Q → Given an integer array where every element occurs twice except for 1 element that occurs once. Find that unique element.

A = [4 5 5 4 ① 6 6] Ans = 1

A = [7 5 1 7 5 ⑥ 1] Ans = 6

$x \wedge x = 0$

$x \wedge 0 = x$

$7 \wedge 5 \wedge 1 \wedge 7 \wedge 5 \wedge 6 \wedge 1$

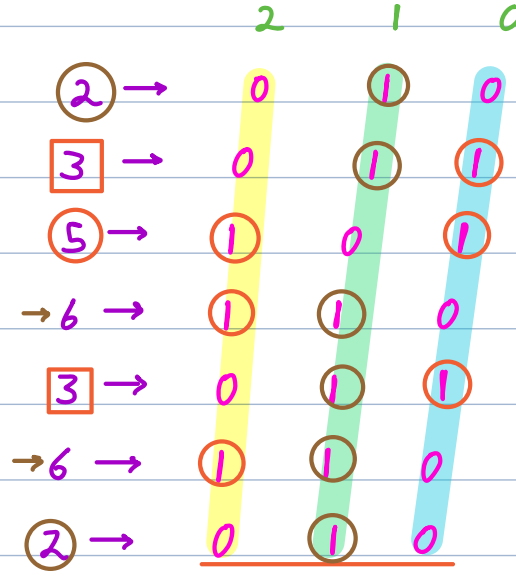
$= 7 \wedge 7 \wedge 5 \wedge 5 \wedge 1 \wedge 1 \wedge 6$

$= 0 \wedge 0 \wedge 0 \wedge 6 = 6$

```
ans = A[0]
for i → 1 to (N-1) {
    ans ^= A[i]
}
return ans
```

TC = O(N) SC = O(1)

A = [2 3 5 6 3 6 2]



#of set bits → even → 0 (2x)

→ odd → 1 (2x + 1)

#1's → 3 6 3

1 0 1 → 5 (Ans)

Q→ Given an integer array where every element occurs thrice except for 1 element that occurs once. Find that unique element.

A = [4 4 5 4 5 1 6 6 5 6] Ans = 1

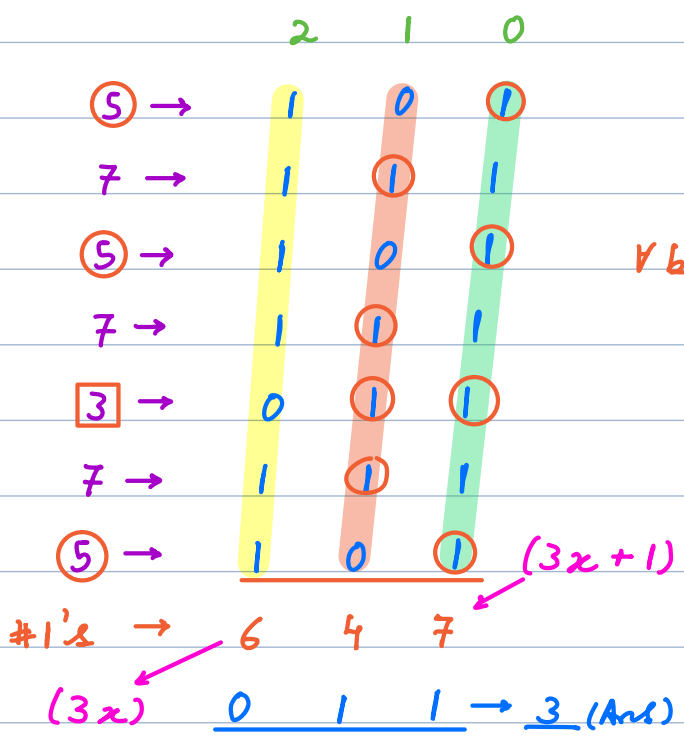
A = [5 7 5 7 3 7 5]

$5 \wedge 7 \wedge 5 \wedge 7 \wedge 3 \wedge 7 \wedge 5$

$= 5 \wedge 5 \wedge 5 \wedge 7 \wedge 7 \wedge 7 \wedge 3$

$= 0 \wedge 5 \wedge 0 \wedge 7 \wedge 3 = 5 \wedge 7 \wedge 3$ (Not helpful)

A = [5 7 5 7 3 7 5]



∀ bits, count of 1's

(3x+1) (3x)

1 0

```
ans = 0
for b → 0 to 31 {
    cnt = 0
    for i → 0 to (N-1) {
        if ((A[i] & (1<<b)) > 0)   cnt++
    }
    if (cnt % 3 == 1)
        ans = ans | (1<<b)    // set b^th bit
}
return ans
```

TC = O(N) SC = O(1)

Find unique element if all other elements are present K times. K (even) → XOR of all elements

#1's → Kx → 0

Kx+1 → 1

Q → Given an integer array, every element occur twice except for 2 elements. Find those two unique elements.

A = [4 5 4 1 5 2] Ans = {1, 2}

Will XOR be helpful?

4 ^ 5 ^ 4 ^ 1 ^ 5 ^ 2 = 1 ^ 2 = 3

(x != y) → x ^ y > 0

→ There exist a set bit.

$1 \wedge 2 = 3 \rightarrow$ (2 1 0) 0 1 1

one of the two nos. only has this bit as set.

A = [4 5 4 1 5 2]

0^{th} bit → 1 { 5 1 5 } → XOR of all elements

→ 0 { 4 4 2 }

```
xor = A[0]
for i → 1 to (N-1) {
    xor ^= A[i]
}
// Find position of anyone set bit
b = -1
for i → 0 to 31 {
    if ((xor & (1<<i)) > 0) { // check ith bit
        b = i
        break
    }
}
x = 0    y = 0
for i → 0 to (N-1) {
    if ((A[i] & (1<<b)) > 0)    x ^= A[i]
    else                        y ^= A[i]
}
return {x, y}
```

TC = O(N + 32 + N) = O(N)

SC = O(1)

Q → Given an integer array find max value of (A[i] & A[j]) s.t $i != j$.

```
        0  1  2  3
A = [ 5  4  6  8 ]
```

5 → 101

4 → 100

6 → 110

8 → 1000

i	j	A[i] & A[j]
0	1	5 & 4 = 4
	2	5 & 6 = 4
	3	5 & 8 = 0
1	2	4 & 6 = 4
	3	4 & 8 = 0
2	3	6 & 8 = 0

Ans = 4

```
        0  1  2  3
A = [ 21 18 24 17 ]
```

21 → 10101

18 → 10010

24 → 11000

17 → 10001

21 & 18 = 16

21 & 24 = 16

21 & 17 = (17) Ans

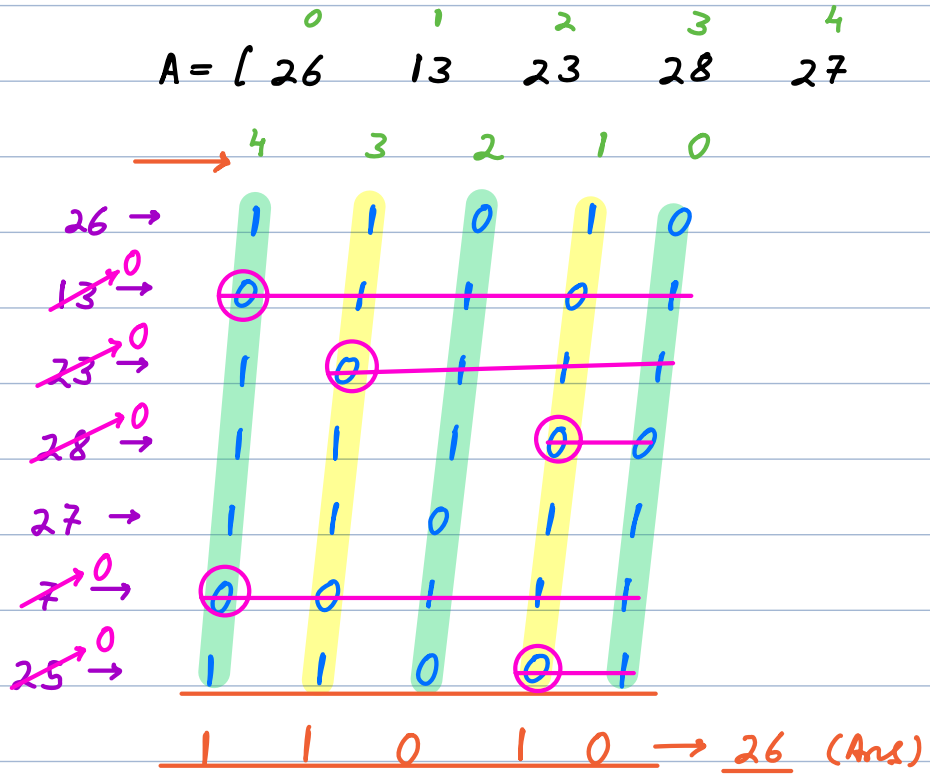
18 & 24 = 16

18 & 17 = 16

24 & 17 = 16

Bruteforce → TC = O(N²) SC = O(1)

```
   x          y
  10000      01111
   16    >    15
```




```
ans = 0
for b → 31 to 0 {
    cnt = 0
    for i → 0 to (N-1) {
        if ((A[i] & (1<<b)) > 0)   cnt++
    }

    if (cnt >= 2) {
        ans = ans | (1<<b)
        for i → 0 to (N-1) {
            if ((A[i] & (1<<b)) == 0)
                A[i] = 0
        }
    }
}
return ans
```

TC = O(N) SC = O(1)

$A = [\underset{0}{8} \quad \underset{1}{9} \quad \underset{2}{10}]$

$8 \rightarrow 1000$

$9 \rightarrow 1001$

$10 \rightarrow 1010$

max & value = 8

H.W → Count # pairs with max AND value.

K non-zero elements → ${}^{K}C_{2} = \frac{K*(K-1)}{2}$