number of bits in each word. For example, a word can have a length of 16 bits, 32 bits, 64 bits etc.

Number systems and their representation

- **A number system** is a set of symbols used to represent values derived from a common base or radix.
- As far as computers are concerned, number systems can be classified into two major categories:

- decimal number system
- binary number system
- octal number system
- hexadecimal number system

Character Data Representation : Coding Scheme apply in computer ,ASCII,BCD,EBCDIC uni code etc.

Decimal number system

- The term decimal is derived from a Latin prefix deci, which means ten. Decimal number system has ten digits ranging from 0-9. Because this system has ten digits; it is also called a base ten number system or denary number system.
- A decimal number should always be written with a subscript 10 e.g. X_{10}
- But since this is the most widely used number system in the world, the subscript is usually understood and ignored in written work. However ,when many number systems are considered together, the subscript must always be put so as to differentiate the number systems.
- The magnitude of a number can be considered using these parameters.

Followings are three important component to represent Number

1. Absolute value
2. Place value or positional value
3. Base value
    - **The absolute** value is the magnitude of a digit in a number. for example the digit 5 in 7458 has an absolute value of 5 according to its value in the number line.
    - **The place value** of a digit in a number refers to the position of the digit in that number i.e. whether; tens, hundreds, thousands etc.
    - **The total value** of a number is the sum of the place value of each digit making the number.
    - **The base value** of a number also k known as the **radix**, depends on the type of the number systems that is being used .The value of any number depends on the radix.

For example :-

$(5679)_{10}$ - 5 x 1000 + 6 x 100 + 7 x 10 + 9

- $5 \times 10^3 + 6 \times 10^2 + 7 \times 10^1 + 9 \times 10^0$

- Σ (D x base $^{n-1}$)where n is place number of digit in magnitude.

(564329) - $5 \times 10^5 + 6 \times 10^4 + 4 \times 10^3 + 3 \times 10^2 + 2 \times 10^1 + 9 \times 10^0$

Binary Number System :-

It uses two digits namely, 1 and 0 to represent numbers. unlike in decimal numbers where the place value goes up in factors of ten, in binary system, the place values increase by the factor of 2.binary numbers are written as X_2.consider a binary number such as 1011_2.The right most digit has a place value of 1×2^0 while the left most has a place value of 1×2^3.
For Example

$(1101)_2$ - $1 \times 8 + 1 \times 4 + 0 \times 2 + 1$

- $1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$

Octal number system:-

Consists of eight digits ranging from 0-7.the place value of octal numbers goes up in factors of eight from right to left.

$(5673)_8$ - $5 \times 8^3 + 6 \times 8^2 + 7 \times 8^1 + 3 \times 8^0$

Hexadecimal number system :

This is a base 16 number system that consists of sixteen digits ranging from 0-9 and letters A-F where A is equivalent to 10,B to 11 up to F which is equivalent to 15 in base ten system. The place value of hexadecimal numbers goes up in factors of sixteen.

- A hexadecimal number can be denoted using 16 as a subscript or capital letter H to the right of the number .For example, 94B can be written as 94B16 or 94BH.

$(94BA)_{16}$ - $9 \times 16^3 + 4 \times 16^2 + B \times 16^1 + A \times 16^0$

- $9 \times 16^3 + 4 \times 16^2 + 11 \times 16^1 + 10 \times 16^0$