

Welcome 😊

Agenda : BM 2
3 questions.

Q Given an integer array where every number occurs twice except one element. Find the unique element

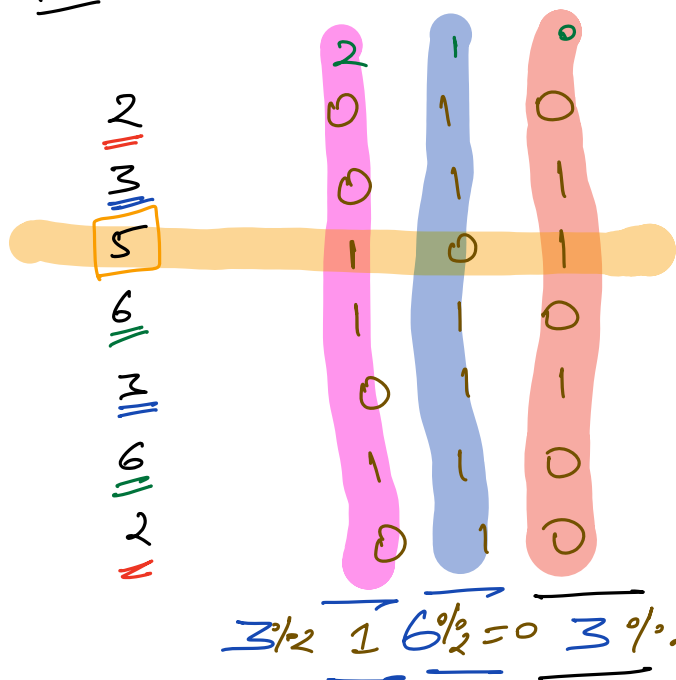
App 1 \Rightarrow XOR of all the elements
T.C $\Rightarrow O(N)$
S.C $\Rightarrow O(1)$

App 2 \Rightarrow Use hashset/map and store freq.
T.C $\Rightarrow O(N)$
S.C $\Rightarrow O(N)$

App 3 \Rightarrow Sort the array and check
T.C $\Rightarrow O(N \log N)$
S.C $\Rightarrow O(1)$

App 4. V. Interesting Solⁿ

eg: A : [2 3 5 6 3 6 2]



$$101 = 5$$

Count of set bits on any posⁿ \Rightarrow $\begin{cases} \text{odd} \Rightarrow 2n + \underline{1} \rightarrow \text{unique element} \\ \text{even} \Rightarrow \underline{2n} \\ \text{pairs repeating numbers} \end{cases}$

code

```
for ( i=0 ; i<32 ; i++)
```

```
{
```

```
    count = 0
```

```
    for ( j=0 ; j<N ; j++)
```

```
    {
```

```
        if ( checkbit ( arr[j] , i ) == true )
```

```
        {
```

```
            count ++
```

```
        }
```

```
    }
```

```
    if ( count % 2 == 1 )
```

```
    {
```

```
        // ith bit of unique element is set
```

```
        ans = ans | ( 1 << i )
```

```
    }
```

```
}
```

```
return ans
```

Q Given an integer array where every number occurs thrice except one element. Find the unique element

eg: [4 5 5 4 1 6 6 4 5 6]

Solⁿ Brute force.

→ Use two for loops and count occurrence of each number.

T.C $O(N^2)$
S.C $O(1)$

Solⁿ 2

XOR of all number ~~X~~

~~4 ^ 5 ^ 5 ^ 4 ^ 1 ^ 6 ^ 6 ^ 4 ^ 5 ^ 6~~

$1 ^ 4 ^ 5 ^ 6$

Solⁿ 2

Use hashset/map and store freq.

T.C = $O(N)$
S.C = $O(N)$

Solⁿ 3

Sort the array and check

T.C = $O(N \log N)$
S.C = $O(1)$

Solⁿ 4

Since every element occurs thrice.

count % 3 will give us unique element.

```
for ( i=0 ; i<32 ; i++)
```

```
{
```

```
    count = 0
```

```
    for ( j=0 ; j<N ; j++)
```

```
    {
```

```
        if ( checkbit ( arr[j], i ) == true )
```

```
        {
```

```
            count ++
```

```
        }
```

```
    }
```

```
    if ( count % 23 != 0)
```

```
    {
```

```
        // ith bit of unique element is set
```

```
        ans = ans | (1 << i)
```

```
    }
```

```
}
```

```
return ans
```

T.C $\Rightarrow O(N \times 32)$

S.C $\Rightarrow O(1)$

Extensions

1) Every ele. occurs 4 times except 1. XOR

2) Every ele. occurs thrice except one ele. which is repeating twice. above solⁿ will work.

Q Given N elements where every element occurs twice except 2 unique element. Find the two unique elements.

eg: 3 6 4 4 3 8
o/p → 6, 8.

Sol¹ Brute force.
→ Use two for loops and count occurrence of each number.
T.C $O(N^2)$
S.C $O(1)$

Sol² XOR of all number ~~X~~
3 6 4 4 3 8
 $6 \wedge 8$

Sol² Use hashset/map and store freq.
T.C = $O(N)$
S.C = $O(N)$

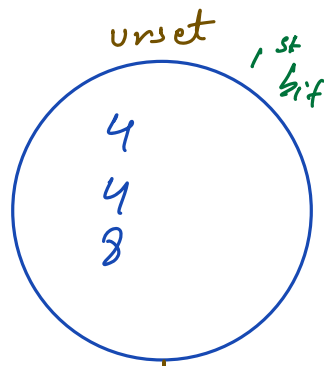
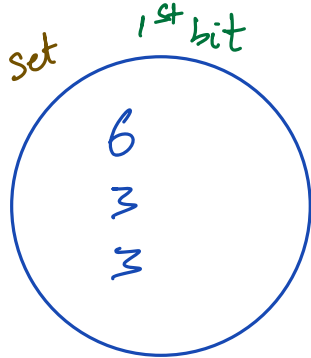
Sol³ Sort the array and check
T.C = $O(N \log N)$
S.C = $O(1)$
 $6 \wedge 8$

	3	2	1	0
6	0	1	1	0
8	1	0	0	0
	1	1	1	0

= 14

⇒ You can use 1st/2nd/3rd bit to differentiate b/w 2 unique numbers in this case ($6 \wedge 8$)

$6 \rightarrow 110$
 $3 \rightarrow 011$



1) XOR of all elements

Code 2) Set bit in XOR ans.

```

posn = -1
for (i = 0; i < 32; i++)
{
    if (checkBit(ans, i) == true)
    {
        posn = i // differentiator.
        break;
    }
}

```

3) Split array into two baskets using posⁿ

```

set = 0    unset = 0
for (i = 0; i < N; i++)
{
    if (checkBit(arr[i], posn) == true)
    {
        set = set ^ arr[i]
    }
    else
    {
        unset = unset ^ arr[i]
    }
}
print(set)    print(unset)

```

T.C $\Rightarrow O(N+N)$
 $\Rightarrow O(N)$
 S.C $\Rightarrow O(1)$

Q Given an array A of N integers. Find the sum of bitwise XOR of all pairs of numbers in the array.

eg: [1 2 3]

$$\{ 1 \ 2 \} \rightarrow 3$$

$$\{ 2 \ 3 \} \rightarrow 1$$

$$\{ 1 \ 3 \} \rightarrow 2$$

$$\underline{6} \leftarrow \text{o/p}$$

$$1 \rightarrow 01$$

$$2 \rightarrow 10$$

$$3 \rightarrow 11$$

$$\wedge \begin{array}{r} 01 \\ 10 \\ \hline 01 \end{array}$$

Solⁿ Contribution Tech

$$(\text{set}, \text{unset}) = 1 \text{ } i^{\text{th}} \text{ bit}$$

$\forall i^{\text{th}} \text{ bit}$

X elements with i^{th} bit set

Y elements with i^{th} bit unset

$$0 \ 0 \ 0 \rightarrow 3$$

$$0 \ 0 \rightarrow 2$$

$$\underline{3 \times 2}$$

$X \times Y$ pairs whose i^{th} bit is set.

$$(1 \leq i \leq 2^i)$$

$$\text{Contribution of } i^{\text{th}} \text{ bit} \rightarrow (X \times Y) \times (1 \ll i)$$

$$[1 \ 2 \ 3]$$

$$1 \rightarrow 01$$

$$2 \rightarrow 10$$

$$3 \rightarrow 11$$

$$0^{\text{th}} \text{ bit} \Rightarrow (2 * 1)^* 2^0 = 2 \quad \begin{matrix} \times & \times \\ 1, 3 & 2 \end{matrix}$$

$$1^{\text{st}} \text{ bit} \Rightarrow (2 * 1)^* 2^1 = 4 \quad \begin{matrix} 2, 3 & 1 \end{matrix}$$

$$\underline{2+4} = 6$$

[11 12 13]

$$11 \rightarrow \begin{matrix} 3 & 2 & 1 & 0 \\ 1 & 0 & 1 & 1 \end{matrix}$$

$$12 \rightarrow \begin{matrix} 3 & 2 & 1 & 0 \\ 1 & 1 & 0 & 0 \end{matrix}$$

$$14 \rightarrow \begin{matrix} 3 & 2 & 1 & 0 \\ 1 & 1 & 1 & 0 \end{matrix}$$

$$0^{\text{th}} \text{ bit} \Rightarrow (2 * 1)^* 2^0 = 2 \quad \begin{matrix} \times & \times \\ 11 & 12, 14 \end{matrix}$$

$$1^{\text{st}} \text{ bit} \Rightarrow (2 * 1)^* 2^1 = 4 \quad \begin{matrix} 11, 14 & 12 \end{matrix}$$

$$2^{\text{nd}} \text{ bit} \Rightarrow (2 * 1)^* 2^2 = 8 \quad \begin{matrix} 12, 14 & 11 \end{matrix}$$

$$3^{\text{rd}} \text{ bit} \Rightarrow (3 * 0)^* 2^3 = 0 \quad \begin{matrix} 12, 14, 11 & - \end{matrix}$$

$$\underline{\underline{14}}$$