C++

int, ~~float~~, do~~ub~~le, char, long long, unsigned ······,

1B = 8bit ← binary digit

int ⟶   1B → 2^8

int a;   4B → 2^{32}

$\underline{1 bit}$ $\underline{3 bit}$
0   ☐☐☐
1   0 0 0
          1 1 1

$\underline{2bit}$
00 → 0 $2 \times 2 \times 2 = 2^3$
01 → 1
10 → 2
11 → 3

$$\left[0 \backsim 2^{32} - 1 \right]$$

int a; $\boxed{2^2}$ ⟶ $[0, 2^2 - 1]$

2^{32}
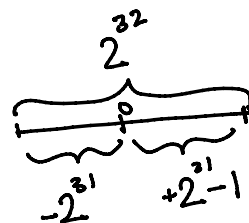
-2^{31} $+2^{31}-1$

0, 1, 2, 3

-3 -2 -1   0 +1 +2 +3 ⟶ $[-2^{①}, 2^1 - 1]$

(actual) $[-2^{31}, 2^{31}-1]$

── o ──

Overflow

$[-2^3, 2^3-1] \to [-8, 7]$

sint a = 0 .

a += 5 ;

0
15   1
14   2
13   3

-3 -2 -1 0 1
-4   2
          3

a += 5;
a += 6;
a += 5;
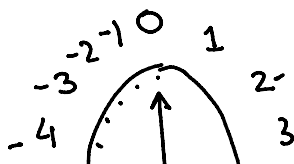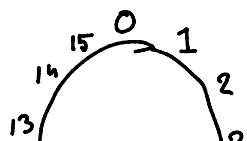
int a;
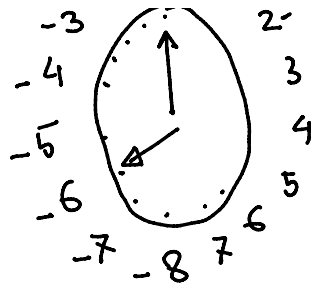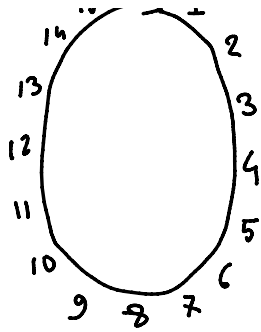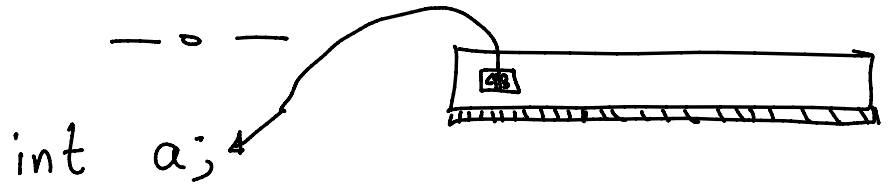
cout << a;

— o —

$f(\text{input}) = \text{output}$

Bit representation:

1B

$$O\ O\ O\ O\ O\ O\ O\ O$$

1 left shift
$$n \xrightarrow{\hspace{1cm}} 2n$$

$O\ O\ O\ O\ O\ 1\ O\ O \rightarrow 4$

$O\ O\ O\ O\ 1\ O\ O\ O \rightarrow 8$

2 LS
$$\xrightarrow{\hspace{1cm}} 2(2n)$$
$$4n$$

$O\ O\ O\ 1\ O\ O\ O\ O \rightarrow 16$

$O\ O\ O\ 1\ O\ 1\ O\ 1 \rightarrow 21$

3 LS
$$\xrightarrow{\hspace{1cm}} 2(2(2n))$$
$$8n$$

$O\ O\ 1\ O\ 1\ O\ 1\ O \rightarrow 42$

$O\ 1\ O\ 1\ O\ 1\ O\ O \rightarrow 84$

$1\ O\ 1\ O\ 1\ O\ O\ O \rightarrow 168$

$$\boxed{n \xrightarrow{k\,LS} (2^k)n} \longrightarrow$$

$$(n, k) \xrightarrow{n << k} (2^k) \cdot n$$

$$(1, k) \xrightarrow{1 << k} (2^k)$$

$$(1 << k) \rightarrow 2^k$$

$$k \xrightarrow{1 << k} 2^k$$

$O\ O\ O\ O\ O\ O\ O\ 1 \rightarrow 1$

$O\ O\ O\ O\ 1\ O\ O\ O \rightarrow 2^3$

o o o o o o o , . .

o o o o 1 o o o → 2^3

1 o o o o o o o o

---

o o o o o o o 1

o o o 1 o o o o

_____

Is n a power of 2 ?

(10)
↓

1, 2, 4, 8, 16

```
int n;
cin >> n;
int currValue = 1;
int found = 0;
for (int i=0; i<31 ; i++)
{  if (currValue == n)
   {
       found = 1;
       break;
   }
   currValue *= 2;
}
if (found) ──→ YES
else ──────→ NO
```

```
  1 0 0 0 0 0
& 0 1 1 1 1 1
_____
  0 0 0 0 0 0
```

$(n \,\&\, (n-1) == 0)$ ──→ YES

↳ NO

int n;

c_1 && c_2

c_1	c_2	c_1 && c_2
0	0	0
0	1	0
1	0	0
1	1	1

```
cin >> n;
if ( n & (n-1) == 0)  → YES
                      → NO
```

→ true/false

&& → conditional AND

& → bitwise AND

c_1 & c_2 → int

$\underbrace{010110}$ $\underbrace{101010}$

```
  010110
  101010
 ─────────
  000010
```