

7:05AM

Topics 8  
1-Special index  
- even/odd PS

2-Majority Element

## P1.1

### Interview Problems

Given an array of size N and Given Q queries

of (s,e) for every query return the sum of  
all even indexed elements in the range s to e.

ex

$a[] : \{ 2, 3, 1, 6, 4, 5 \}$

$Q \rightarrow$

S	E	sum-even
1	3	1
2	5	5
0	4	7
3	3	0

prefix sum?

### Quiz

$A : \{ 2, 4, 3, 1, 5 \}$

$PS_e : \{ 2, 2, 5, 5, 10 \}$

$$\text{sum}_Q(L, R) = \begin{cases} PS[R] - PS[L-1] & L \neq 0 \\ PS[R] & L = 0 \end{cases}$$

$$PS_e[i] = \begin{cases} a[0] & i=0 \\ PS_e[i-1] + a[i] & i \text{ is even \& not } 0 \\ PS_e[i-1] & i \text{ is odd} \end{cases}$$

$$PS_o[i] = \begin{cases} 0 & i=0 \\ PS_o[i-1] & i \text{ is even \& not } 0 \\ PS_o[i-1] + a[i] & i \text{ is odd} \end{cases}$$

# Google

P1.2

Given an array, count number of special index

in the array. Special index is after removing which

sum of all even index elements in the resulting array  
 =  
 sum of all odd index elements in the resulting array

INDEX

ex  $a[] : \{ 4, 3, 2, 7, 6, -2 \}$

special index?  
after removing

i	→ result	Sum	Sum <sub>0</sub>	SI
0	3, 2, 7, 6, -2	8	8	✓ SI
1	4, 2, 7, 6, -2	9	8	X
2	4, 3, 7, 6, -2	9	9	✓ SI
3	4, 3, 2, 6, -2	4	9	X

Count=2

Quiz  $a[] : \{ 4, 1, 5, 3, 7, 10 \}$

$4, 1, 3, 7, 10$  ans=8

Quiz  $a[] : \{ 2, 3, 1, 4, 0, -1, 2, -2, 10, 8 \}$

$2, 3, 1, 0, -1, 2, -2, 10, 8$  ans=3+0+2+10=15

Quiz

$2, 3, 1, 4, 0, -1, 2, -2, 10, 8$

$2, 3, 1, 0, -1, 2, -2, 10, 8$  ans=2+1-1-2+8  
=8 ✓

we want to solve the special index problem

sum of  
odd  
indexes

sum of odd index after removing i=3

sum of odd[0,2] + sum of even[4,9]

sum of  
even  
indexes

sum of even index after removing i=3

sum of even[0,2] + sum of odd[4,9]

for evaluating  
index i

$$\text{Sum}_{\text{even}} = \underbrace{\text{S}_{\text{even}}[0, i-1]}_{\text{A}} + \underbrace{\text{S}_{\text{odd}}[i+1, n-1]}_{\text{B}}$$
$$\text{Sum}_{\text{odd}} = \underbrace{\text{S}_{\text{odd}}[0, i-1]}_{\text{C}} + \underbrace{\text{S}_{\text{even}}[i+1, n-1]}_{\text{D}}$$

Apply  
PS

$\text{PS}_e$  ← apply Prefix sum  
 $\text{PS}_o$

$$Q(L, R) \rightarrow \text{PS} = \begin{cases} \text{PS}[R] - \text{PS}[L-1] & L \neq 0 \\ \text{PS}[R] & L = 0 \end{cases}$$

A  $\text{S}_{\text{even}}[0, i-1] = \text{PS}_e[i-1]$

i=0 C  $\text{S}_{\text{odd}}[0, i-1] = \text{PS}_o[i-1]$

skip

A&C

Assignat B

B  $\text{S}_{\text{odd}}[i+1, n-1] = \text{PS}_{\text{odd}}[n-1] - \text{PS}_{\text{odd}}[i]$

D  $\text{S}_{\text{even}}[i+1, n-1] = \text{PS}_{\text{even}}[n-1] - \text{PS}_{\text{even}}[i]$

calculation PS<sub>o</sub>

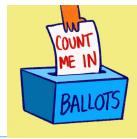
for(i=0; i<n; i++){  
    // A, B, C, D // O(1)

SC: O(n)

TC: O(n)

| if ( $\text{Sum}_{\text{even}} = \text{Sum}_{\text{odd}}$ ) count SI ++

}



## P2 Majority element (M.E.)

Given an array of  $N$  positive numbers, return  
-if exists- an element with frequency  $> \frac{N}{2}$

$\text{ans} = 1$  SC :  $O(1)$

$$\text{ex } \left\{ \frac{1}{6}, \frac{6}{1}, \frac{1}{2}, \frac{1}{3}, \frac{2}{4}, \frac{1}{5} \right\} \quad \left\{ \frac{2}{0}, \frac{1}{1}, \frac{4}{2} \right\} \quad \left\{ \frac{3}{0}, \frac{3}{1}, \frac{9}{2}, \frac{2}{3}, \frac{9}{4}, \frac{7}{5}, \frac{2}{6}, \frac{9}{7} \right\}$$

$$n=6 \quad \frac{n}{2}=3 < 4 \quad n=3 \quad \frac{3}{2}=1.5 < 2 \quad n=8 \quad \frac{n}{2}=4 < 4$$

Quiz

$$a[] : \left\{ \frac{3}{0}, \frac{4}{1}, \frac{3}{2}, \frac{6}{3}, \frac{1}{4}, \frac{3}{5}, \frac{2}{6}, \frac{5}{7}, \frac{3}{8}, \frac{3}{9}, \frac{3}{10} \right\}$$

$$\frac{11}{2}=5.5 < 6 \quad \text{ans} = 3$$

Quiz

$$a[] : \left\{ \frac{4}{0}, \frac{6}{1}, \frac{5}{2}, \frac{3}{3}, \frac{4}{4}, \frac{5}{5}, \frac{6}{6}, \frac{4}{7}, \frac{4}{8}, \frac{4}{9} \right\}$$

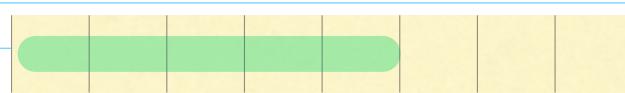
$$\frac{10}{2}=5 < 5 \quad \text{M.E. doesn't exist} \quad \text{ans}$$

ideas? Select private chat, send ideas along TC

Sort  $\text{TC} \approx O(n \log n) + O(n)$   
 $\text{SC} \approx O(1)$

Quiz if M.E.

exist  
it will be unique



$$\frac{8}{2}=4$$

Visualisation

real world

2 1 6 1 1 4 1 1 7

- ① M.E exist
- ② M.E not exist

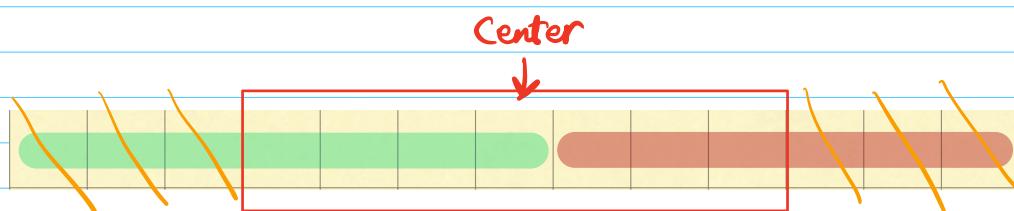
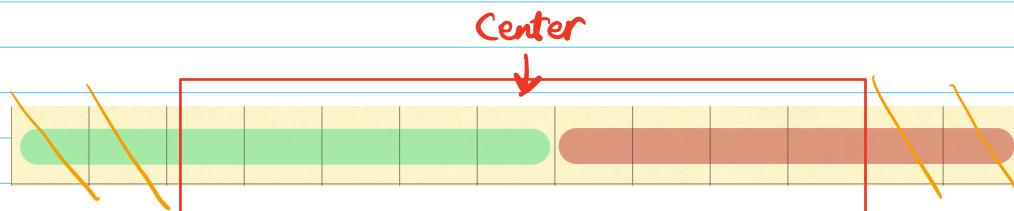
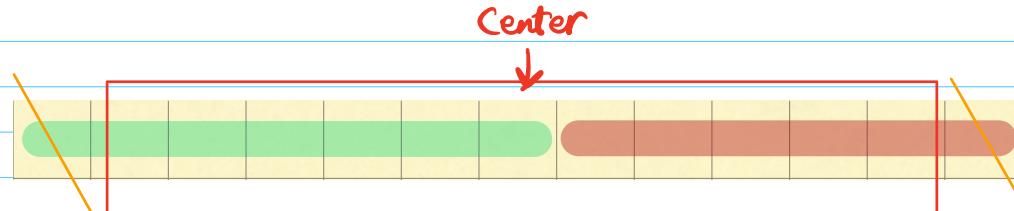
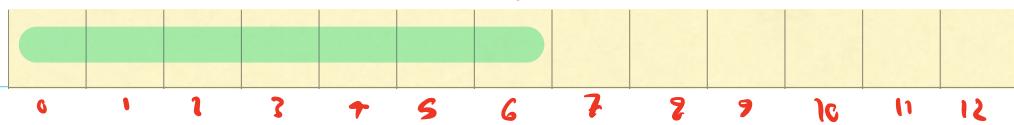
1-ME exist

2-ME is known

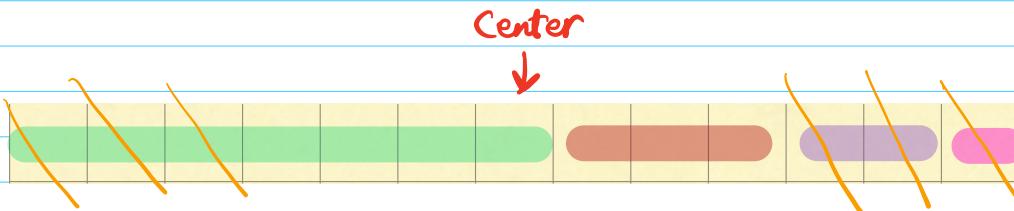
3-MEs are grouped together from 0.

$\frac{13}{2}$

⑦



if we remove one ME & one non-ME,  
ME will be the same



Conclusion

if we remove two distinct elements  
M.E will be the same

How to use this conclusion to solve majority problem?

## Majority Problem

$$\{3, 4, 3, 6, 3, 5, 6, 5, 3, 3, 3\}$$

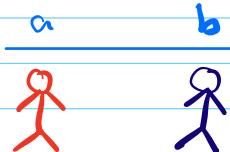
~~2 3 X~~

Moar's  
Algo

negative  
Counting

ex

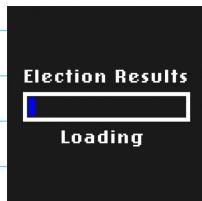
simple  
example  
assume two party



a	b
X	X
X	X
X	X
X	-

b, a, a, b, b, b, a, a, a, b, b

$$6 > \frac{11}{2}$$



ex

1	2	3	4	5	6
Red	Blue	Green	Pink	Orange	Yellow

3, 4, 3, 6, 1, 2, 2, 5, 3, 3, 4, 3, 2

0	ME	3	0	3	0	1	0	2	0	3	3	3	3
0	Count	1	0	1	0	1	0	1	2	3	2	2	2

3 ✓

$$\frac{5}{2} = 2.5$$

0	ME	1	0	1	2	3	4
0	Count	1	0	1	0	1	1

exist?

ME

(bool, int) MajorityElement(int a[]){

    ME = a[0]

    c = 1

TC: O(n)

SC: O(1)

    for(i=1; i < n; i++) {

        if(ME == 0) {

            ME = a[i]

            c = 1

    } else if(ME != 0 && ME != a[i]) {

        c--

        if(c == 0) ME = 0

    } else if(ME != 0 && ME == a[i]) {

        c++

}

// double check the number in ME

reaches to threshold

→ O(n) : TC

O(1) : SC

## HW N3 Majority

Given an array of  $N$  positive numbers, return

-if exists - an element with frequency  $> \frac{N}{3}$

SC:  $O(1)$

ME1      ME2  
C1          C2

1 [2 2 2] [3 3 3] 4 5

# Spiral Matrix

```
9:21 PM Thu Dec 22 *** 52%
xcodesnare
1 public class Solution {
2     public int[][] solve(int[] A, int B, int C) {
3         int di[] = {0,1,0,-1};
4         int dj[] = {1,0,-1,0};
5         int dir=0;
6
7         int i=0, j=-1;
8         int[][] mat = new int[B][C];
9
10        for(int k=0;k<A.length;k++){
11            int nextI = i+di[dir];
12            int nextJ = j+dj[dir];
13
14            // check if out of boundry OR if already the cell occupied with a number
15            if(nextI < 0 || nextI >= B || nextJ < 0 || nextJ >= C || mat[nextI][nextJ] != 0){
16                dir = (dir+1) % 4; //if so change direction to next direction
17                nextI = i+di[dir];
18                nextJ = j+dj[dir];
19            }
20
21            mat[nextI][nextJ] = A[k];
22            i=nextI;
23            j=nextJ;
24        }
25
26        return mat;
27    }
}
```

