Adobe | Goldman Sachs

Q.1. There are N doors and a person is standing in front of every door, initially all doors are closed, give ith person toggle the door:- (ith person toggles multiple of i)

1st P ⇒ 1 2 3 4 5 6 7 ———— N

2nd P ⇒ 2 4 6 8 10 ———— N

3rd P ⇒ 3 6 9 12 ———— N

4th P → 4 8 12 16 ———— N

return all doors that remain open

ex ⇒ 1 2 3 4 5 6 7 8 9 10

↑1 ↑2 ↑3 ↑4 ↑5 ↑6 ↑7 ↑8 ↑9 ↑10

O/P = 1 4 9 → remains open

ex ⇒ 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

18 19 20

18 → closed / open ⇒ 18 → 1, 2, 3, 6, 9, 18

C → O → C → O → C → O → $\boxed{C}$ → closed

16 → 1, 2, 4, 8, 16 open
↓
c → o → c → o → c → $\boxed{o}$

hate
18 → 1, 2, 3, 6, 9, 18
↓
c → o → c → o → c → o → $\boxed{c}$

1st 2nd 3rd 4th 5th 6th

1st 3rd 5th

odd → open

even → closed

* every gate getting toggled by its factors (✓)

* odd toggles means gate remains open & even toggles means get remains closed.

16 → 1, 2, 4, 8, 16 ⇒ 5 ⇒ odd
↓
c → o → c → o → c → $\boxed{o}$ (open)

numbers having odd factors will remain open, nos. having even factors will remain closed.

9 → 1 3 9 ⇒ 3 ⇒ open

c → o → c → $\boxed{o}$

15 → 1 3 5 15 ⇒ 4 ⇒ closed

c → o → c → o → $\boxed{c}$

3 → 1 3 ⇒ 2 → even → closed.

c → o → $\boxed{c}$

numbers having odd factors will remain open, nos. having even factors will remain closed

⇒ Check if a gate no. has odd factors ⇒ gate remains open

else gate remains closed

$i, N/i$ ⇒ factors always occur in pair

$N = 18$ ⇒ 1 2 3 6 9 18 ⇒ even

$N = 16$ ⇒ 1 2 4 8 16 ⇒ odd

$N = 36$ ⇒ 1 2 3 4 6 9 12 18 36 ⇒ odd

$N = 25$ ⇒ 1 5 25 ⇒ odd

[** If the door no. is a perfect sq. it will remain open else closed.]

task ⇒ solve it till most optimised approach

⟹ TC ⇒ $O(\sqrt{N})$

SC ⇒ $O(1)$

because we have to return an array of open doors.

SC ⇒ O(no. of perfect sq. till N)

Q2. N^{th} magical no.

Given a no. N, return N^{th} magical no.

Magical no. :- Its a no. that can be presented as sum of unique powers of 5, where power > 0.

Sl. No

$1 \rightarrow 5^1 \Rightarrow 5$

$\cancel{5^1+5^1}$ (x)

$2 \rightarrow 5^2 \Rightarrow 25$

$3 \rightarrow 5^2+5^1 \Rightarrow 30.$

$4 \rightarrow 5^3 \Rightarrow 125$

$5 \rightarrow 5^3+5^1 \Rightarrow 130.$

$6 \rightarrow 5^3+5^2 \Rightarrow 125+25 = 150.$

$7 \rightarrow 5^3+5^2+5^1 \Rightarrow 155$

$8 \rightarrow 5^4 \Rightarrow 625$

$9 \rightarrow 5^4+5^1 \Rightarrow 630$

⋮

4	3	2	1	
0	0	0	5^1	→ 0 0 0 1
0	0	5^2	0	→ 0 0 1 0
0	0	5^2	5^1	→ 0 0 1 1
0	5^3	0	0	→ 0 1 0 0
0	5^3	0	5^1	→ 0 1 0 1
0	5^3	5^2	0	→ 0 1 1 0
0	5^3	5^2	5^1	→ 0 1 1 1
5^4	0	0	0	→ 1 0 0 0
5^4	0	0	5^1	→ 1 0 0 1
	⋮			

N^{th} magical $\Rightarrow 11^{th} \Rightarrow$ 1 0 1 1

5^4 0 5^2 5^1

TODO → Implementation

$\Rightarrow 5^4+5^2+5^1 \Rightarrow 625+30 = 655$

Google

Q.3. Majority element

Given an array of size N, return if there exists a no. with freq > N/2, else -1.

{ No extra space
TC ⇒ O(N)

ex ⇒ A ⇒ 1 6 1 1 2 1 N = 6

min freq = 4

O/P ⇒ 1

Quiz ⇒ 3 4 3 6 1 3 2 5 3 3 3

N = 11

> (11/2) = 5

O/P → 3.

Quiz ⇒ 4 6 5 3 4 5 6 4 4 4

N = 10

4 → 5 times ~~5 > 10/2~~

O/P = -1

Brute force: Check freq of every element

TC ⇒ $O(N^2)$
SC ⇒ $O(1)$

```
for (i = 0 → N-1) {
    freq = 0
    for (j = 0 → N-1) {
        if (arr[i] == arr[j])
            freq++
    }
```

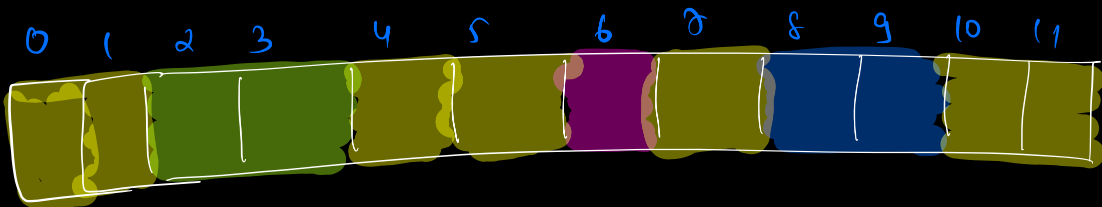
if (freq > N/2)
        return arr[i]
}
return -1

ex => 3 4 3 6 1 3 2 5 3 3 3

i

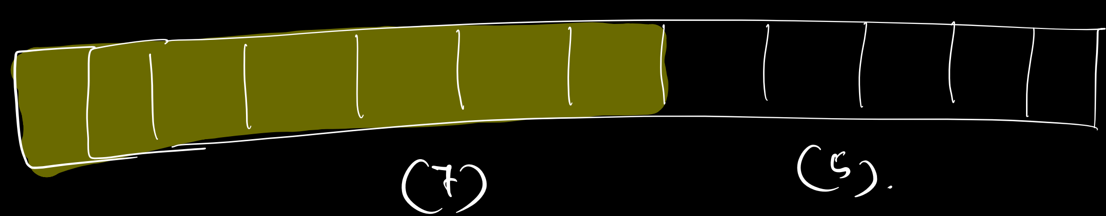
j → j

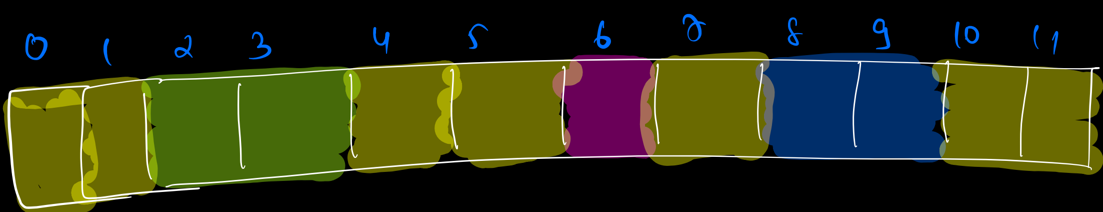
Quiz At max how many majority element can be present in array => 1



N=12

Yellow => $7 > 12/2$ ✓ (ME)





⇒ 0 1 4 5 7 ~~10~~ ~~11~~

⇒ 2 3

⇒ ~~6~~

⇒ 8 ~~9~~.

BJP party

→ ~~7~~ ~~6~~ 5

Bigparty → ~~5~~ 4 3

{ Count of ME is greater than count of every other elements combined.

⇒ [If we remove two distinct element from an array ME remains the same.]

ex ⇒

0	1	2	3	4	5	6	7	8	9	10
~~3~~	~~4~~	~~3~~	~~6~~	~~1~~	~~3~~	~~2~~	~~5~~	3	3	3

N = 11

N	ME	count of ME
~~11~~	3	6
9	3	$5 > 9/2$
7	3	$4 > 7/2$
5	3	$4 > 5/2$.

3 3 3 > 3/2.

ex ⇒ 3 3 3 2 4 4 ⇒ -1

How to solve

Moore's Voting algorithm

	0	1	2	3	4	5	6	7	8	9	10
	3	4	3	6	1	3	2	5	3	3	3
ME →	3	3	3	3	1	1	2	2	3	3	3
C →	~~1~~	0	1	0	1	0	1	0	1	2	3

3 6 1 3 2 5 3 3 3

3 → verify ME { M 3, K 1 }

* this algo doesn't prove at ME (calculated) is actually a ME.
* this algo gives best possible candidate, so, verification is needed.

ex ⇒

	0	1	2	3	4	5	6	7	8	9	10	11	12
arr ⇒	5	5	2	3	5	1	2	5	5	5	4	1	1
ME →	5	5	5	5	5	5	2	2	5	5	5	5	1
C →	1	2	1	0	1	0	1	0	1	2	1	0	1

ME ⇒ 1 → verify → fails return -1

arr ⇒ 3 4 3 6 3 1 3 2 3 5 3 ⇒ 1

ME → 3 3 3 3 3 3 3 3 3 3 3

c → 1 0 1 0 1 0 1 0 1 0 1

ME ⇒ 3

freq of 3 ⇒ 6 > 11/2 = return 3

i) 1 iteration → $\underbrace{\text{algo.}}$

best possible candidate ⇒ x

ii) find freq of x

if freq > N/2 return x

else return -1

pseudo

TODO

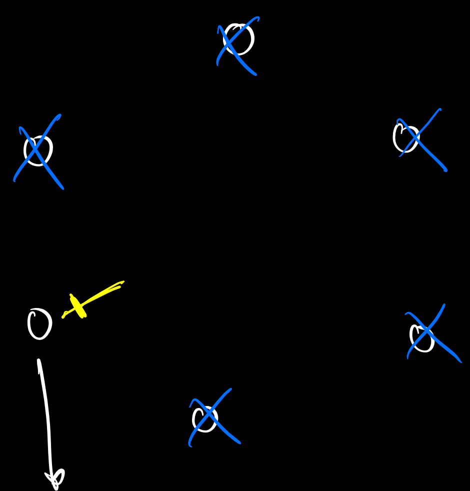
$$\boxed{\begin{array}{l} TC \Rightarrow O(N+N) \Rightarrow O(N) \\ SC \Rightarrow O(1) \end{array}}$$

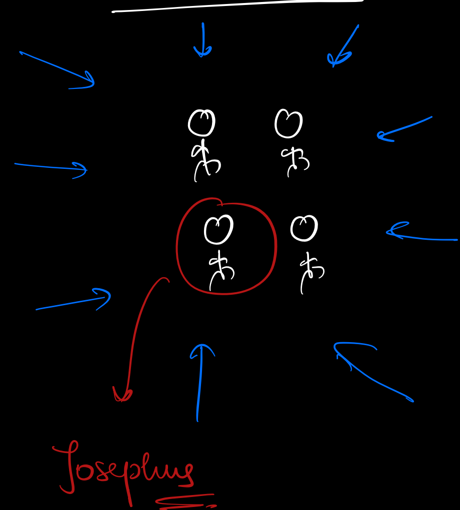
HW Q Find majority element (freq $> N/3$).

Here, An array can have two ME's

Q4. Josephus problem :-

war stories





last man standing.

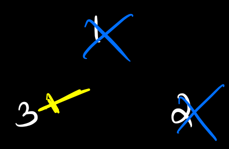
Surrender + joined Romans [Josephus].

If there are N people standing in a circle, where should you stand, so that you are the last man standing.

$N = 1 \rightarrow 1$

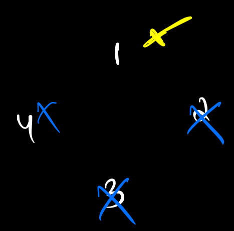
$N \Rightarrow 2 \rightarrow$ 1 $\cancel{2}$ $\Rightarrow 1$

N = 3 →



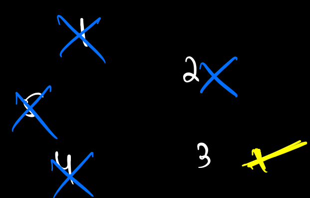
⇒ 3.

N = 4 →



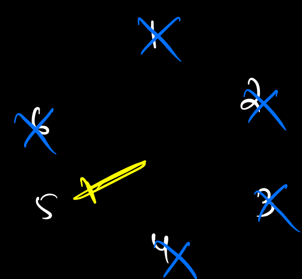
⇒ 1.

N = 5 →



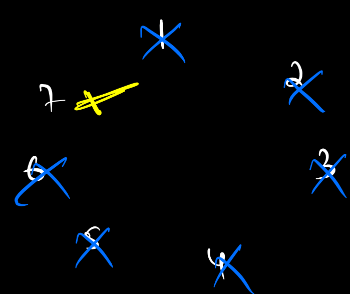
⇒ 3.

N = 6 ⇒



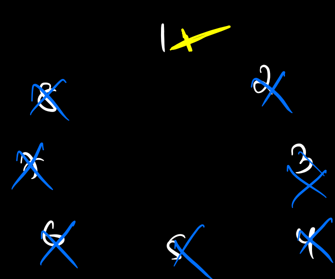
⇒ 5.

N = 7 ⇒



⇒ 7.

N = 8 ⇒



⇒ 1.

$N = 1$

$\boxed{N = 2 \longrightarrow 1}$

$N = 3 \longrightarrow 3$

$\boxed{N = 4 \longrightarrow 1}$

$N = 5 \longrightarrow 3$

$N = 6 \longrightarrow 5$

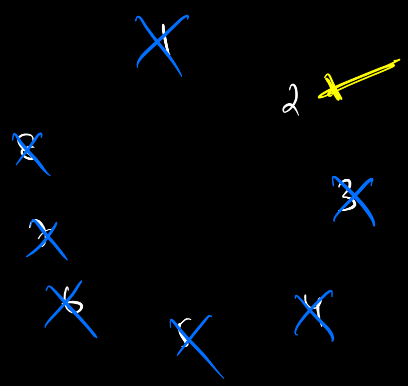
$N = 7 \longrightarrow 7$

$\boxed{N = 8 \longrightarrow 1}$

N is a power of 2,

$N \rightarrow 2^k$,

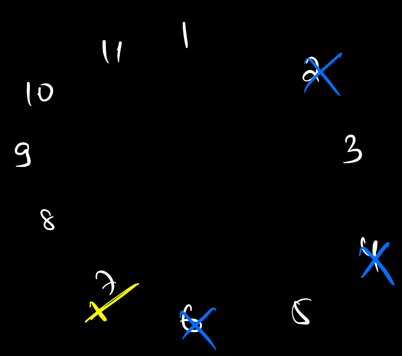
last man standing, but the person starting to kill.



Starting → 2

last man sta → 2.

$N = 11 \rightarrow$

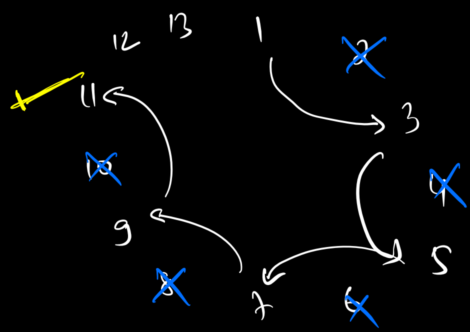


no. of alive = 8 = 2^3

starting pt ⇒ 7

last man stan ⇒ 7

$N = 13$



$(2*1+1)$

$(2*2+1)$

$(2*3+1)$

x kills $\Rightarrow 2 \times x + 1$

N, find the nearest $(<)$ 2^k

$13 \longrightarrow 8$

no. of losers $(x) = N - 2^k$

$= 13 - 8$

$= 5$

position $= 2x+1$

$= 2(5)+1$

$= 11 \longrightarrow$ ans

pseudo

i) find nearest power of 2 $(2^k < N)$

ii) $x = N - 2^k$

iii) ans $= 2x+1$

$N = 17$

$\downarrow$

nearest power of 2^k = 16

$x = 17 - 16$

$= 1$

position $= 2(1) + 1$

$= 3.$