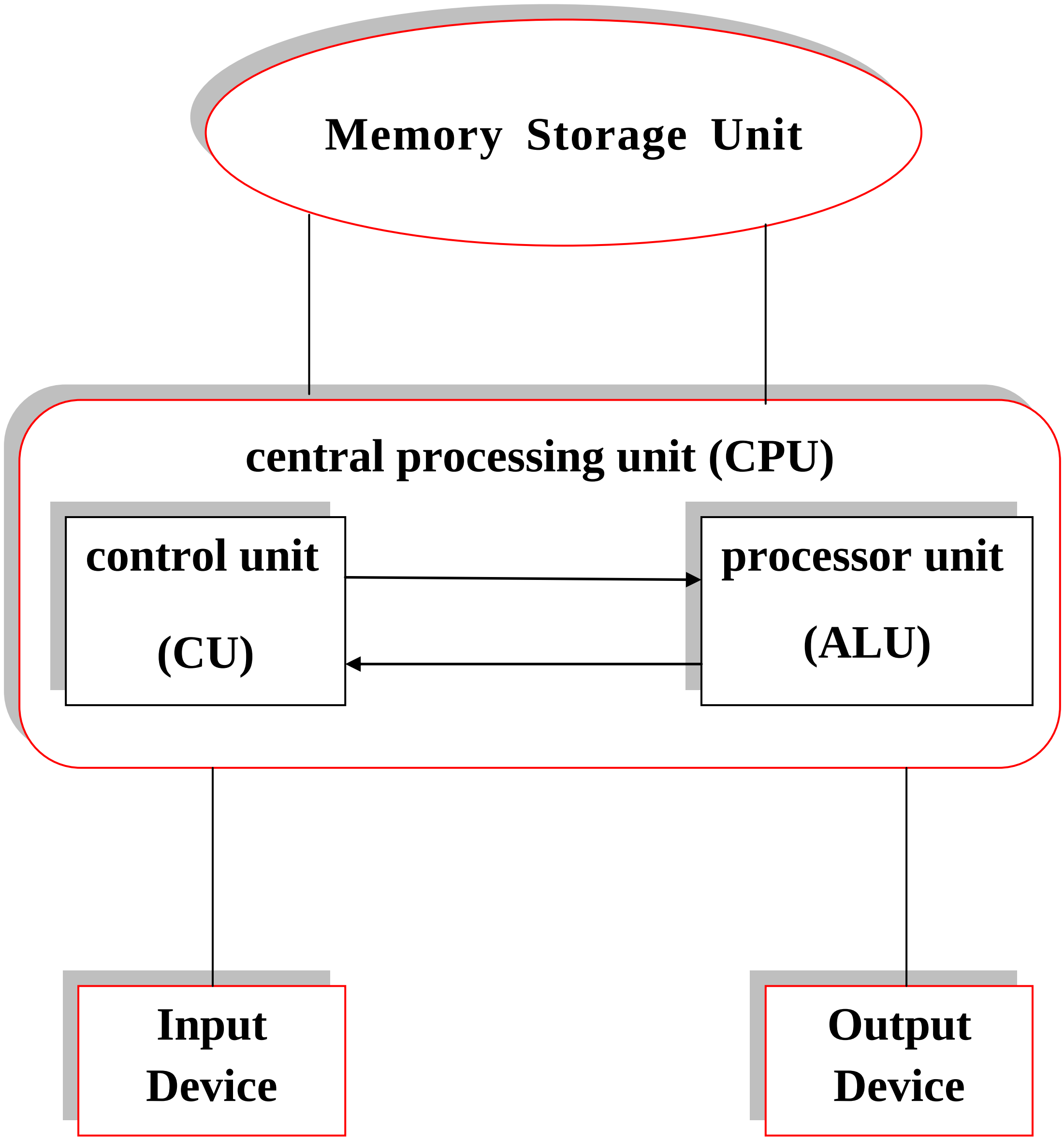
DIGITAL COMPUTER

A block diagram of Digital Computer is show below:



Number Base Conversion

we present a general procedure for converting a decimal number to a number in base r . If the number include a radix point , it is necessary to seperate the number into an integer part and fraction part , Since each part must be converted differently .

Decimal to Binary Conversion :

Example 1 / convert the decimal number (41) to Binary

sol /

integer	reminder		
41	2	1	LSB
20	2	0	
10	2	0	
5	2	1	
2	2	0	
1	2	1	MSB
0			

$$\mathbf{(41)_{10} = (101001)_2}$$

Example 2 / convert the decimal number (153) to Binary

Sol /

integer		reminder	
153	2	1	LSB ↑
76	2	0	
38	2	0	
19	2	1	
9	2	1	
4	2	0	
2	2	0	
1	2	1	MSB
0			

$(153)_{10} = (10011001)_2$

Example 3 / convert the decimal number (50) to Binary

sol /

integer		reminder	
50	2	0	LSB ↑
25	2	1	
12	2	0	
6	2	0	
3	2	1	
1	2	1	
0			
			MSB

$(50)_{10} = (110010)_2$

Example 4 / convert $(0.6875)_{10}$ to Binary

sol /

$0.6875 \times 2 = 1.375$	1	↓	MSB
$0.375 \times 2 = 0.75$	0		
$0.75 \times 2 = 1.5$	1		
$0.5 \times 2 = 1.0$	1		LSB

$(0.6875)_{10} = (.1011)_2$

Example 5 / convert $(25.25)_{10}$ to Binary

sol /

integer		reminder		
25	2	1	↑	LSB
12	2	0		
6	2	0		
3	2	1		
1	2	1		MSB
0				

$0.25 \times 2 = 0.5$	0	↓	MSB
$0.5 \times 2 = 1$	1		LSB

$(25.25)_{10} = (11001.01)_2$

Example 5 / $(28.26)_{10} = (?)_2$

sol /

integer		reminder	
28	2	0	LSB
14	2	0	
7	2	1	
3	2	1	
1	2	1	MSB
0			

$0.26 \times 2 = 0.52$	0	MSB
$0.52 \times 2 = 1.04$	1	
$0.04 \times 2 = 0.08$	0	
$0.08 \times 2 = 0.16$	0	LSB

$$(28.26)_{10} = (11100.0100)_2$$

Binary to Decimal Conversion :

Example / convert Binary numbers to Decimal

1. $(110)_2$
2. $(0.101)_2$
3. $(1010.011)_2$

sol / 1. $(110)_2 = 1\times 2^2 + 1 \times 2^1 + 0 \times 2^0 = 4 + 2 + 0 = (6)_{10}$

2. $(0.101)_2 = 1\times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3} = 0.5 + 0 + 0.125 = (0.625)_{10}$

3. $(1010.011)_2 = 1\times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 0\times 2^0 + 0\times 2^{-1} + 1\times 2^{-2} + 1\times 2^{-3}$
$= 8 + 2 + 0.25 + 0.125$
$= (10.375)_{10}$

NOTE / The conversion from decimal to any base-r- system similar to the previous
. examples , except that division is done by (r) instead of 2

Octal to Decimal Conversion :

$(2374)_8 = (?)_{10}$

$= 2 \times 8^3 + 3 \times 8^2 + 7 \times 8^1 + 4 \times 8^0$

$= 1024 + 192 + 56 + 4 = (1276)_{10}$

$(27)_8 = (?)_{10}$

$= 2 \times 8^1 + 7 \times 8^0$

$= 16 + 7 = (23)_{10}$

Decimal to Octal Conversion :

$(359)_{10} = (?)_8$

359	8	$0.875 \times 8 = 7$
44	8	$0.5 \times 8 = 4$
5	8	$0.625 \times 8 = 5$
0		

$(359)_{10} = (547)_8$

Octal to Binary Conversion :

$(27)_8 = (?)_2$

(010 111)

Binary to Octal Conversion :

(a) 110101 (b) 101111001 (c) 100110011010

sol /

(a) 110 101 $= (65)_8$

6 5

(b) 101 111 001 $= (571)_8$

5 7 1

(c) 100 110 011 010 $= (4632)_8$

4 6 3 2

Binary to hexadecimal Conversion :

(a) 110010100111 (b)111100111100

sol/

(a) $(\underline{1100}\ \underline{1010}\ \underline{0111})_2 = (C57)_{16}$

c 5 7

(b) $(\underline{1111}\ \underline{0011}\ \underline{1100})_2 = (F3c)_{16}$

f 3 c

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hexadecimal to Binary Conversion :

(a) $(10A4)_{16}$ (b)$(CF8E)_{16}$ (c)$(9742)_{16}$

sol/

(a) $(10A4)_{16} = (0001\ 0000\ 1010\ 0100)_2$

(b)$(CF8E)_{16} = (1100\ 1111\ 1000\ 1110)_2$

(c)$(9742)_{16} = (1001\ 0111\ 0100\ 0010)_2$

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hexadecimal to Decimal Conversion :

(a) $(1C)_{16}$ (b)$(A85)_{16}$

sol /

(a)$(1C)_{16} = (0001\ 1100)_2 = 2^4 + 2^3+2^2 = 16+8+4=(28)_{10}$

(b)$(A85)_{16} = (1010\ 1000\ \ 0101)_2 = 2^{11} + 2^9+2^7+2^2+2^0 = (2693)_{10}$

Example / convert the decimal number (650) to hexadecimal

650	16	$0.625 \times 16 = 10$	= A
40	16	$0.5 \times 16 = 8$	= 8
2	16	$0.125 \times 16 = 2$	= 2

$$\mathbf{(650)_{10} = (28A)_{16}}$$

LOGIC GATES

1.Inverter :- The inverter (NOT CIRCUIT) performs the operation called inversion or complementation . The inverter change one logic level to the opposite level . In terms of bits , it changes (1) to (0) and (0) to (1) .

Standard logic symbols for inverter are show below :-

The logic expression is :-

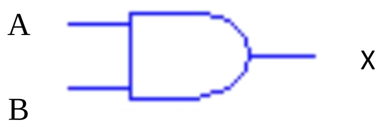
$$\overline{x} = A$$

The truth table is :-

A	X
0	1
1	0

2.AND gate :- The AND gate is one of the basic gates that can be combined to form any logic function . AND gate can have two or more input and performs what is known as a logic multiplication .

The standard logic symbols is shown below :-



The logic expression is :-

$$x = A \cdot B$$

The truth table is :-

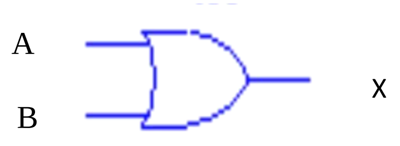
I/P		O/P
A	B	X
0	0	0
0	1	0
1	0	0
1	1	1

The number of possible combinations of binary inputs to a gate is determined by the following formula :-

$$N = 2^n$$

where **N :** is the number of possible input combination .
n : is the number of input variables .

3.OR gate :- The OR gate is another of the basic gates form which all logic function are constructed . An OR gate can have two or more inputs and performs what is known as logical addition .
The standard logic symbols is shown below :-



The logic expression is :-

$$X = A + B$$

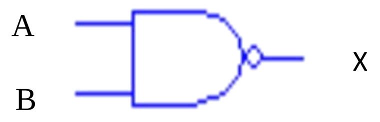
The truth table is :-

I/P		O/P
A	B	X
0	0	0
0	1	1
1	0	1
1	1	1

For two input variable : N= 2^2 = 4 combinations
For three input variable : N= 2^3 = 8 combinations
For four input variable : N= 2^4 = 16 combinations

4.NAND gate :- The NAND gate is a popular logic element because it can be used as a universal gate , That is NAND gate can be used in combination to perform AND , OR and inverter operation .

The standard logic symbols is shown below :-



The logic expression is :-

$$x = \overline{A . B}$$

The truth table is :-

I/P		O/P
A	B	X
0	0	1
0	1	1
1	0	1
1	1	0