## **Bit Manipulation - 2**

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Bitwise operators works on bits

# Given arr[N] where every no. is present two times except one unique no. Find that unique number.

$$arr[] \rightarrow [4,5,5,1,6,4,6]$$

int ans = 
$$120^{5} \cdot 6^{6} \cdot 6^{1} \cdot 120^{5}$$
  
=  $120^{120} \cdot 6^{6} \cdot 6^{5} \cdot 5^{5}$   
=  $0^{0} \cdot 0^{6} \cdot 6^{5} \cdot 5^{5}$ 

## Idea - Take XOR of entire array

```
ans = 0

for (i=0; i<n; i++);

ans = ans ^{^{^{^{^{^{^{^{3}}}}}}}

sc: 0(1)

return ans;

2, 3, (2) 3, (4)
```

# Idea 2 - Use hashmap

$$\begin{array}{cccc}
7 & \text{key} & \text{value} \\
2 & \rightarrow & 2 \\
3 & \rightarrow & 2 \\
4 & \rightarrow & 1
\end{array}$$



#### Another Approach

1

6

6%2

0

0

3

31,2

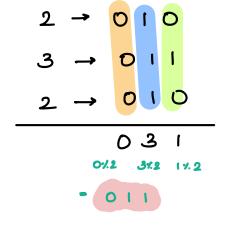
1

0

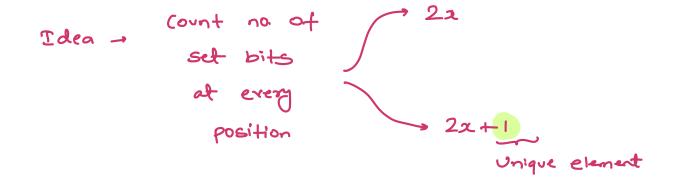
3

34.2

1



If every element is coming twice, then count of set bit at it position should be a multiple of 2.





#### </>Code

```
Merge Intervals II
  ans = 0
  for (1=0; 1<32; 1++)?
     Count = 0
     for (j=0;j<n;j++)?
       if (A(j) & (1<<1) > 0) count ++;
     if (count &1 >0)1 // count 1.2
       ans = ans (1441); // ans = ans + 21
 return ans:
                                  Tc:0(n)
                                  SC: 0(1)
```



# 2 Single Number 2

Given an integer array of size N, where all the elements occur thrice except one element. Find that unique element.

arr[] 
$$\rightarrow$$
 [4,5,5,5,4,11,6,6,4,5,6]  
0 1 2 3 4 5 6 7 8 9

for 
$$(i=0 \rightarrow n)$$
  
 $(ount = 0)$   
 $ele = A(i);$   
 $for (j=0 \rightarrow n)$   
 $if (A[j] = ele) count +++;$   
 $sc : O(1)$   
if  $(count = 1)$  return ele;

#### + Idea 1

Brute force -> Check the frequency of each elements & if freq (ele) == 1

# + Idea 2 Use hashmap

01. Fill hashmap with distinct ell frequencies

02. Eterate on array & get frequency of each ele

2f (freq = =1) return ele

TC:0(n)

+ Idea 3

Sort the entire array & iterate on it.

sc:0(n)



### + Idea 4

arr[] →	[ 5			4 7 3 4	11 5	11 6	9	11	7 9	5 10	4	4
	3	2	1	0								
5 →	0	1	O	1								
7 →	0	1	1	1								
5 →	0	1	O	1								
4 →	0	1	O	0								
<b>7</b> →	0	1	1	1				Cod	l J			
11 →	1	0	1	1				Cod	₽O			
11 →	1	0	1	1				<u></u>		•		
9 →	1	0	O	1								
11 →	1	0	1	1								
7 →	0	1	1	1								
5 →	0	1	O	1								
4 →	0	1	O	0								
4 →	0	1	0	0								
	4	9	6	10								
	4%3	9%3	6%3	101.3								
	1	D	0	1	$\Rightarrow$	9						

on Every element is repeating thrice except one, which is repeating twice.

9f (count 1/03 > 0) 1 ans = take the contribution)

- or. Every element is repeating 4 times, except one which is repeating one time.
  - Just take XOR of entire array
- is repeating two time.
  - = if ( count /. 4 >.0) ans = set .tw. it .bit .
- .04. Every element is repeating 4 times, except one which is repeating three time.
  - Take XOR of entire array



#### **②** Question

Given an integer array of size N, where all elements repeat twice except two. Find those two elements.

$$\begin{cases}
T.C - O(N) \\
S.C - O(1)
\end{cases}$$

$$arr[] \rightarrow [4,5,4,1,6,6,5,2]$$
 Ans = 1 and 2

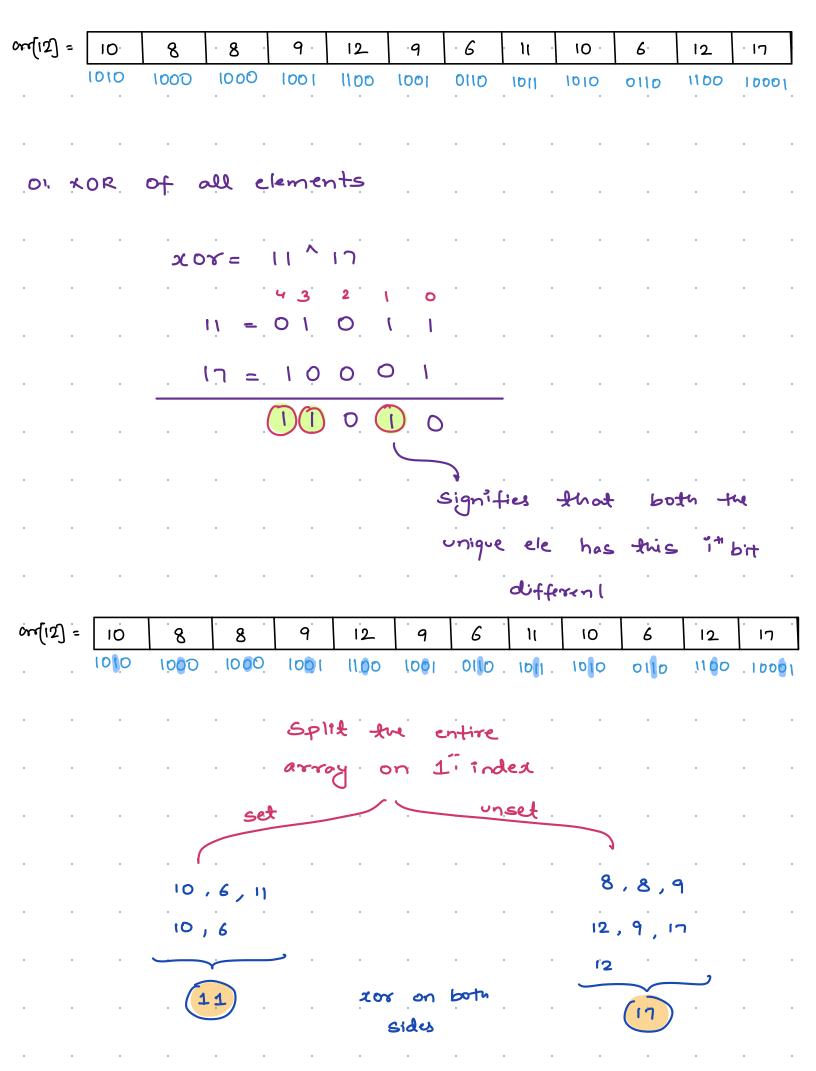
- \* Use hashmap
- \* Use sorting

Idea = 
$$\times 0R$$
 of all elements
$$A() = \{364438\}$$

$$\times 08 = 3^{6}4^{4}3^{8}$$

$$\times 08 = 3^{6}4^{4}3^{8}$$

$$\times 08 = 6^{8}$$





#### **Step 1:** Take XOR of all the elements.

```
val=0

for (1=0; 1<n; 1++);

val= val ^ A[i];
```

## Step 2: Find any set. bit position in val.

```
int idx = -1;

for (?=0; ?<32; ?++)?

if (val & (!<<1) > 0)?

| idx = ?;
| break;
```

## **Step 3:** Split the array on the basis of pos<sup>th</sup> bit.

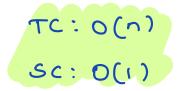
```
set=0, unset=0

for (1=0; 1<n; 1++) d

if (A(1) & (1<< 1dx) > 0) dset = set ^ A(1));

else d unset = unset ^ A(1) }
```

## Step 4: Print the unique numbers.





#### Maximum AND Pair

Given n +ve array elements. Find the maximum value of (arr[i] & arr[j]) where i! = j (indices must be different for 2 no.)

$$arr[] \rightarrow [27 \ 18 \ 20]$$

+ Idea 1 = Consider all valid pairs and find
bitwise AND of all pairs, update the

for 
$$(i=0 \rightarrow n)$$

for  $(j=i+1 \rightarrow n)i$ 
 $val = A[i] & A[j]$ 

if  $(val > ans) \ ans = val;$ 

$$\begin{array}{ccc} & & & & & & \\ & & & & & \\ & & & & & \\ & & & & & \\ & & & & & \\ & & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & \\ & & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\$$

Tdeo	- Since	e wise	contaphit	es the r	mascimun	, <b>5</b> 0 .	
•	stor	if town	MSB —	LSB	4 +	to make	
	the	bits	in ans	26   ,			
	, A [ ] =	<del>-</del>	13 23	28 27	. 7	25 J	
	 26 =		 	0	 		
•	 13 <del>-</del>			· · ·	0	1	•
	<u> </u>		0				
	28=			. 0		<u> </u>	
	.27 = =		0			1	
	25 =			0	0	1	
count	of =	<u>.</u>		Pairing X	<b>2</b>	Paring X	
	Ans =	1	1	. 0 .	1	(O)	
			<i>*</i>				
91 3		= 100					
		= 110			• •		
		.= 1.00					
	Ans	100					



#### </>Code

```
Merge Intervals II
     ons= 0
  for ( 1= 31; 120; 1--)7
      11 count set bits
      count = 0
      for (j=0;j<n;j++)?
        9f (A(j) & (K<1) > 0) count ++;
      9f (count ≥ 2) }
         ans = ans (1<<1) // ans = ans + 2
        for (j=0; j <n; j++) }
         *f (A(j) & (1<<i) = =0) d A(j) = 0 j;
   return ans;
   * Bitwise operators has very low priority.
       Please enclose them incide brackets.
```

Doubts

