Binary Number System

Binary Number System is the most important number system in the context of computer.

Number System

In the Number System, we generally have the numbers on the basis of which we perform the calculations.

Decimal → 0 – 9 Dec (Base 10)
10 dig 10

Binary → 0 – 1 Binary (Base 2)
2 dig 2

Octal → 0 – 7 Octal (Base 8)
8 dig 8

Hexadecimal → 0 – 15 Hexa decimal (Base 16)
0–9 – A, B, C, D, E, F 16
10, 11, 12, 13, 14, 15

Conversions

① → Decimal to Binary

For Example

42

$$\begin{array}{r|l} 2 & 42 \\ 2 & 21 - 0 \\ 2 & 10 - 1 \\ 2 & 5 - 0 \\ 2 & 2 - 1 \\ & 1 - 0 \end{array}$$

$(101010)_2$

Binary to Decimal

$(101010)_2$

$2^5 + 2^4 + 2^3 + 2^2 + 2^1 + 2^0$

$32 + 16 + 8 + 4 + 2 + 1$

check which one is ON/OFF

OR

$1 \times 32 + 0 \times 16 + 1 \times 8 + 0 \times 4 + 1 \times 2 + 1 \times 0$

$= 32 + 8 + 2$

$= 42$

A simple logic for Binary conversion as well :-

$42 - 32 = 10 - 8 = 2 - \cancel{2} = 0$

As we know some spaces will be occupied by it

2^6

$2^5 \ 2^4 \ 2^3 \ 2^2 \ 2^1 \ 2^0$

64	32	16	8	4	2	1
Big	✓	Big	✓	Big	✓	0
✗	1	0	1	0	1	0

→ $(101010)_2$

Can be verified as well.

Code logic

Decimal to Binary

```
decnum
ans=0 → Binary Number
pow=1 → 10^0 → 10^1 → 10^2 – 10^3
 while(decNum >0){
 rem = decNum % 2
 decNum= decNum/2
 ans+ = (rem * pow)
 pow = pow * 10
   }
   ans
```

Binary to Decimal

```
binum= binary Number given
ans=0
 pow= 1/2^0
while(binnum >0){
  rem = binnum % 10
  ans+ = binnum * pow
    binnum/= 10
     pow *= 2
      }
     ans
```

Two's Complement

As we know int takes 4 bytes

- int → 4 bytes → 8 bits = 1 byte → 32 bits.

int n = 10 — $(1010)_2$

In memory

$\underbrace{\hspace{6cm}}$ 32 bits (Allocated

In case of +ve number ———— 1010

int n = -10

In the backend

① Binary

10 = (1010)

② Prefix with a zero

01010

↓

Most Significant (MS)

MS → 0 → +ve

MS → 1 → -ve

③ 1's Complement

0 → 1 1 → 0

01010

10101

④ Now Added 1

$$\begin{array}{r} 10101 \\ 1 \\ \hline (10110)_2 \end{array}$$

Final form to be stored

$(10110)_2$

Now, we must know that the particular binary form is of a negative number.

So,

10110

① 1' complement

01001

0(1001)

└ Extracting it as it represents the direction.

$$\begin{array}{r} 01001 \\ +1 \\ \hline 01010 \end{array}$$

0(1010) → $(10)_{10}$

$(-10)_{10}$