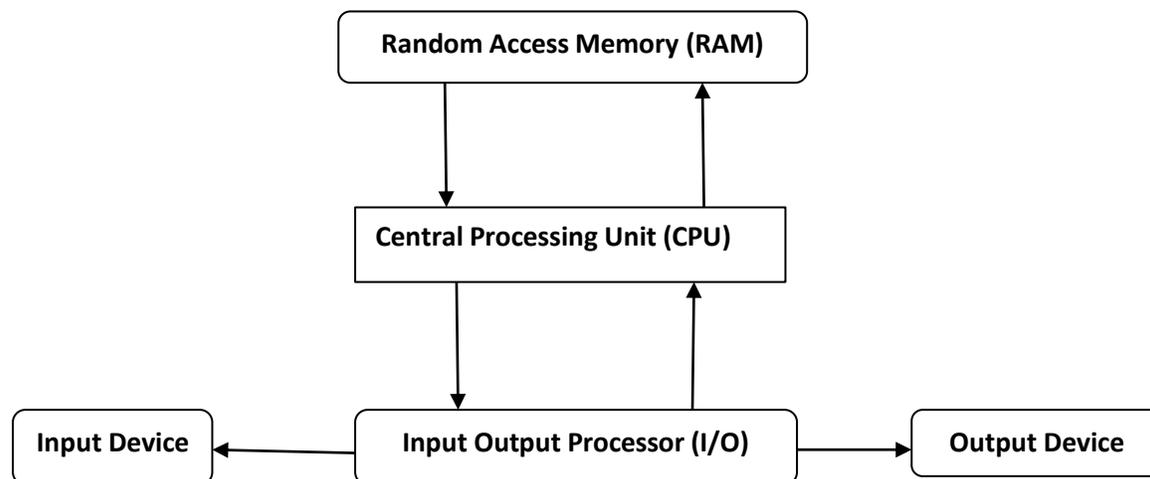


Unit 1:- Introduction to Digital Computers

Digital Computer: - The word digital implies that the information in the computer is represented by variables that take a limited number of discrete values. The decimal digits 0, 1, 2, ..., 9, for example, provide 10 discrete values. The first electronic digital computer, developed in the late 1940s.

A computer that performs calculation and logic operation with quantities represented as digits usually in the binary number system. It operates on data, including magnitudes, letters, and symbols, that are expressed in binary code.

Diagram of Digital Computer



Analog Computer: - Analog computer is that computer which is used to process continuously varying data. Everything, we see and hear is change continuously. This changeable continuous stream of data is called Analog data. Analog computer can be used in scientific and industrial application such as measure the electrical current, frequency and resistance of capacitor.

Examples of Analog computers are temperature, pressure, telephones lines, speedometer, resistance of capacitor, frequencies of signal and voltage etc.

Difference between Digital computer & Analog computer

There are following difference between Digital computer & Analog computer:-

1. The basic difference between Digital computer and Analog computer is that how they process the data, digital computer are electronic based rather than continuous and use binary number data i.e., in the form of 0 and 1. Analog computer are used for situation where data not to be transformed into digits.
2. Digital computer shows result in form of monitor or other output devices while Analog computer shows result in the form of voltage signals.
3. Digital computers use electronic circuits while analog computer use resistor for flow of continuous signal.
4. Analog computer is used where exact values are not always required such as temperature and speed while digital computer are used where exact values required.
5. Analog computer can't be produced repeated result with exact equivalence, which means Analog computer is less accurate as compare to Digital computer.
6. As comparing with speed, Analog computers are slower and less reliable where as digital computer are faster and reliable.
7. Digital computer is flexible while Analog computer is not flexible.
8. Digital computer maintenance cost is low while Analog computer maintenance cost is high.
9. Digital computer consumes more power supply while Analog computer consumes less power supply.

10. Digital computer is portable in nature while Analog is large in size, it consume large space.

Characteristics of Digital Computers

There are following characteristics of Digital computers:-

1. Automatic
2. Speed
3. Accuracy
4. Diligence
5. Versatility
6. Power of remembering
7. No IQ
8. No Feeling

1. **Automatic:** - Computers are automatic machine because once started as a job, they carry out the job until is finished. We need to instruct a computer using coded instruction that specify exactly how it will do a particular job.
2. **Speed:** - A Computer is very fast devices. It can perform in a few seconds.
3. **Accuracy:** - Computers are very accurate. Accuracy of computer is consistency high and the degree of its accuracy depends upon its design. A computer performs every calculation with the same accuracy.
4. **Diligence:** - Unlike human beings, a computer is free from tiredness. It can continuous for many hours without creating any error.
5. **Versatility:** - It is one of the most wonderful things about a computer. A 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:** - A computer can store any data, information and recall any amount of information because of its secondary storage capability.

7. **No IQ:** - Computer is dumb machine and it can't do any work without instruction from the user. So, a computer can't take its own decision as you can.
8. **No feelings:** - Computers have not feeling tiredness. Computer makes judgment based on the instruction given to them in the form of programs that are written by us. It doesn't have feeling or emotion, taste, knowledge and experience. Thus, it doesn't get tired even after long hours work.

Unit2:- Binary Numbers, Codes and Arithmetic

Numbering System: - Numbering systems are technique to represent numbers in the computer system architecture, every value that you are saving or getting into/form computer memory has a defined number system.

A number system is way to represent numbers. We are used to using the base-10 numbers system, which is also called decimal number system.

Types of number system

Computer system supports following numbers system:-

1. Binary Number System
2. Octal Number System
3. Decimal Number System
4. Hexadecimal Number System

1. Binary Number System: - A binary number system has only two (2) digits that are 0 and 1. Every number (value) represents with 0 and 1 in this number system. The base of binary number system is 2, because it has only two digits.

2. Octal Number System: - Octal number system has only eight (8) digits from 0 to 7. Every number (value) represents with 0,1,2,3,4,5,6 and 7 in this number system. The base of octal number system is 8, because it has only eight (8) digits.

3. Decimal Number System:- Decimal number system has only ten (10) digits from 0 to 9. Every number value represent with 0, 1, 2,3,4,5,6,7,8 and 9 in this number system. The base of decimal number system is 10, because it has only ten (10) digits.

4. Hexadecimal Number System:- Hexadecimal number system has sixteen (16) alphanumeric values from 0 to 9 and A to F. Every number

represents with 0-9 and A-F in this number system. The hexadecimal number system is 16, because it has 16 alpha-numeric values.

Number System Conversion

There are many methods or techniques which can be used to convert numbers from one base to another base.

There are following types of conversion in number system

1. Converting from another base to decimal
2. Converting from decimal to another base
3. Other base system to Non-Decimal
4. Shortcut method for binary to octal
5. Shortcut method for octal to binary
6. Shortcut method for binary to hexadecimal
7. Shortcut method for hexadecimal to binary

1. Converting from another base to decimal:-

The following steps are used to convert a number in any other base to a base decimal number.

Step1:- Determine the column (positional) value of each digit. (This depends on the position of the digit and the base of the number system.)

Step2:- Multiply the obtained column values (in step1) by the digits in the corresponding columns.

Step3:- Sum up the products calculated in step2. The total is the equivalent in decimal.

Question1:- Converting from $(11001)_2$ (Binary Number) to $(?)_{10}$ Decimal Number.

Step1:- Determine column values.

Column Number (From Right)	Column Value
1	$2^0=1$
2	$2^1=2$

3	$2^2=4$
4	$2^3=8$
5	$2^4=16$

Step2:- Multiply the Column values by the correspondence column digits.

16	8	4	2	1
x1	x1	x0	x0	x1
<hr/>				
16	8	0	0	1

Step3:- Sum up the products

$$16+8+0+0+1=25$$

$$(11001)_2=(25)_{10}$$

Question2:- Converting from $(4706)_8$ (Octal Number) to $(?)_{10}$ Decimal Number.

Step1:- Determine column values.

Column Number (From Right)	Column Value
1	$8^0=1$
2	$8^1=8$
3	$8^2=64$
4	$8^3=512$

Step2:- Multiply the Column values by the correspondence column digits.

512	64	8	1
x4	x7	x0	x6
<hr/>			
2048	448	0	6

Step3:- Sum up the products

$$2048+448+0+6=2502$$

$$(4706)_8=(2502)_{10}$$

Question3:- Converting from $(111001)_2$ (Binary Number) to $(?)_{10}$ Decimal Number.

$$1x2^5 + 1x2^4 + 1x2^3 + 0x2^2 + 0x2^1 + 1x2^0 \text{ (From right to left)}$$

$$= 32 + 16 + 8 + 0 + 0 + 1$$

$$= 57$$

$$(111001)_2 = (57)_{10}$$

2. Converting from decimal to another base:-

The following steps are used to convert a base 10 decimal number to other base. It is also called division remainder technique.

Step1:- Divide the decimal number by the value of the new base.

Step2:- Record the remainder from step1 as the write most digit of the new base number.

Step3:- Divide the quotient of the previous division by the new base.

Step4:- Record the remainder from step 3 as the next digit of the new base number.

Repeat step3 and step4, according to number from right to left until the quotient becomes zero in step3.

Note- The last remainder, thus obtained will be the most significant digit of the new base number.

Question4:- Converting from $(25)_{10}$ (Decimal Number) to $(?)_2$ Binary Number.

25/2	12	1
12/2	6	0
6/2	3	0
3/2	1	1
1/2	0	1



$$(25)_{10} = (11001)_2$$

Question5:- Converting from $(428)_{10}$ (Decimal Number) to $(?)_{16}$ hexadecimal Number.

428/16	26	12-C	↑
26/16	1	10-A	
1/16	0	1	

$$(428)_{10} = (1AC)_{16}$$

3. Converting from Other base system to Non-Decimal:-

The following steps are used to convert a number in a base other than 10, to a number in another base other than 10.

Step1:- Convert the original number to a base ten (10) decimal number.

Step2:- Convert the decimal number obtained in step1 to the new base number.

Question6:- Converting from $(545)_6$ to $(?)_4$.

Step1:- Convert from base 6 to base 10.

$$545 = 5 \times 6^2 + 4 \times 6^1 + 5 \times 6^0$$

$$= 5 \times 36 + 4 \times 6 + 5 \times 1$$

$$= 180 + 24 + 1$$

$$= 209$$

$$(545)_6 = (209)_{10}$$

Step2:- Convert from base 10 to base 4.

$$(209)_{10} = (?)_4$$

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209/4	52	1
52/4	13	0
13/4	3	1
3/4	0	3

$$(545)_6 = (209)_{10} = (3101)_4$$