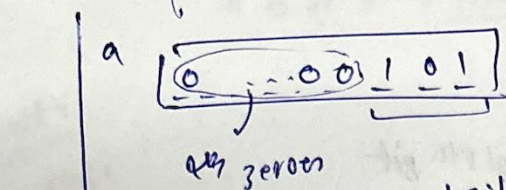


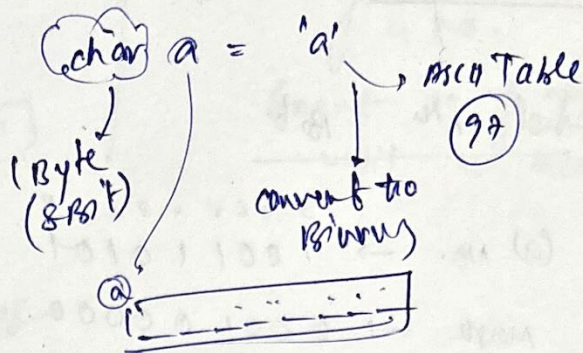
left byte (32 bit)



for (-ve) no. } First Bit  
 0  $\Rightarrow$  (+ve) no.  
 1  $\Rightarrow$  (-ve) no.

- ① ignore (-ve) sign
- ② convert to Binary
- ③ Take 2's complement
- ④ to print like your 2's comp.

## Bit Manipulation



1's comp  $\Rightarrow$  Reverse Bit (0  $\rightarrow$  1, 1  $\rightarrow$  0)

2's comp  $\Rightarrow$  +1  
 (- -)

note

## # Bitwise operator

AND  $\rightarrow$  &  
 OR  $\rightarrow$  |  
 NOT  $\rightarrow$  ~  
 XOR  $\rightarrow$  ^

(0  $\rightarrow$  1)  
 (1  $\rightarrow$  0)

a = 5 = 101  
 b = 7 = 111  
 AND 101  
 OR 111  
 NOT 111  
 XOR 010

## # Left/Right shift operator

5  $\ll$  1  
 10000...00101  $\Rightarrow$  5  
 10000...1010  $\Rightarrow$  10

18  $\gg$  1  
 5  $\gg$  2  
 1000...0101  $\rightarrow$  10  
 1000...0010  $\rightarrow$  1

padding with zero  
 (for +ve no)

padding is compiler dependent  
 (for -ve no)

note for small nos-

$\ll$   $\equiv$   $\times 2$   
 $\gg$   $\equiv$   $\div 2$



### Level 3

## # Bit Masking

### (A) Find nth Bit

(a) No.  $\rightarrow$   $\begin{matrix} 8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 & 0 \\ 1 & 0 & 0 & 1 & 1 & 0 & 1 & 0 & 1 \end{matrix}$

Mask  $\rightarrow$   $\begin{matrix} 8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \end{matrix}$

$\&$   $\begin{matrix} 8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \end{matrix}$

$\rightarrow$   $\boxed{1 \ll 5}$  find 5th bit

if a & mask  $\rightarrow$  non-zero  $\Rightarrow$  5th bit was 1.  
 $\rightarrow$  zero  $\Rightarrow$  5th bit was 0.

### (B) Set nth Bit

(a) No.  $\rightarrow$   $\begin{matrix} 8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 & 0 \\ 1 & 0 & 0 & 1 & 0 & 1 & 1 & 0 & 1 \end{matrix}$

Mask  $\rightarrow$   $\begin{matrix} 8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \end{matrix}$

or  $\Rightarrow$   $\begin{matrix} 8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 & 0 \\ 1 & 0 & 0 & 1 & 1 & 1 & 1 & 0 & 1 \end{matrix}$

Mask  $\rightarrow$   $\begin{matrix} 8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 & 0 \\ 1 & 1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 \end{matrix}$

$\&$   $\Rightarrow$   $\begin{matrix} 8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 & 0 \\ 1 & 0 & 0 & 1 & 1 & 1 & 0 & 1 & 0 & 1 \end{matrix}$

$\rightarrow$   $\boxed{1 \ll 4}$  set 4th bit to 1  
 $\rightarrow$   $\boxed{1 \ll 3}$  set 3rd bit to 1

### Note

①  $a = 1001100$   
 $b = 1100110$   
 $a \& b = 011010 \rightarrow \text{3 bits are different}$

### ② To count 1's in a byte

$n = 011010$

$\downarrow$  check last digit & right-shift

$001101 \rightarrow i=1$

$000110 \rightarrow i=2$

$000011 \rightarrow i=3$

$\vdots$

$i=3$

Trick

$\begin{matrix} i \geq 0 & \text{or} & \end{matrix}$

no. of set bits (Binary rep)  $= \lceil \log_2(n+1) \rceil$

no. of set bits (Decimal rep)  $= \lceil \log_{10}(n+1) \rceil$



① to set last occurring 2 to 0

$$A = \boxed{000 \dots 1100000}$$

← from last

$$A \& (A-1) = \boxed{000 \dots 1100000}$$

can be used to count no. of set bits in a no.  
(Count no. of operations until no. become zero)

Leet4

Note

① XOR

x	y	out
0	0	0
1	1	0
0	1	1
1	0	1

some prop

①  $A \wedge A = 0$

②  $0 \wedge A = A$

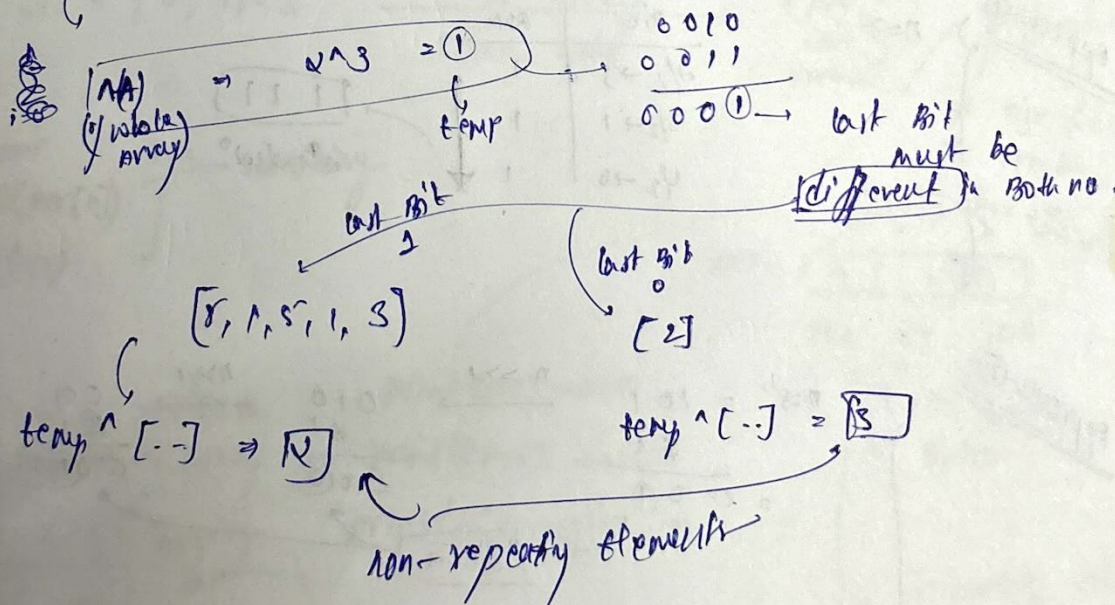
②

last bit  
 $\boxed{\dots 0} \Rightarrow$  Even No.  
 $\boxed{\dots 1} \Rightarrow$  Odd No.

Ques

$$A = [2, 1, 5, 1, 2, 3]$$

find non-repeating elements





Wet  
#

$$\begin{array}{r}
 \text{sur} \\
 \hline
 \text{nit}
 \end{array}
 \begin{array}{r}
 001 \rightarrow 1 \\
 010 \rightarrow 2 \\
 101 \rightarrow 4
 \end{array}
 \begin{array}{l}
 \left. \begin{array}{l} \\ \\ \\ \end{array} \right\} \times 3 \\
 \hline
 316
 \end{array}$$

↓ % ③ → 3 times present

[0 1 0]  $\xrightarrow{\text{convert}}$  [V]  $\xleftrightarrow{\text{AM}}$

to no.

## Decimal & Binary No. system

- ③ estimate from no.

- ① NA to Binary

Steps

1. By
2. store reminder
3. Reverse order

Approach 1  $n=2$

div	rem
$2/2 \rightarrow 3$	1
$3/2 \rightarrow 1$	1
$4/2 \rightarrow 0$	1

$2^2 + 0 + 2^0 \Rightarrow 7$

Answer ②

$$1128 = 101$$

$n \gg 1$

$$\begin{array}{r} 010 \\ \times 1 \\ \hline 000 \end{array}$$

$$\begin{array}{r} 001 \\ 81 \\ \hline 009 \end{array}$$

stone