UNIT-5

Number system – Binary system – Addition – Subtraction – 1's & 2's Complement method of Subtraction – multiplication – Division – Binary to decimal & decimal to binary conversion.

Number System :-

Number system is a way to represent the numbers in the computer architecture.

There are four different types of the number system, such as :

1. Binary number system (base 2)
2. Octal " " (base 8)
3. Decimal " " (base 10)
4. Hexadecimal " " (base 16)

What is a Binary Number System?

~~Binary number system~~ :-

According to digital electronic and mathematics, a binary number is defined as a number that is expressed in the binary system (or base 2 numeral system.

It describes numeric values by two seperate symbols 1 (one) and 0 (zero).

A single binary digit is called a "Bit."

Binary Numbers Table

Number	Binary Number
1	1
2	10
3	11
4	100
5	101
6	110
7	111
8	1000
9	1001
10	1010

Thousands	Hundred	Tens	ones
Decimal	10^3	10^2	10^1 10^0
Binary	2^3	2^2	2^1 2^0

Addition

Adding two binary numbers will give us a binary number itself. It is the simplest method.

Addition of two single digit binary number is given in the table below.

Binary numbers		Addition
0	0	0
0	1	1
1	0	1
1	1	0 ; carry → 1

For example :-

Add 1101_2 and 1001_2.

Solution :-

$$\begin{array}{r} 1101 \\ 1001 \\ \hline 10110 \end{array}$$

ex :-

$$\begin{array}{r} 0110\ 0100 \\ 0011\ 0010 \\ \hline 1001\ 0110 \end{array}$$

There are four possible cases, both numbers +ve a +ve number and a smaller -ve number a negative number and a smaller the no. and both numbers negative.

Case 1 :-

+83 , +16

+83 ⇒ 0101 0011

+16 ⇒ 0001 0000

$$\begin{array}{r} +83 \\ 16 \\ \hline 99 \end{array} \quad \begin{array}{r} 0101\ 0011 \\ +\ 0001\ 0000 \\ \hline 0110\ 0011 \end{array}$$

01100011

Case 2:

+125, −68

+125 ⇒ 0111 1101

−68 ⇒ 1011 1100

```
  125      0111 1101
+ (-68)  + 1011 1100
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   57    1| 0011 1001
```

⇒ 0011 1001

Case 3:

+37, −115

+37 ⇒ 0010 0101

−115 ⇒ 1000 1101

```
  +37      0010 0101
+ (-115) + 1000 1101
---------  ---------
  -78      1011 0010
```

1011 0010

Case 4: −43, −78

−43 ⇒ 1101 0101

−78 ⇒ 1011 0010

```
  -43      1101 0101
+ (-78)  + 1011 0010
---------  ---------
 -121    1| 1000 0111
```

1000 0111

1 . 1 0 0 1 1

2^{-1} 2^{-2} 2^{3} 2^{2} 2^{1} 2^{0}

Binary to Decimal Conversion

Convert $(1010)_2$ to Decimal equivalent.

Sol:

① $1010_2 = (1\times2^3)+(0\times2^2)+(1\times2^1)+(0\times2^0)$

$1010_2 = 8+0+2+0$

$1010_2 = 10_{10}$

1011.110

② ~~1011.110~~

$1011.110 = (1\times2^3)+(0\times2^2)+(1\times2^1)+(1\times2^0)+(1\times\frac{1}{2})+(1\times\frac{1}{4})+(0\times\frac{1}{8})$

$= 8+0+2+1+.5+0.25+0$

$(1011.110)_2 = (11.75)_{10}$

Decimal to Binary

① $(68)_{10} = ?$

2	68	0
2	34	0
2	17	1
2	8	0
2	4	0
2	2	0
	1	

2	23	
2	11	1
2	5	1
2	2	1
2	1	0
	0	1

$(1000100)_2 = (68)_{10}$ (1011)

② 174_{10} to Binary

$\Rightarrow 10101110_2$

③ $(28.125)_{10} = \underset{?}{\_\_\_\_}_2$

$28 + 0.125$

2	28	
2	14	0
2	7	0
2	3	1
	1	1
	0	

$28 = 11100$

$0.125 \times 2 = 0.250 \quad \lfloor 0$

$0.250 \times 2 = 0.500 \quad \lfloor 0$

$0.500 \times 2 = 1.000 \quad \lfloor 1$

$0.125 = 0.001$

$28.125_{10} = 11100.001_2$