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Number System in Computer Architecture

* Number system -

Number system are the technique to represent numbers in the computer system architecture, every value that you are saving or getting into/from computer memory has a defined number system.

→ Computer architecture supports following number system -

i) Binary number system
ii) Octal number system
iii) Decimal number system
iv) Hexadecimal (hex) number system.

i) Binary number system -

→ A binary number system has only two digits that are 0 and 1.

→ In this system, every number (value) represent with 0 and 1.

→ The base of binary number system is 2, because it has only two digits.

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ii) Octal number system -

→ Octal number has only eight digit from 0 to 7.

→ Every value represents with 0, 1, 2, 3, 4, 5, 6 & 7 in this system.

→ The base of octal number system is 8, because it has only 8 digits.

iii) Decimal number system -

→ Decimal number system has only ten digits from 0 to 9.

→ In this number system, every value represents with 0, 1, 2, 3, 4, 5, 6, 7, 8 & 9.

→ The base of decimal number system is 10, because it has only 10 digits.

iv) Hexadecimal number system -

→ A hexadecimal number system has sixteen alphanumeric values from '0' to '9' and 'A' to 'F'

→ In this system, every value represents with 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D E & F.

→ The base of hexadecimal system is 16.

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Here,

A = 10   E = 14

B = 11   F = 15

C = 12

D = 13

Conversion of Number System

i) Binary into → Octal $( )_8$, Decimal $( )_{10}$, Hexadecimal $( )_{16}$

ii) Decimal $( )_{10}$ into → Binary, Octal, Hexadecimal

iii) Octal $( )_8$ into → Binary, Decimal, Hexadecimal

iv) Hexadecimal $( )_{16}$ into → Binary, Octal, ~~Hex~~ Decimal

* Conversion of Binary to other number system -

i) Binary to decimal -

Eg:- i) $(1\,0\,1)_2 = (\quad)_{10}$

Sol:-

$$\begin{array}{ccc} 1 & 0 & 1 \\ 2 & 1 & 0 \end{array}$$

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

$$= 4 + 0 + 1 = (5)_{10}$$

2) $(10101)_2 = (\quad)_{10}$

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

$$= 16 + 0 + 4 + 0 + 1$$

$$= (21)_{10}$$

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iii) $(11011)_2 = (\ )_{10}$

$= 1\times2^4 + 1\times2^3 + 0\times2^2 + 1\times2^1 + 1\times2^0$

$= 16 + 8 + 0 + 2 + 1$

$= (27)_{10}$ Ans

* Binary to decimal (Fraction part) -

Eg:- 1) $(10100.101)_2 = (\ )_{10}$

$$\begin{array}{ccccccccc} 1 & 0 & 1 & 0 & 0 & . & 1 & 0 & 1 \\ 4 & 3 & 2 & 1 & 0 & & 1 & 2 & 3 \end{array}$$

$= 1\times2^4 + 0\times2^3 + 1\times2^2 + 0\times2^1 + 0\times2^0 + 1\times2^{-1} + 0\times2^{-2} + 1\times2^{-3}$

$= 16 + 0 + 4 + 0 + 0 + \frac{1}{2} + 0 + \frac{1}{8}$

$= 20 + 0.5 + 0 + 0.125$

$= 20 + 0.625 = (20.625)_{10}$

2) $(1110.11)_2 = (\ )_{10}$

$$\begin{array}{ccccccc} 1 & 1 & 1 & 0 & . & 1 & 1 \\ 3 & 2 & 1 & 0 & & 1 & 2 \end{array}$$

$= 1\times2^3 + 1\times2^2 + 1\times2^1 + 0\times2^0 + 1\times2^{-1} + 1\times2^{-2}$

$= 8 + 4 + 2 + 0 + \frac{1}{2} + \frac{1}{4}$

$= 14 + 0.75$

$= (14.0.75)_{10}$

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ii) Binary to octal -

Eg :-

i) $(1001000100001010)_2 = (\quad)_8$

Octal no.		Binary equivalent
0	→	000
1	→	001
2	→	010
3	→	011
4	→	100
5	→	101
6	→	110
7	→	111

Rule -

i) Make group of 3 bits each from right to left -

1 001 000 100 001 010

Add extra 0's to make three bits in the left most group -

001	001	000	100	001	010
↓	↓	↓	↓	↓	↓
1	1	0	4	1	2

$= (110412)_8$ Ans

ii) $(110100101)_2 = (\quad)_8$

110	100	101
↓	↓	↓
6	4	5

$= (645)_8$ Ans

* Binary to Octal (Fractional part) -

Eg:- 10001011111 . 11010 = $(\ )_8$

grouped from right to left ← → group from left to right

i.e - $\underset{2}{\underline{010}}$ $\underset{1}{\underline{001}}$ $\underset{3}{\underline{011}}$ $\underset{7}{\underline{111}}$. $\underset{6}{\underline{110}}$ $\underset{4}{\underline{100}}$

$= (2137.64)_8$

ii) $(110111001.100001)_2 = (\ )_8$

$\underset{6}{\underline{110}}$ $\underset{7}{\underline{111}}$ $\underset{1}{\underline{001}}$. $\underset{4}{\underline{100}}$ $\underset{1}{\underline{001}}$

$= (671.41)_8$ Ans

iii) Binary to hexadecimal -

Eg:- $(1001000100001010)_2$

$= (\ )_{16}$

Rule-1) Make group of 4 bits each from right to left.

$\underset{9}{\underline{1001}}$ $\underset{1}{\underline{0001}}$ $\underset{0}{\underline{0000}}$ $\underset{10(A)}{\underline{1010}}$

$= (910A)_{16}$ Ans

Hexa		Binary
0	→	0000
1	→	0001
2	→	0010
3	→	0011
4	→	0100
5	→	0101
6	→	0110
7	→	0111
8	→	1000
9	→	1001

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Hexa		Binary
10 - A	→	1010
11 - B	→	1011
12 - C	→	1100
13 - D	→	1101
14 - E	→	1110
15 - F	→	1111

ii) $(1110100010111100)_2$

$= (\;)_8$

1110	1000	1011	1100
14(E)	8	11(B)	12(C)

$= (E8BC)_{16}$ Ans

* Fractional part -

$(\cancel{1}1\cancel{0}1\ 1\cancel{1}0\cancel{0}\ 1\cancel{1}0\cancel{1}\ 1\cancel{1}\cancel{0}\cancel{1})_2$

i) $(1101110011011101 \cdot 10110011)_2 = (\;)_{16}$

1101	1100	1101	1101	·	1011	0011
13(D)	12(C)	13(D)	13(D)		11(B)	3

$(DCDD \cdot B3)_{16}$ Ans

* Decimal to other number system -

i) Decimal to Binary -

Eg :- i) $(125)_{10} = (\;)_2$

2	125	
2	62	1
2	31	0
2	15	1
2	7	1
2	3	1
	1	1

$= (1111101)_2$ Ans

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* Fractional part -

Eg:- $(125.65)_{10} = (\ )_2$

Binary of 125 is 1111101

Now, binary of 0.65 -

(सिर्फ fractional वाले पार्ट को 2 से गुणा करना है)

(तब तक गुणा करें जब तक same no. या 0 ना आ जाए)

0.62 × 2 = 1.30
0.30 × 2 = 0.60
0.60 × 2 = 1.20
0.20 × 2 = 0.40
0.40 × 2 = 0.80
0.80 × 2 = 1.60

same

$= (1111101.101001)_2$ Ans

ii) $(20.425)_{10} = (\ )_2$

Binary of 20 -

2	20	
2	10	0
2	5	0
2	2	1
	1	0

$= (10100)_2$

Binary of 0.425 -

0.425 × 2 = 0.850 = 0
0.850 × 2 = 1.700 = 1
0.700 × 2 = 1.400 = 1
0.400 × 2 = 0.800 = 0
0.800 × 2 = 1.600 = 1
0.600 × 2 = 1.200 = 1
0.200 × 2 = 0.400 = 0

Same

$= (10100.0110110)_2$ Ans

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ii) Decimal to octal -

Eg:- i)

8	673	
8	84	1
8	10	4
	1	2

$= (1241)_8$

ii) $(39286)_{10} = (\ )_8$

8	39286	
8	4910	6
8	613	6
8	76	5
8	9	4
	1	1

$= (114566)_8$ Ans

* Fractional -

i) $(673.125)_{10} = (\ )_8$

Octal of 673 = 1241

Now.

Octal of 0.125 -

$0.125 \times 8 = 1.000 = 1$ (Integer part)

$= (1241.1)_8$ Ans

ii) $(423.03125)_{10} = (\ )_8$

Octal of 423 =

8	423	
8	52	7
	6	4

$= (647)_8$

Now octal of .03125 :

$0.03125 \times 8 = 0.250 = 0$

$.250 \times 8 = 2.00 = 2$

$= (647.02)_8$ Ans

iii) Decimal to hexadecimal -

Eg:- 1) $(8234)_{10} = (\ )_{16}$

16	8234	
16	514	10
16	32	2
	2	0

$= 2 \quad 0 \quad 2 \quad 10$

$= (202A)_{16}$ Ans

ii)

16	673	
16	42	1
	2	10

$= 2 \quad 10 \quad 1$

$= (2A1)_{16}$ Ans

Fractional -

Eg:- $(673.125)_{10} = (\ )_{16}$

Hexadecimal of 673 = 2A1

Now,

Hexadecimal of 0.125

$= 0.125 \times 16 = 2.000 = 2$

$\therefore (2A1.2)_{16}$ Ans

ii) $(2863.225)_{10} = (\ )_{16}$

Hexa of 2863 =

16	2863	
16	178	15
	11	2

$= 11 \quad 2 \quad 15$

$B \quad 2 \quad F$

$= (B2F)_{16}$

Now, Hexadecimal of 0.225 =

$= 0.225 \times 16 = 3.6 = 3$

$= 0.6 \times 16 = 9.6 = 9$

$\therefore (B2F.39)_{16}$ Ans

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* Conversion of Octal to other system

i) Octal to ~~binary~~ Decimal-

Eg:- $(2315)_8 = (\;)_{10}$

$= 2\times 8^3 + 3\times 8^2 + 1\times 8^1 + 5\times 8^0$

$= 1024 + 192 + 8 + 5$

$= (1229)_{10}$

ii) $(349)_8 = (\;)_{10}$

$= 3\times 8^2 + 4\times 8^1 + 9\times 8^0$

$= 192 + 32 + 9 \quad = (233)_{10}$

Fractional-

Eg:- $(428\cdot 235)_8 = (\;)_{10}$

$4\times 8^2 + 2\times 8^1 + 8\times 8^0 + 2\times 8^{-1} + 3\times 8^{-2} + 5\times 8^{-3}$

$= 256 + 16 + 8 + 2\times \frac{1}{8} + 3\times \frac{1}{64} + 5\times \frac{1}{512}$

$= 280 + 0\cdot 306640$

$= (280\cdot 306640)_{10}$ Ans

ii) Octal to binary-

Eg:- $(3461)_8 = (\;)_2$

First, convert the above into decimal-

$(3461)_8 = 3\times 8^3 + 4\times 8^2 + 6\times 8^1 + 1\times 8^0$

$= 3\times 512 + 4\times 64 + 48 + 1$

$= 1536 + 256 + 49$

$(1841)_{10}$

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Now, Convert the decimal number into binary -

2	1841	
2	920	1
2	460	0
2	230	0
2	115	0
2	57	1
2	28	1
2	14	0
2	7	0
2	3	1
	1	1

= ~~10111.001~~

$= (11100110001)_2$ Ans

2nd method

ii) $(706)_8 = (\ )_2$

Binary of 7 = 111

0 = 000

6 = 110

$= (111000110)_{10}$ Ans

* Fractional -

$(356.50)_8 = (\ )_2$

$= \underline{011}\ \underline{101}\ \underline{110}\ \underline{101}\ \underline{000}$

3 5 6 5 0

$= (011101110.101000)_{10}$ Ans

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iii) Octal to hexadecimal -

$$(121327)_8 = (\quad)_{16}$$

First of all find its binary -

1 = 001
2 = 010
1 = 001
3 = 011
2 = 010
7 = 111

$= (001010001011010111)_2$

Now make group of '4' right to left -

0000	1010	0010	1101	0111
0	10(A)	2	D	7

$= (A2D7)_{16}$ Ans

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* Conversion of Hexadecimal to other system

i) Hexadecimal to decimal-

Eg:- 1) $(A15)_{16} = (\ )_{10}$

$$\overset{2}{A}\ \overset{1}{1}\ \overset{0}{5}$$

$$= 10 \times 16^2 + 1 \times 16^1 + 5 \times 16^0$$
$$= 2560 + 16 + 5$$
$$= (2581)_{10}$$

2) $1\,2\,C$

$$= 1 \times 16^2 + 2 \times 16^1 + C \times 16^0$$
$$= 256 + 32 + 12 \times 1$$
$$= (304)_{10}$$

* Fractional-

Eg:- $(A15.B)_{16} = (\ )_{10}$

$$\overleftarrow{A15}.\overrightarrow{B}$$

$$A \times 16^2 + 1 \times 16^1 + 5 \times 16^0 + B \times 16^{-1}$$
$$10 \times 256 + 16 + 5 + 11 \times \frac{1}{16}$$
$$= 2560 + 21 + 0.6875$$
$$= (2581.6875)_{10}$$

$(2A1.2)_{16} = (\ )_{10}$

$$= 2 \times 16^2 + 10 \times 16^1 + 1 \times 16^0 + 2 \times 16^{-1}$$
$$= 2 \times 256 + 160 + 1 + \cancel{2} \times \frac{1}{\cancel{16}_8}$$
$$= 512 + 161 + 0.125$$
$$= (673.125)_{10}$$

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ii) Hexadecimal to binary -

Eg:- $(A2D7)_{16} = (\ )_2$

Binary of -

A = 1010   2 = 0010   D = 1101   7 = 0111

$= (1010\,0010\,1101\,0111)_2$

* Fractional -

Eg:- $(E28.C3)_{16} = (\ )_2$

E = 1110 , 2 = 0010 , 8 = 1000

C = 1100 , 3 = 0011

$= (111000101000.11000011)_2$

iii) Hexadecimal to octal -

Eg:- $(A2D7)_{16} = (\ )_8$

First of all find its binary -

A = 1010 , 2 = 0010 , D = 1101 , 7 = 0111

$= (1010001011010111)_2$

Now make group of '3' bits from right to left

$\underset{1}{001}\ \ \underset{2}{010}\ \ \underset{1}{001}\ \ \underset{3}{011}\ \ \underset{2}{010}\ \ \underset{7}{111}$

$= (121327)_8$ Ans

* Airthmetic operation of Number System -

i) Binary ~~air~~ arithmetic -

→ Addition -

Carry	0	0	0	1
Augend	0	0	1	1
Addend	0	1	0	1
Sum	0	1	1	0

carry

$1+1 = 2 \xrightarrow{\text{binary}} 10$

Q $(1101)_2 + (1001)_2$

$$\begin{array}{rl} 1101 & \xrightarrow{\text{Decimal}} 13 \\ +\ 1001 & \xrightarrow{\text{Decimal}} 9 \\ \hline 10110 & \xrightarrow{\text{Decimal}} 22 \end{array}$$

$2 \rightarrow 10$ (1 ↓ carry)

Q $(1011)_2 + (111)_2 + (1011)_2 = (?)_2$

$$\begin{array}{rl} 1011 & \rightarrow 11 \\ 0111 & \rightarrow 7 \\ +\ 1011 & \rightarrow 11 \\ \hline 11101 & \rightarrow 29 \end{array}$$

$4 \rightarrow 100$ (1 ↓ Carry(2))

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Q $(1011.01)_2 + (11.1)_2$

$$\begin{array}{r} \quad 1\ 0\ 1\ 1\ .\ 0\ 1 \\ +\ 0\ 0\ 1\ 1\ .\ 1\ 0 \\ \hline 1\ 1\ 1\ 0\ .\ 1\ 1 \end{array}$$

Ans

→ Subtraction :-

Borrow	0	1	0	0
Minuend	0	0	1	1
Subtrahead	0	1	0	1
Difference	0	1	1	0

Q $(1010)_2 - (110)_2 = (?)_2$

$$\begin{array}{r} 1\ 0\ 1\ 0 \rightarrow 10 \\ 0\ 1\ 1\ 0 \rightarrow 6 \\ \hline 0\ 1\ 0\ 0 \rightarrow 4 \end{array}$$

Ans

Q $(10000)_2 - (1111)_2 = (?)_2$

$$\begin{array}{r} 1\ 0\ 0\ 0\ 0 \\ 0\ 1\ 1\ 1\ 1 \\ \hline 0\ 0\ 0\ 0\ 1 \end{array}$$

Ans

Q $(1011)_2 - ($

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→ Multiplication :-

Multiplicand	0	0	1	1
Multiplier	0	1	0	1
Partial product	0	0	0	1

Product
(Sum of partial product)

Q. $(1010)_2 * (101)_2 = (?)_2$

```
      1 0 1 0
      × 1 0 1
   ----------
      1 0 1 0
    0 0 0 0
  1 0 1 0
 ------------
  1 1 0 0 1 0
```

Ans

Q. $(101.1)_2 * (10)_2$

```
    1 0 1 . 1
        × 1 0
  -----------
    0 0 0 0
  1 0 1 1
  -----------
  1 0 1 1 . 0
```

Ans

→ Division -

Q.
```
101 ) 110010 ( 1010
      101
      -----
      00101
        101
      -----
        000
```

Q.
```
1010 ) 110010 ( 101
       1010
       ------
       001010
         1010
       ------
         0000
```

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ii) Octal arithmetic -

→ Addition -

Q $(166)_8 + (76)_8 = (?)_8$

When it is greater than 8 & equal to 8 then subtract 8.

It is used one time means carry one

$$\begin{array}{r} 1\ 1\ \\ 1\ 6\ 6 \\ +\ \ 7\ 6 \\ \hline 2\ 6\ 4 \end{array}$$

Steps -

i) $6+6 = 12-8 = 4$

ii) $1+6+7 = 14-8 = 6$ (and 1 carry)

iii) $1+1 = 2$

Q $(16.5)_8 + (7.6)_8$

$$\begin{array}{r} 1\ 1\ \ \ \\ 16.5 \\ +\ \ 7.6 \\ \hline 26.3 \end{array}$$

Ans

$5+6 = 11-8 = 3$ (and 1 carry)

$1+6+7 = 14-8 = 6$ (1 carry)

→ Subtraction -

Q $(76.2)_8 - (66.6)_8$

$$\begin{array}{r} 5\ \ \ \ \\ 7\ 6\ .\ 2 \\ -\ 6\ 6\ .\ 6 \\ \hline 0\ 7\ .\ 4 \end{array}$$

Ans

Steps -

i) 2 borrow 8 from 6 then 2 (2+8) becomes 10 i.e $10-6 = 4$

ii) 6 becomes 5

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iii) Hexadecimal arithmetic :-

→ Addition -

Q $(1F)_{16} + (2A)_{16} = (?)_{16}$

greater than 16 then subtract 16

$$\begin{array}{r} \overset{1}{1}\ F \\ +\ 2\ A \\ \hline 4\ 9 \\ \hline \end{array}$$

$F(15) + A(10) = 25 - 16 = 9$
1 carry

Ans

Q $(29)_{16} + (17)_{16} = (?)_{16}$

$$\begin{array}{r} \overset{1}{2}\ 9 \\ +\ 1\ 7 \\ \hline 4\ 0 \\ \hline \end{array}$$

$9 + 7 = 16 - 16 = 0$
1 carry

Ans

Q $(28)_{16} + (17)_{16}$

$$\begin{array}{r} 2\ 8 \\ 1\ 7 \\ \hline 3\ F \\ \hline \end{array}$$

$8 + 7 = 15 \rightarrow F$

Ans

Q $(A)_{16} + (6)_{16} \rightarrow (?)_{16}$

$$\begin{array}{r} ^{1}A \\ +\ 6 \\ \hline 1\ 0 \\ \hline \end{array}$$

$A \rightarrow 10 + 6 = 16 - 16 = 0$
1 carry

Ans

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→ Subtraction -

Q $(A\,2)_{16} - (96)_{16}$

9 → 2+16 = 18

A 2
− 9 6

X C

2 borrow 16 from A and A(10) become 9.

18 − 6 = 12 (C)

Q $(102)_{16} - (FF.F)_{16} = (?)$

(16)

1 0 2 . 0
F F . F

0 0 2 . 1

* Complements of numbers -

i) Base value ii) Largest value

→ Complements of decimal number system -
i) 9's complement
ii) 10's complement

→ Complements of Binary number system -
i) 1's complement
ii) 2's complement

Q $(56)_{10}$ < ? 9's complement / ? 10's complement

(9's complement)
Rule → given no. = 56 (two digit)
→ largest value of two digit in decimal = 99
then subtract (99 − 56)

9's complement = 99 − 56 = 43
10's complement = 43 + 1 = 44

→ (For 10's, just add '1' to the 9's)

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Q. Find 9's & 10's compement of decimal no. 1265.45

9's complement = 9999.99
− 1265.45
8734.54

10's complement : 8734.54 +
+ 1
8734.55 Ans

Q. $(1011)_2$ → ? 1's complement
→ ? 2's complement

1's complement = 1111 → largest value of 4 digit in binary form
− 1011
0100 Ans

2's complement = 0100
1
0101 Ans

Trick for 1's complement of binary no. → Just exchange 1 with 0 & 0 with 1

Q. Find 1's & 2's complement of binary no- $(10101001.1001)_2$

1's complement = 01010110.0110 Ans

2's complement = 01010110.0110
1
01010110.0111 Ans

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* Subtraction ~~in~~ using 1's complement -

Rule

i) No. of bits must be equal of minuent and subtrahead.

ii) Find complement (1's) of subtrahead

iii) Add the minuend with complemented subtrahead

iv) Check, did you find carry at most significant -

If yes - then ~~find~~ add the carry to the sum, the result will be +ve.

Else - Find complement of sum, the result will be -ve.

Q $(1011)_2 - (0111)_2$

1's complement of subtrahead (0111) is 1000

Sum of minuend (1011) & complemented subtr (1000)

```
 1 1011
   1000
 ------
  10011
```

Here we found carry at most significant, so add the carry to the sum, therefore result will be +ve.

```
        0011
           1
        ----
(+ve)   0100
```

Ans

Q $(10111)_2 - (1011)_2$

1's complement of subtr (01011) - 10100

```
   10100
 + 10111
 -------
  101011   (Here we found carry)
```

01011 + 1 = 01100 (+ve)

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* $(10011.1)_2 - (01101.01)_2$ using 2's complement

Step-1 2's compl of subtrahend (01101.01)

$= 10010.10 \rightarrow$ 1's
$+1$
$10010.11 \rightarrow$ 2's

Step-2 - Find sum of minuend & complemented subtrahend -

$$\begin{array}{r} 10011.10 \\ 10010.11 \\ \hline 100110.01 \end{array}$$

Step-3 Here we found carry in sum at M.S.B so, ignore the carry, therefore the result will be +ve.

$: \cancel{1}00110.01$

$= (110.01)_2$

Q $(01101.01)_2 - (10011.10)$ using 2's -

Step-I 2's compl. of subt - (10011.10)

$01100.01 \rightarrow$ 1's
$+1$
$01100.10 \rightarrow$ 2's

Step-2

$$\begin{array}{r} 01101.01 \\ 01100.10 \\ \hline 11001.11 \end{array}$$

~~Here we not found carry so, find 2's comp of the sum. Therefore final result will be -ve~~

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Sum : 11001.11
1's : 00110.00

2's : 00110.01 : $(110.01)_2$ Ans

Q. $(1101.01)_2 - (101)_2$ using 1's complement -

~~0101~~ $(1101.01)_2 - (0101.00)_2$ (No. of bits are same)

Step - I $(0101.00)_2 \xrightarrow[1's]{} 1010.11$

Step - II -

```
  1010.11
  1101.01
 ---------
 11000.00
```

(Found carry at M.S.B)

Step - III -

```
  1000.00
        1
 ---------
  1000.01
```

(+ve value)

Q. $(0101.00)_2 - (1101.01)_2$ using 1's complement ?

$1101.01 \xrightarrow[1's]{} 0010.10$

```
~~0.0~~  0010.10
       + 0101.00
       ---------
         0111.10
```

(Here we not found carry so find 1's comp of sum)

$0111.10 \rightarrow 1000.01$ (-ve value)

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* BCD code - (Binary coded decimal) -

In this code each digit of a decimal number system is converted into its binary equivalent instead of converting the entire decimal value.

We use group of 4 bits to represent a digit in BCD. 4 bits represent only digits because 4 bits are insufficient to represent various characters used by the computer.

Eg:- Find the BCD code of 321.

3	2	1
↓	↓	↓
0011	0010	0001

After combining - 001100100001 (BCD)

* EBCDIC code (Extended Binary coded Decimal Interchange code).

In this code, it is possible to represent 256 (2^8) different characters. It is a 8 bit code developed by IBM.

→ It has two types of format -
i) Zoned Decimal Format.
ii) Packed " "

* ASCII (American Standard code for Information Interchange) -

It is accepted by several computer manufacturers as their computer's internal code.

Trick - 64 + No. of Uppercase Char → gives ASCII / Eg :- 64 + C = 64 + 3 = 67

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This code is popular in data communication. It is used to represent data internally in micro computers.

→ ASCII is of two types -

i) ASCII-7 → 7 bit code → 2^7 = 128 character

ii) ASCII-8 → 8 bit code → 2^8 = 256 "

* ASCII value of -

A = 65 , B = 66 , C = 67 ------- Z = 90 (Upper case)

a = 97 , b = 98 , c = 99 ----- z = 122 (lower case)

0 = 48 , 1 = 49 , 2 = 50 ----- 9 = 57 (digit)