

Dys # 1 : Nov 7, 2:00 pm

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~~✓~~ Topic : Theory lectures ✓ 1, 2, 3

- Arithmetic :  $\frac{+, -, *, /}{\cdot}$   $\rightarrow$  + 
- Bitwise AND, OR, XOR
- Complexity :
- Array - efficient

Arithmetic  
Operations

$$\begin{array}{c} A + B \\ \downarrow \quad \downarrow \\ A - B \end{array} \rightarrow A + (-B)$$

$$\begin{array}{c} A * B \\ \downarrow \quad \downarrow \\ A + A + \dots + A \end{array}$$

(how our computer  
stores  $\rightarrow$  ve)

$$\begin{array}{c} -5 \\ \boxed{-5} \end{array} + \begin{array}{c} 1 \\ 0 \\ 1 \end{array}$$

is stored  $5 \rightarrow 101$

$$A * B$$


$$\begin{array}{c} 3 * 5 \\ \hline -3 + 3 + 3 + 3 + 3 \\ -5 + 5 + 5 \end{array}$$

Booster

$$\frac{A}{B} \leftarrow \frac{\cancel{A}}{\cancel{B}} = \frac{10}{50} \rightarrow \frac{5}{50} \leftarrow \frac{5}{\cancel{5}} = 1$$

B) A (

7

Bitwise  
operations

AND , OR, XOR, NOT  
NAND NOR XNOR

JNAN

A	B
0	0
0	1
1	0

Given an integer,  
find out whether it is

odd / even?

$$\cancel{123} \% 2 = \cancel{1}0$$

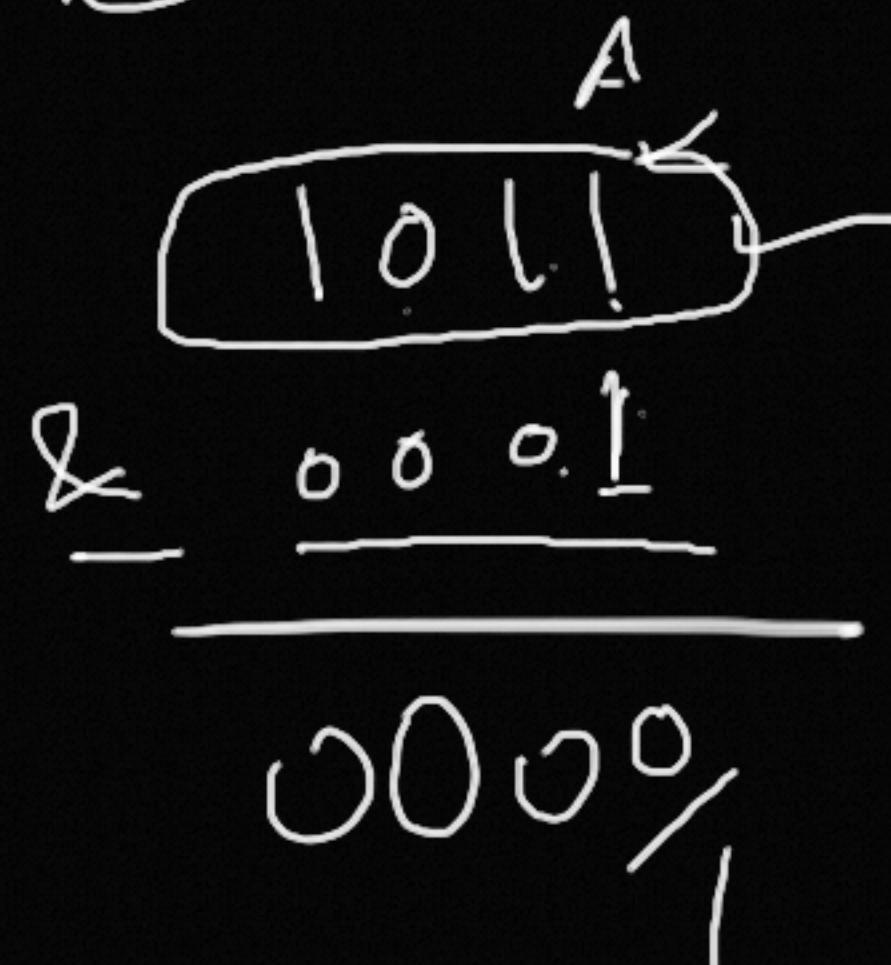
loops

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if ( $\cancel{(A \% 2 = 0)}$ )  
  even  
else  
  odd

$$\begin{array}{r} \text{1011} \\ \text{Lsb} \\ \hline \text{11} \end{array} \rightarrow \begin{array}{r} \text{11} \\ \hline \text{t} \end{array} \quad A \otimes B$$

- AND → &
- OR → |
- XOR → ^
- NOT



Ins odds

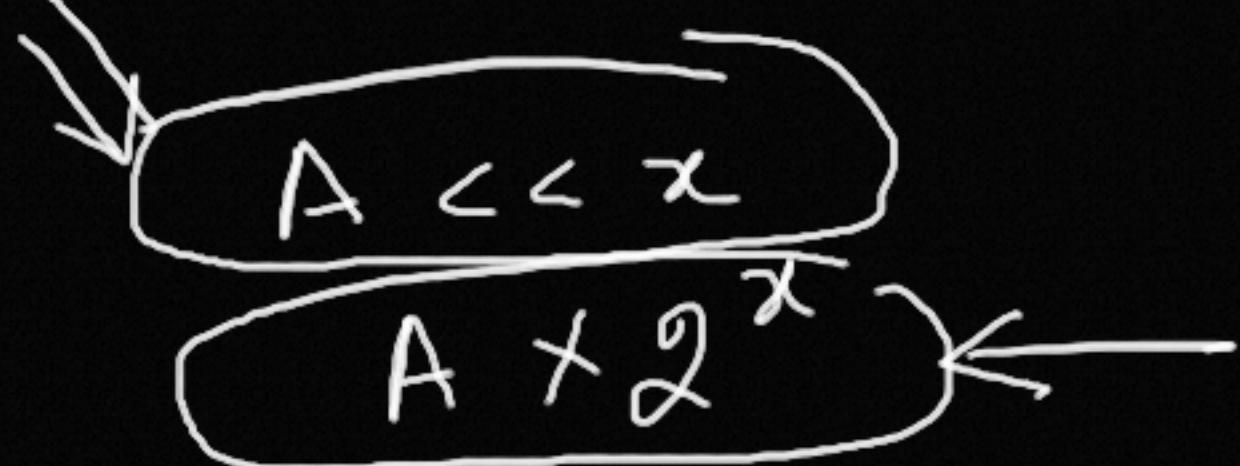
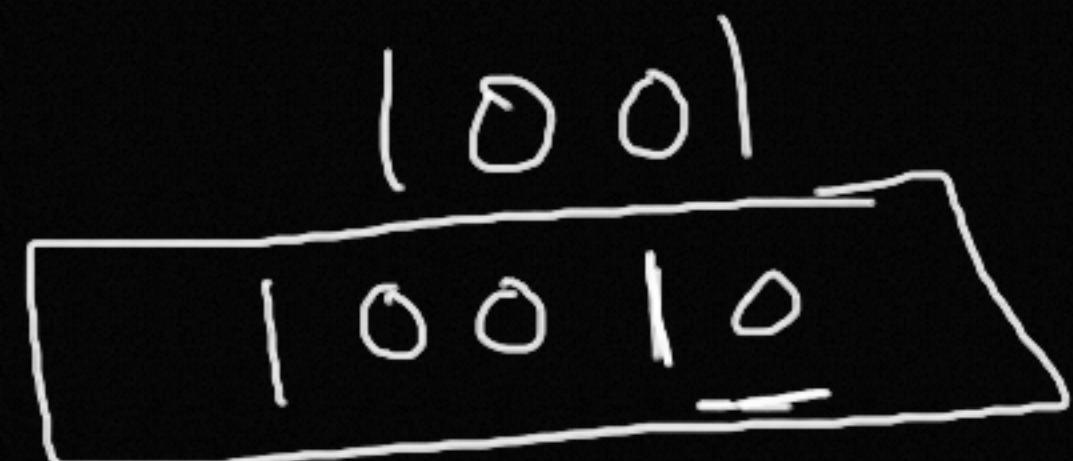
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if ((A & 1) == 0) even / else odd

logical and  
odd      T      T

## Shift operators

left-right



$$\begin{array}{c} (1001)_2 \times (10)_2 \\ \downarrow \qquad \qquad \qquad \downarrow \\ = (10010)_2 \end{array}$$

$$\begin{array}{l} A \ll 2 \\ 3 \rightarrow 8 \\ \qquad\qquad\qquad 2 \times 2 \times 2 \\ 4 \rightarrow 16 \end{array}$$

$$\begin{array}{l} (101)_2 \not= 5 \\ 1010 \rightarrow 10 \\ 10100 \rightarrow 20 \end{array}$$

$A \times 128$



$A \ll 7$

$\overline{A >> 1}$

$2^7$

Right Shift

$$\because \text{at } \left(\frac{9}{2}\right) \Rightarrow 4$$

$$9 \leftarrow \begin{array}{|c|} \hline 1001 \\ \hline \end{array}$$

$$4 \leftarrow \begin{array}{|c|} \hline 100 \\ \hline \end{array} \times$$

$$\begin{array}{|c|} \hline 100 \\ \hline \end{array}$$

$$\text{int} \left( \frac{\begin{array}{|c|} \hline 1001\phi \\ \hline \end{array}}{\begin{array}{|c|} \hline (\phi)_2 \\ \hline \end{array}} \right) = 1001$$

$$A \times \underline{2}^x \rightarrow A \ll \mathbb{X}$$
$$A / \underline{2}^x \rightarrow A \gg \mathbb{X}$$
$$A \times 12 \rightarrow A \ll ?$$
$$A / 12 \rightarrow A \gg ?$$



Memory

`for (i=1; i<=108; i++)`

⋮

↓ sec : 10<sup>8</sup> loop

`for (i=1, 1000)`

`for (j=1, 1000)`

$1000 \times 1000$

$O(M \times N)$

for ( i=1 , 100 ) { } O( M + N )

- - -

2

```
for ( i=1, N )
```

— 1 —

3

$$\begin{aligned} & O(M + N) \\ \Rightarrow & \underline{O(\max(M, N))} \end{aligned}$$

3850

Time limit : sec

→ Memory limit : 32  
64 / MB  
512 / 500

Array

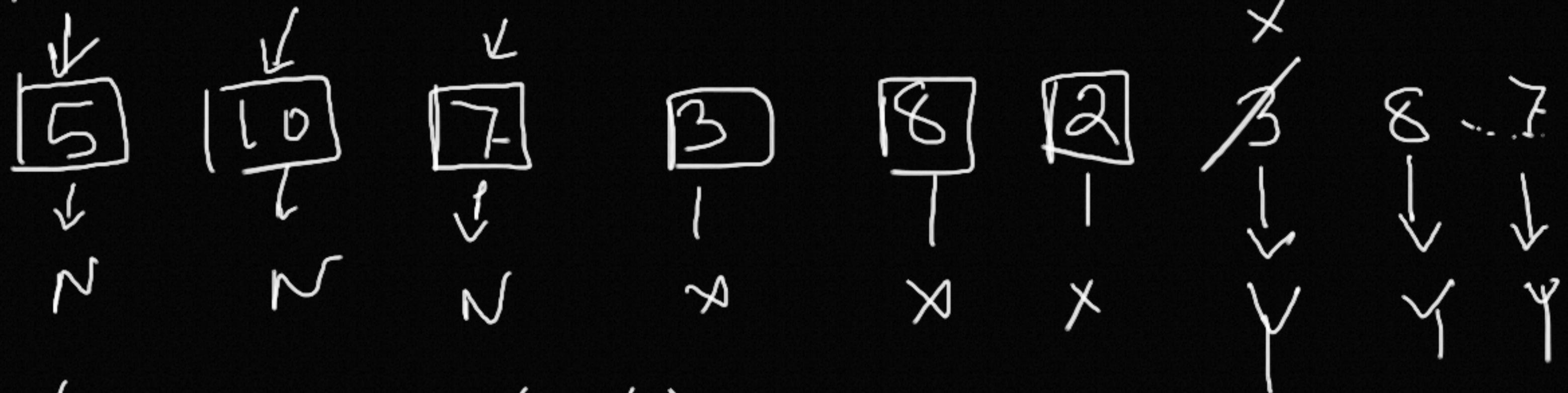
int → 4B  
→ 8B

1000 × 4 B

## Use of Array

input: A stream of rates

$10^6$ ,  $1 \leq A \leq 10^5$

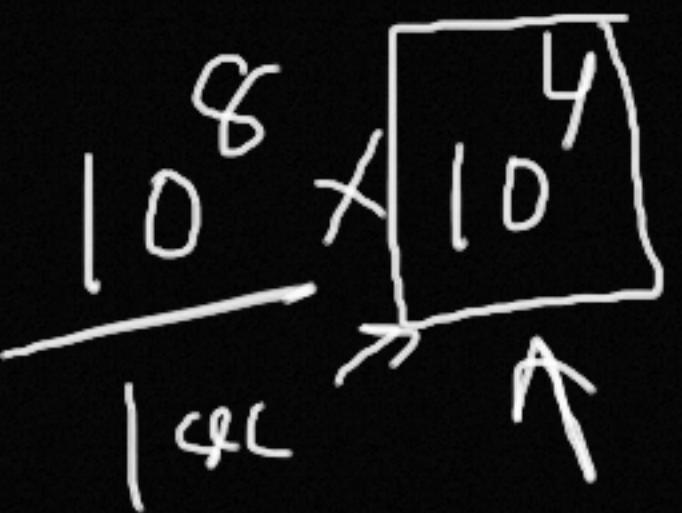


$A[10^6]$

$O(10^6)$

$$\cancel{0+1+2+3+\dots} + t \left( \frac{10^6}{N} \right)$$

$$1 + 2 + 3 + \dots + N = O\left(\frac{N(N+1)}{2}\right)$$

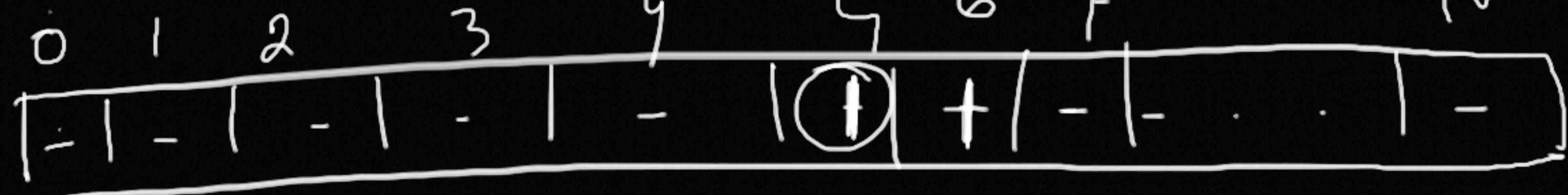
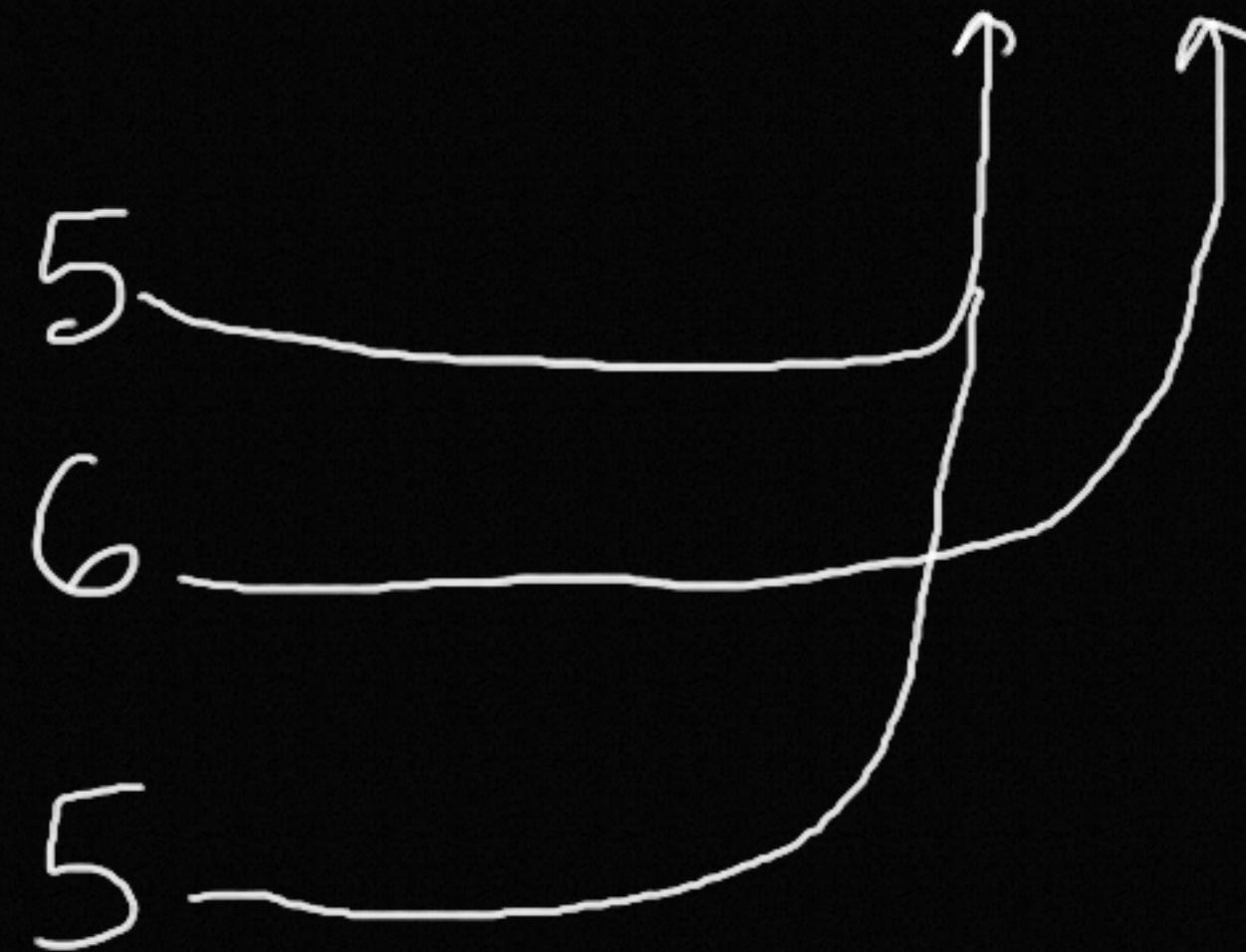
$$10^{12} \rightarrow \frac{10^8}{10^4} \times 10^4$$


$$O(N(N+1))$$

$$O(N^2 + N)$$

$$O(N^2)$$

$$\downarrow \\ 10^6$$

$10^6$  $1 \leq A \leq \underline{10^5} \checkmark$  $A[10^5]$  $A[0]$ Flag $10^5$

$\rightarrow \text{for}(i=1, N) \quad O(N)$

int P;

un >> P;

if(A[P] == L) — "seen"

else

→ unseen

A[P] = L

→ fat

31      30 |      . . .      5 | 1 | 2 | 1 | 0  
       [ ] |      [ ] |      [ ] |  
       -----  
       ↓      MSB      32 bits      ↑  
       ↓      LSB

$$\begin{array}{r} 5 \\ \times 8 \\ \hline A \end{array}$$

$$O(N)$$

1st : 31 — 0

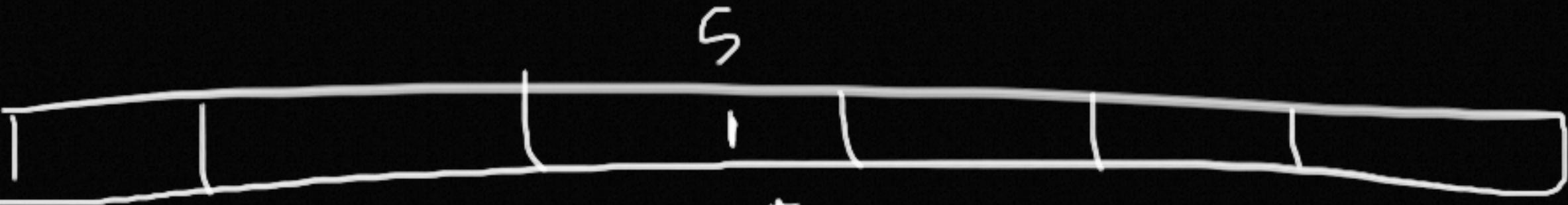
$$\text{2nd: } \begin{array}{ccc} 31 & \xrightarrow{\quad} & 0 \\ \downarrow & & \uparrow \quad \uparrow \\ 63 & & 33 \end{array}$$

1 → 0 1 0  
or 0 1 0 ← ?  
-----  
1 1 1 0 ←

Shift operation

1 ← 4 1  
1 0 << 1  
1 0 0

input  
5.



7 6 5 4 3 2 1 0  
| 0 | 0 1 | 1 | 0

5

—  
—  
0 0 0 0 0 0 0  
%