# Topics to discuss

- Introduction of bits and Representation.
- Convert decimal to binary
- Convert binary to decimal
- Representation of Negative number in binary
- Most Significant bit & least significant bit
- Range of Int

## What is bit ?

→ A bit (binary digit) is a smallest unit of data that a computer can process and store.

We know,

int ⟶ 4 byte

1 byte ⟶ 8 bit

4 byte / int ⟶ 4x8 = 32 bit.

A bit can hold only one of two values either 0 or 1.

```
int a = 10 ;
```

How to represent 'a' in binary or 32 bit format.

a = 10 10

$$a = (10)_{10} = (1010)_2$$

**Compiler** : A compiler translate high level programming Language source code into machine code or binary code without changeing its meaning.

① $a = (10)_{10}$ convert this into binary.

| 2 | 10 | |
|---|---|---|
| 2 | 5 | 0 |
| 2 | 2 | 1 |
| | 1 | 0 |

$a = (1010)_2$

In 32 bit representation,

$a =$ 0 0 0 0 0 ..... 1 0 1 0

28 bit | 4 bit

$0^{th}$ bit

$1^{st}$ bit

$31^{st}$ bit

② $a = (1010)_2$ , Convert this into decimal.

| 1 | 0 | 1 | 0 |
|---|---|---|---|
| $2^3$ | $2^2$ | $2^1$ | $2^0$ |

$= (1 \times 2^3) + (0 \times 2^2) + (1 \times 2^1) + (0 \times 2^0)$

$= 8 + 2$

$= (10)_{10}$

③ $a = (-45)_{10}$ , convert into binary.

Step 1 : Convert $+a$ into binary

Step 2 : find 1's complement of $+a$.

Step 3 : find 2's complement.

| | | |
|---|---|---|
| 2 | 45 | |
| 2 | 22 | 1 |
| 2 | 11 | 0 |
| 2 | 5 | 1 |
| 2 | 2 | 1 |
| | 1 | 0 |

$a = (1\,0\,1\,1\,0\,1)_2$ , Assume 8 bit binary

$a = 0\,0\,1\,0\,1\,1\,0\,1$

1's complement $= 1\,1\,0\,1\,0\,0\,1\,0$

2's complement = (1's complement) + 1

$$\begin{array}{r} 1\,1\,0\,1\,0\,0\,1\,0 \\ \qquad\qquad\qquad\quad 1 \\ \hline 1\,1\,0\,1\,0\,0\,1\,1 \end{array}$$

Ans = $(-45)$ = $1\,1\,0\,1\,0\,0\,1\,1$

④ $a = 11001011$ , Assume 8 bit binary convert into decimal.

Ans: Since it is 8 bit binary, so most significant bit (MSB) is 1.
It indicates number is negative.

for, $a = 1\ 1\ 0\ 1\ 0\ 0\ 1\ 1$

$\overline{2^7}\ \overline{2^6}\ \overline{2^5}\ \overline{2^4}\ \overline{2^3}\ \overline{2^2}\ \overline{2^1}\ \overline{2^0}$

$a = -2^7 + 2^6 + 2^4 + 2^1 + 2^0$

$= -128 + 64 + 16 + 2 + 1$

$= -128 + 85$

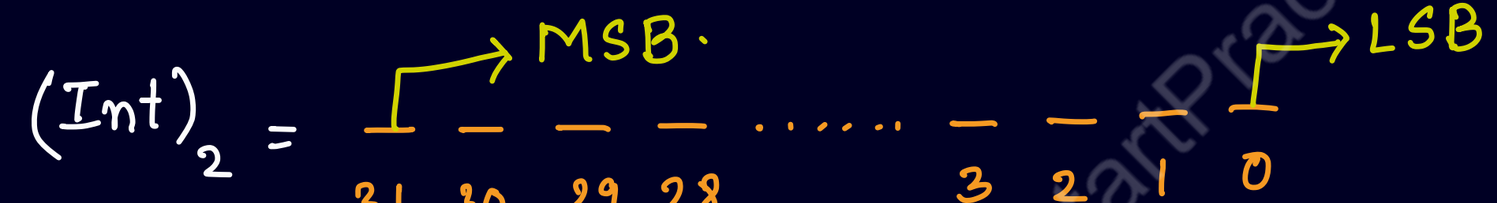
$= -45$

# Most Significant Bit (MSB) and Least Significant Bit (LSB)

In 32 bit binary representation,

$0^{th}$ bit position is LSB and

$31^{st}$ bit position is MSB.



$$(Int)_2 = \underbrace{\_\ \_\ \_\ \cdots\cdots\ \_\ \_\ \_\ \_}_{31\ 30\ 29\ 28 \qquad\qquad 3\ 2\ 1\ 0}$$

MSB → (leftmost bit) LSB → (rightmost bit)

$$(GP)_{sum} = \frac{a\cdot(r^n-1)}{r-1}$$

$$= 2^{31} + 2^{30} + 2^{29} + 2^{28} + \cdots\cdots + 2^2 + 2^1 + 2^0$$

$$= (2^0 + 2^1 + 2^2 + \cdots\cdots + 2^{30})$$

$$= \frac{1 \times (2^{31} - 1)}{2-1}$$

$$= 2^{31} - 1$$

$$\boxed{2^{31} > 2^{31} - 1}$$

$$MSB = \begin{cases} 0, & \text{no. is +ve} \\ 1, & \text{no. is -ve} \end{cases}$$

For 32 bit binary representation,

0 → unset bit

1 → set bit

Min. number = 1 0 0 0 0 .... 0 0 0 0

$$= -2^{31}$$

Max. number = 0 1 1 1 1 .... 1 1 1 1

$$= 2^{30} + 2^{29} + 2^{28} + \dots + 2^2 + 2^1 + 2^0$$

$$= 2^0 + 2^1 + 2^2 + \dots + 2^{30}$$

$$= \frac{1 \cdot (2^{31} - 1)}{2 - 1}$$

$$= 2^{31} - 1$$

Range of int is $-2^{31}$ to $2^{31} - 1$

## Follow Now

Start Practicing

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