# Number

ASCII

Integer

$(5)_{10} \rightarrow (101)_2$

Floating point

$(10.23)_{10} \rightarrow (\_\_\_.\_\_\_)_2$

Characters

A - 65

B - 66

a - 97

# Decimal — Binary

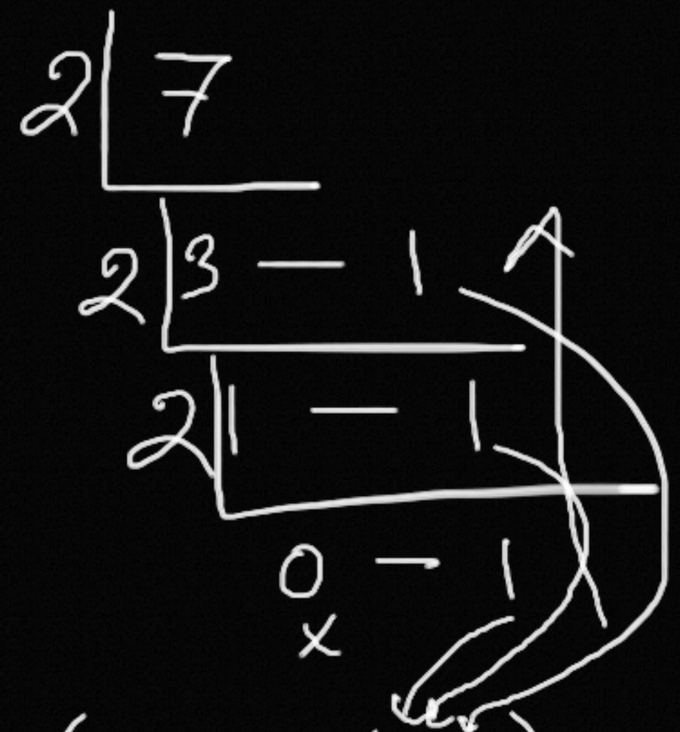
| | | |
|---|---|---|
| $2^0$ ← | 0 | 0 |
| | 1 | 1 |
| $2^1$ ← | 2 | 10 |
| | 3 | 11 |
| $2^2$ ← | 4 | 100 |
| | 5 | 101 |
| | 6 | 110 |
| | 7 | 111 |
| $2^3$ ← | 8 | 1000 |
| | 65 | 1000001 |

123

100

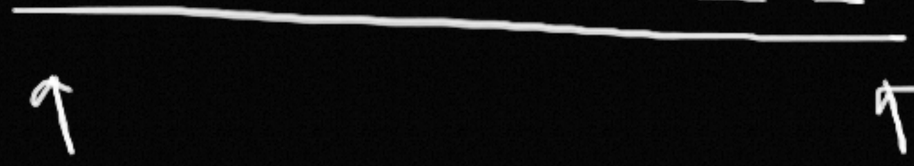
20

3




$(7_{10}) = (111)_2$

MSb LSb



$$123 = 1 \times 10^2 + 2 \times 10^1 + 3 \times 10^0$$

100

20

3

$$(158)_{16} = 1 \times 16^2 + 5 \times 16^1 + 8 \times 16^0$$

$$= \underline{\qquad\qquad}$$

1
2
4
8
16
32
64
128
256

$160 \rightarrow 1 \times 2^2 \rightarrow 4$

$65 \longrightarrow 64 + 1 \rightarrow 2^6 + 2^0$

$10000000$

$43 \rightarrow 32 + 8 + 2 + 1$

$1$

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

$1\ 0\ 1\ 0\ 1\ 1$

$2^4 \rightarrow 10000$

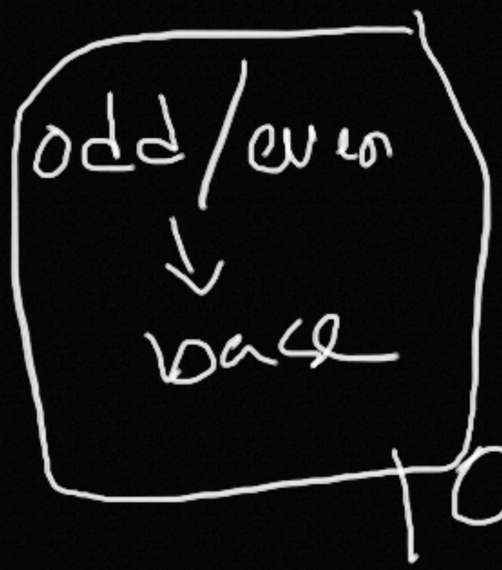
$2^4 - 1 \quad 1111$

(7) - 111

$2^4 - 1 \leftarrow 15 - 1111$

$2^5 - 1 \leftarrow 31 - 11111$

→ 101




1 2 3

1/3/5/7/9

0 - 9

A - 10

B - 11

C - 12

D - 13

E - 14

F - 15

FD

10 - 2

0,1,2, 10 - 3

0 1 2

Infinite number bases?

→ Theoretically ✓

→ Practically — ?

A-10
F-15
Z-35
36

ASCII
→ UNICODE

Unary

$-2, \underset{x}{-1}, \underset{+}{0}, \frac{1}{x}, 2, 3, 4, \ldots, 10, \ldots, \infty$

→ 000

$A \;\%_0\; 2^x = 0$

↓ binary representation

max $x$?

1/2/3/4/5

$16 \;\%_0\; 2^{-} = 0$

↓

$10 \;\%_0\; 2^3 \neq 0$

$10 \;\%_0\; 2^1 = 0$

$(1010)_2 \quad x = ?$

$(10)_{10}$

Naïve

- convert to decimal
- iterate with powers from 1

$10000 \rightarrow 2^{4}$

$10100 \rightarrow 2^{1} \times 2^{2}$

$\rightarrow 100$

3:10

$10200$

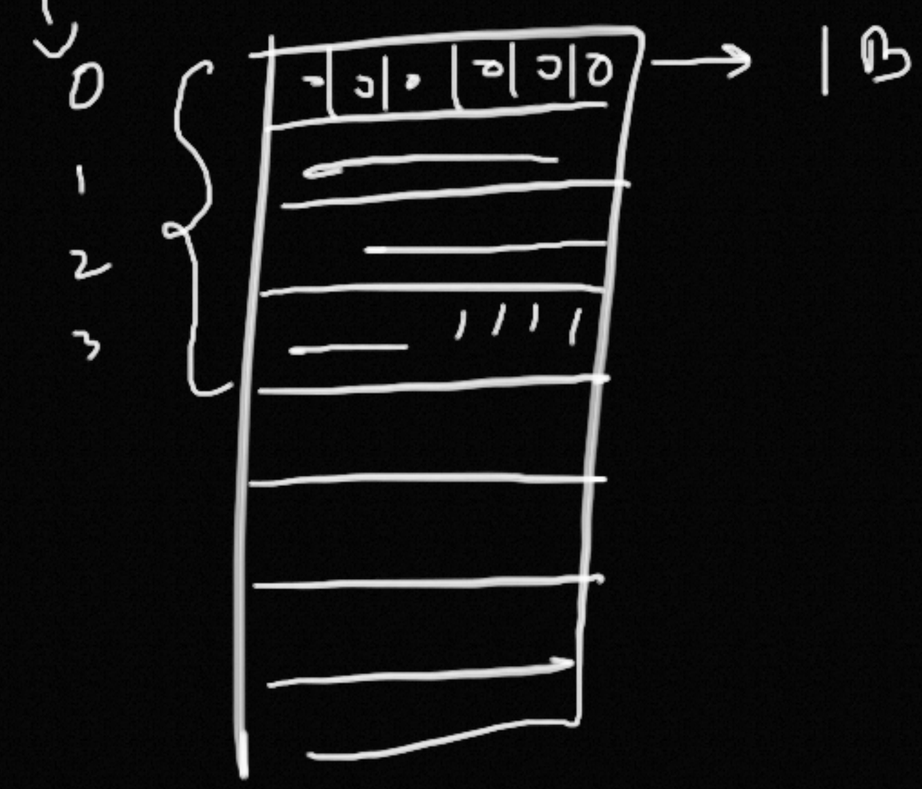
$100$

Integer $\begin{cases} +ve \\ -ve \end{cases}$

$(-4)_{10} \rightarrow (-100)_2$

address

RAM



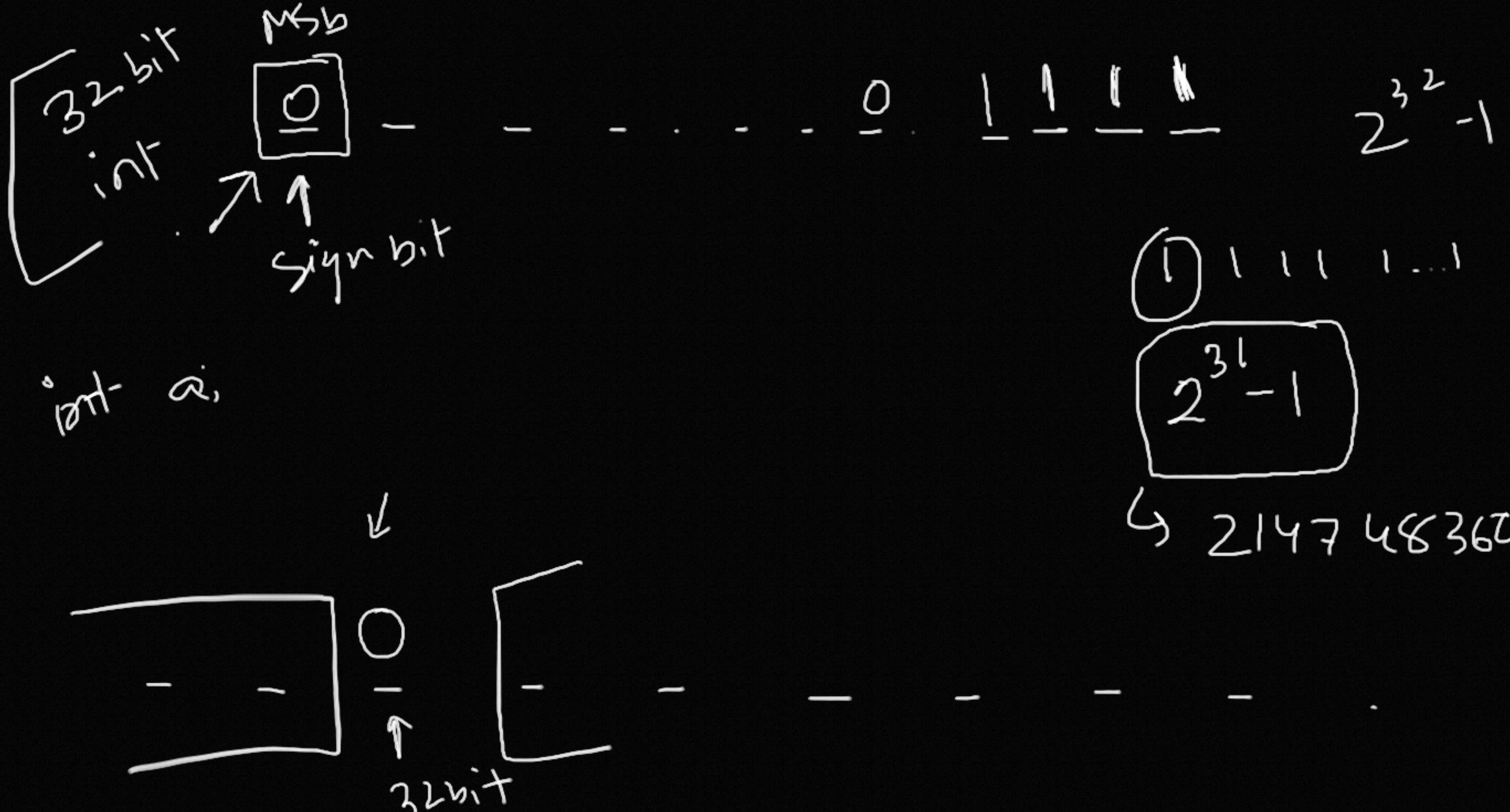

int a = 15;

C/C++/Java

→ int, float, double, long

int → 4B

long → 8B


32 bit
int
MSb
0
0 1 1 1 1
$2^{32}-1$
sign bit
int a;
1 1 1 1 1 ... 1
$2^{31}-1$
2147483647
32bit

$(-5)_{10}$ → 1 . . . . . 1 0 1

5 [0 . . . . 0 1 0 1] → 1's comp

1 . . . . . 1 0 1 0

+1 → +1

-5

1 1 1 1 1 1 1 1 0 1 1 → 1's

0 . . . . 0 0 0 1 0 0 → 1's

+1 → +1

0 . . . . 0 1 0 1

max

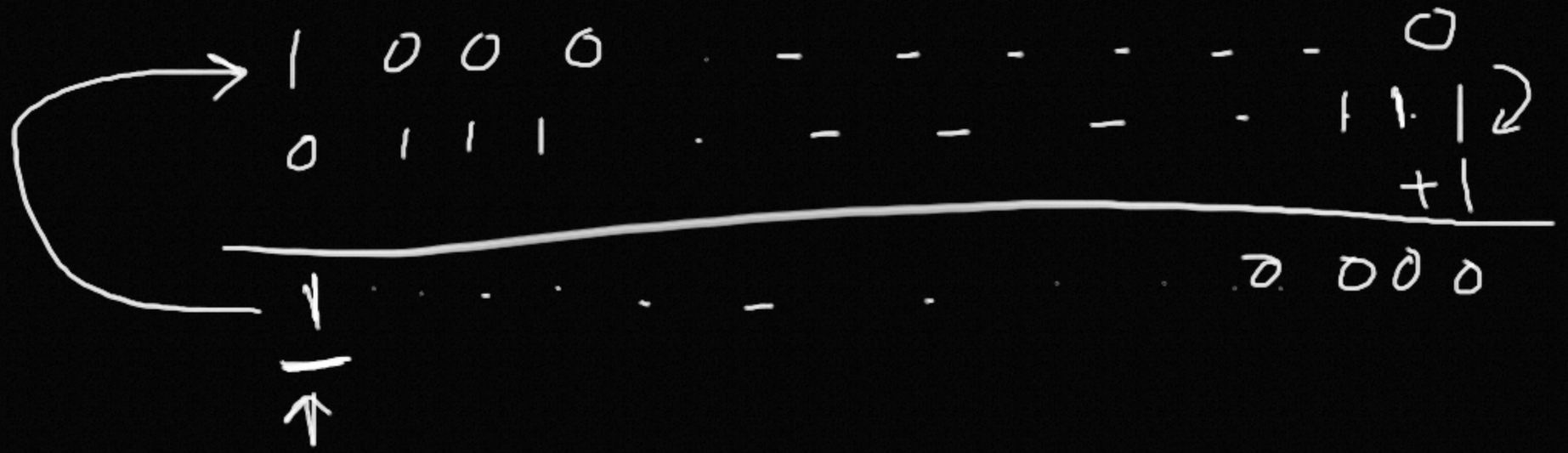
$2^{31}-1$

min

?

$-(2^{31}-1)$

$-2^{31}$




$-2^{31}$

$-1$ → 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 ?

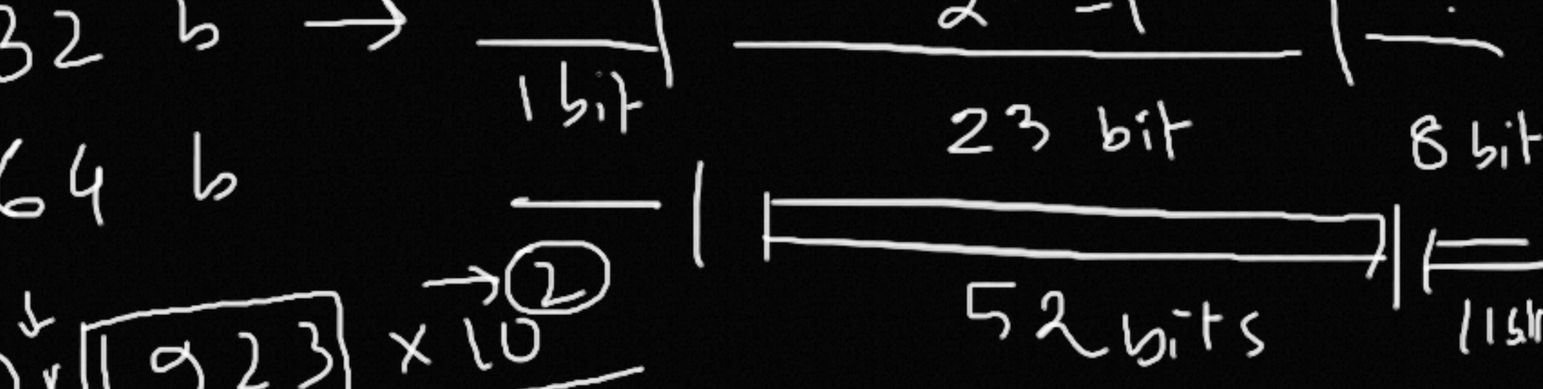
0 0 . . . . . 0

+1

1

Fractions → IEEE 754 format

float — 32 b
double — 64 b




$19.23 = 0.1923 \times 10^{2}$ → IEEE format

$0.012 = 1.2 \times 10^{-2}$

$19.23 = 0.1923 \times 10^{2}$

$0.012 = 0.12 \times 10^{-1}$

Float-

1.2356781239

0 1 1 0 [1 0 0 1 1 1 0 0 0 0 1 1 0]

32 bit

# bitwise Operators → Neat class