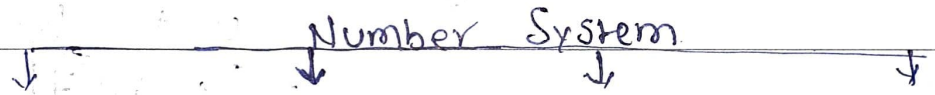
Number System

Debination of number System:-

In digital electroni
The number system is used for representing the information.

The number system has dibberent bases and the most common of them are Decimal, binary, octal and hexa decimal number system.

type of number System



Binary Decimal octal Hexadecimal

* Binary number System:-

In binary number System we have representing only two digits 0's and is, Computer represents all kinds of data and information in binary number it includes audio, graphic, video, text and numbe

→ The base of number system is two. and the rang

0 to (r-1)

0 to (2-1)

⇒ 0 to 1

* Decimal number System:-

In decimal number system we have representing in ten digits (0.....9) range = 0 to (r-1)

= 0 to (10-1)

= 0 to 9

* Octal number System:

In octal number system we have representing in 8 digits (0.....7) range = 0 to (r-1)

0 to (8-1)

= 0 to 7

The base of octal number system is 8

* Hexa decimal number system:-

In Hexadecimal number system we have representing in sixteen digits (0---15)

range = 0 to (r-1)

= 0 to 15

→ This number system base is 16.

10 - A

11 - B

12 - C

13 - D

14 - E

15 - f

Conversion from one to another no. System.

- There are various type of Conversion in number system. like (i) decimal to binary
  (ii) decimal to octal
  (iii) decimal to Hexadecimal
  (iv) binary to decimal
  (v) binary to octal
  (vi) binary to Hexadecin
  (vii) octal to binary
  (viii) Hexa to binary

* Decimal to binary:-

In decimal to binary Conversion we have dividing the decimal number by 2. until the Quotient of 0 is obtained.

The binary number system is obtem by taking the number after each division in the revese order.

It means that, we have written MSB value first. (Most singibicent bit) till to LSB

$(53.065)_{10}$ step 1

2	53	1
2	26	0
2	13	1
2	6	0
2	3	1
	1	

$53 = 110101$

0	0.065	0	0.04
	×2		×2
	0.130		0.08
0		0	
	×2		×2
	0.26		0.16
0		0	
	×2		×2
	0.52		0.32
1		0	
	×2		×2
	1.04		0.64
		1	
			×2
			1.28

Step 1 The integer is 53 and the fraction value 0.5

$(53.5)_{10}$

Step 2 integer Conversion by dividing 2 we get $(110101)_2$

Step 3 fraction Coversion of the decimal no fraction is binary equivalent the obtained by multiply by 2 Countiniously and recording the Carry in the integer position each time the Carries in forword order give the require number system.

$$\begin{array}{r} 0.5 \\ \times 2 \\ \hline 1.0 \end{array}$$

$= (1)_2$

Step 4 So, we get fraction result of 0.5 is as blow

$(.1)_2$

Step 5 The Combination number will give the binary equivilent as

$53.5 = (110101.1)_2$

Step 1: To Convert the binary number to decimal number to use multiple method.

In this Conversion process is the no with base (n) has to be Converted into the a number with base 10 then each digit of

Step: $(1101.11)_2$

$$1\times2^0+0\times2^1+1\times2^2+1\times2^3.\ 1\times2^{-1}+1\times2^{-2}$$
$$= 1+0+4+8.\ 0.5+0.25 = \boxed{13.75}$$

Step: Thus the eqt decimal number for given binary numbes is $(13.75)_{10}$

Step2: In binary to decimal Conversion we have multiply the given number by the base value which is 2 and we have multiplying integer number from left to right and multiplying the fraction no from Right to left

* Octal to binary:-

Method

Conversion from octal to binary and vice versa can be easily carried out for obtaining the binary eqt of octal number each significant bit / digit in the given number is replaced by its three bit binary equt.

for eg:- $(376)_8 = \underset{011}{3}\ \underset{111}{7}\ \underset{110}{6}$

$= (011\ 111\ 110)_2$

Method II

Step1: In this method firstly we have Convert the given number to decimal number

$(68)_8 = 6\times8^1 + 8\times8^0 = (56)_{10}$

Step2: Then we have Convert the ~~dec~~ obtaining decimal nu. into binary number by dividing 2. So

So,

2	56	
2	28	0
2	14	0
2	7	0
2	3	1
	1	1

$= (111000)_2$

* Hexadecimal to binary :- / binary to hexadecimal

Step 1: Conversion from hexadecimal to binary vice versa can be easily carried out from obtaining the binary eqt of hexadecimal each significant digit in the given number is replaced by it 4 bits eqt :

$$(205)_{16} = \underset{0010}{2} \; \underset{1101}{D=13} \; \underset{0101}{5}$$

$$= (001011010101)_2$$

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* Binary Addition:-

Step1: two binary no. can be add in the same way as two decimal no are added. The addition is carried out form the LSB and it proceeds to higher significient bit. adding the carry resulting from previous addition each time.

Eg:- $15 + 10 = (25)_{10}$

$1111 + 1010 =$

MSB → 1111 ← LSB

$$\begin{array}{r} 1111 \\ 1010 \\ \hline 11001 \end{array}$$

Step1: The LSB are added i.e $0+1 = 1$ with Carry 0

Step2: The Carry in the previous state added to the next MSB ie $0+1+1 = 0$ with Carry '1'

Step3: The carry in the above step is added to the next MSB ie $1+1+0 = 0$ with Carry 1

Step4: The preceding Carry is added to the MSB ie $1+1+1 = 1$ with Carry 1

Step5: Thus the sum is 11001, the addition is also shown in the decimal no syste

in order to Compare to result

10+15 = 25 = 11001

N	add	Carry
0+0	0	0
1+0	1	0
0+1	1	0
1+1	0	1

Binary Subtraction :-

⇒ It is also carried out in the same way as decimal no. are subtract. The subtraction is carried out from the LSB and proceed to MSB. When 1 is subtracted from 0, 1 is brow from 0 immediate higher significant bit.

Eg :-

```
MSB ↑        1101 → LSB
             1001
            ------
             0100
```

```
MSB          1001  LSB
           - 0111
            ------
             0010
```

Subtraction table

N	sub	borrow
0 - 0	0	0
0 - 1	1	1
1 - 0	1	0
1 - 1	0	0

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Data Representation

- Magnitude
  - unsigned (+)
  - Signed (+,-)
- Complement
  - 1's complement
  - 2's complement

* Signed binary representation :-

Binary numbers are represented with a spereate sign bit along with the magnitude.

For Example:- In 8-bit binary number the MSB is the sign bit and the remaining 7-bit correspond the magnitude.

Eg:- 13 = 11001

(0) 11001 = +ve

(1) 11001 = -ve

(1) ← sign, 11001 ← magnitude

Code

↓ Weitted / Weithed — Eg:- binary, decimal, BCD

↓ Nonweitted — Eg:- Excess, Gray

→ Code is the Symbolic representation or descrite information which may represent number, letter or physical Quintity

→ the symbols used are binary digit which are arranged according to rule or Code.

* Weighted binary Code:-

Weighted binary, weighting code obey their positional ~~weiting~~ priciple Each position or number represent a Specific weight.

Eg:- Binary, decimal, BCD

* Nonweighted Code:-

It are Codes that are not positionaly weighted these mean that each position within binary no. is not assigned a fix value.

for Eg:- Excess-3, Gray

Decimal	BCD	Excess-3
	8 4 2 1	+3 $(11)_2$
0	0 0 0 0	0 0 1 1
1	0 0 0 1	0001 + 0011 = 00100
2	0 0 1 0	0010 + 0011 = 00101
3	0 0 1 1	0011 + 0011 = 0110
4	0 1 0 0	0100 + 0011 = 0111
5	0 1 0 1	0101 + 0011 = 1000
6	0 1 1 0	0110 + 11 = 1001
7	0 1 1 1	0111 + 11 = 1010
8	1 0 0 0	1000 + 11 = 1011
9	1 0 0 1	1001 + 11 = 1100
10	00010000	00010000 + 11 = 00010011
11	00010001	00010001 + 11 = 00010100

* BCD :- / 8 4 2 1 :

The full form of BCD is Binary Coded decimal.

The BCD is used the binary number system Specific the decimal no 0 to 9.

→ It has four-bits.

→ The weights are arrange according to the position occoupied by this digits. The weight of the first position is $2^0 = 1$, second is $2^1 = 2$, third $2^2 = 4$ forth - $2^3 = 8$.

Reading from left to Right the weight are 8-4-2-1 hence it's called 8421

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* Excess-3 :-

As the name indicate the Excess-3 represented are decimal no in binary borm as a number greater than three.

A Excess-3 Code is obainted by adding through are decimal no.

Eg: $5 + 3 = 8$

$5 = 0101$

$3 = 0011$

$8 = 1000$

* Cray Code :- and binary Code :-

Decimal	Binary	Cray
1	0001	0001
2	0010	0011
3	0011 → 3bit	0010 → always
4	0100 change	0110 → 1bit
5	0101	0111 changes
6	0110	0101
7	0111	0100
8	1000	1100
9	1001	1101
10	1010	1111
0	0000	0000
11	1011	1110

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* Gray Code:-

The gray code belong to a class of code called minimum change code In which only one bit inthe code group changes when moving brom one step to Next step.

-> The gray is a nonweighted code.

-> Therebore it is not suteable bor arithmatic operation.

-> gray code is reblective digit code which has a special properite of containing two ~~exce~~ adjecent code number that dibber by only one-bit. Therebore it is called unit distance ~~code~~.

* Conversion brom binary to Gray Code.

(*) A binary can be converted into its gray code when

(i) The birst bit (MSB) of the gray code is the same as the birst bit of binary number

(ii) The second bit of gray code equals the Ex-OR of the birst and second bit of the binary no that is it will be one if the binary code bit are dibberen and 0 if they are same.

(iii) The third gray code bit equals to Ex-OR of the second and third bit of the binary number.

Eg:- $B_3\ B_2\ B_1\ B_0$ B = binary Code

$g_3\ g_2\ g_1\ g_0$ g = gray code

$g_3 = B_3$

$g_2 = B_3 \oplus B_2$

$g_1 = B_2 \oplus B_1$

$g_0 = B_1 \oplus B_0$

* Conversion from Gray to Binary

Conversion of gray code to Binary in binary involes the following steps:-

(i) The first binary bit (MSB) is the same as the gray code (MSB) bit

(ii) If the second gray bit is 0 the second binary bit is the same as that of first binary. if the second gray bit is one the second binary bit is the inverse of the first binary bit

(iii) Step 2 is repeated each successive bit

Eg: $B_3 B_2 B_1 B_0$: (B = binary no.)

$g_3 g_2 g_1 g_0$: (g = gray code.)

→ $B_3 = g_3$

→ $B_2 = B_3 \oplus g_2$

→ $B_1 = B_2 \oplus g_1$

→ $B_0 = B_1 \oplus g_0$

Gray $g_3 g_2 g_1 g_0$	Binary $B_3 B_2 B_1 B_0$
0 0 0 0	0 0 0 0
0 0 1 0	0 0 1 0
0 1 1 0	0 1 0 0
1 0 0 1	1 0 0 1
1 1 0 1	1 0 0 1
1 1 1 0	1 0 1 0
1 1 1 1	1 0 1 0