

# Interview Problems



Stay motivated, Two Google problems  
coming today :)

## Today's Question

01. Special Index

{  
  | Directi  
  | Google  
  | JP Morgan  
  | Codernation

02. Majority Element

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  | Google  
  | facebook

Q Given an array of size N . Given Q queries of s & e . For every query return the sum of all even indexed elements in the range from s to e.

$$ar[ ] = \begin{array}{|c|c|c|c|c|c|c|} \hline 2 & 3 & 1 & 6 & 4 & 5 \\ \hline 0 & 1 & 2 & 3 & 4 & 5 \\ \hline \end{array}$$

$Q = 4$

st end

$$1 \quad 3 \longrightarrow ar[2] = 1$$

$$2 \quad 5 \longrightarrow ar[2] + ar[4] = 1 + 4 = 5$$

$$0 \quad 4 \longrightarrow ar[0] + ar[2] + ar[4] = 2 + 1 + 4 = 7$$

$$3 \quad 3 \longrightarrow 0$$

Brute force  $\rightarrow$

$Q$  times  $\left\{ \begin{array}{l} \text{Iterate from } s \text{ to } e, \text{ check for} \\ \text{even indexed ele \& add them to your} \\ \text{sum.} \end{array} \right.$

$$TC = O(Q * n)$$

$$SC = O(1)$$

Idea 2

$Pse[i]$  = sum of all even indexed ele from 0 to i

$$Pse[i] = \begin{cases} Pse[i-1] + A[i] & i \text{ is even} \\ Pse[i-1] + 0 & i \text{ is odd} \end{cases}$$

$arr[] = [2 | 3 | 6 | 1 | 4 | 5] \rightarrow n \text{ size}$

$Pse[] = [2 | 2 | 8 | 8 | 12 | 12] \rightarrow n \text{ size}$

`int [] pse = new int[n]`

$pse[0] = arr[0]$

`for (i=1; i<n; i++)`

`if (i%2 == 0) pse[i] = pse[i-1] + arr[i]`

`else pse[i] = pse[i-1] + 0`

`3`

Range sum Query question → **TODO**

Prefix odd org

$\text{arr}[] = \{2, 4, 3, 1, 5\}$

$\text{podd}[] = \{0 \ 4 \ 4 \ 5 \ 5\}$

$\text{int } [] \ pse = \text{new int}[n]$

$pse[0] = 0;$

$\text{for } (i=1; i < n; i++)$

if ( $i \% 2 == 0$ )  $pse[i] = pse[i-1] + \text{arr}[i]$

else  $pse[i] = pse[i-1] + 0$

3

## 02. Special Index

An index is said to be special index, if after deleting that index,

sum of all even indices = sum of all odd indices  
elements elements

Count total no. of special index.

Eg!:  $\text{ar}[6] : [4 \underset{0}{\cancel{}} \underset{1}{\cancel{}} \underset{2}{\cancel{}} \underset{3}{\cancel{}} \underset{4}{\cancel{}} \underset{5}{\cancel{}} 6 \underset{s}{\cancel{-2}}]$

deleting

$$\text{ar}[5]$$

se

$s_0$

special  $\leftarrow 0$   
index

$$\{3 \underset{0}{\cancel{}} 2 \underset{1}{\cancel{}} 7 \underset{2}{\cancel{}} 6 \underset{3}{\cancel{}} -2\}$$

8

8

$$x \quad 1 \quad \{4 \underset{0}{\cancel{}} 2 \underset{1}{\cancel{}} 7 \underset{2}{\cancel{}} 6 \underset{3}{\cancel{}} -2\} \quad 9 \quad 8$$

special  $\leftarrow 2$   
index

$$\{4 \underset{0}{\cancel{}} 3 \underset{1}{\cancel{}} 7 \underset{2}{\cancel{}} 6 \underset{3}{\cancel{}} -2\} \quad 9 \quad 9$$

$$x \quad 3 \quad \{4 \underset{0}{\cancel{}} 3 \underset{1}{\cancel{}} 2 \underset{2}{\cancel{}} 6 \underset{3}{\cancel{}} -2\} \quad 4 \quad 9$$

$$x \quad 4 \quad \{4 \underset{0}{\cancel{}} 3 \underset{1}{\cancel{}} 2 \underset{2}{\cancel{}} 7 \underset{3}{\cancel{}} -2\} \quad 4 \quad 10$$

$$x \quad 5 \quad \{4 \underset{0}{\cancel{}} 3 \underset{1}{\cancel{}} 2 \underset{2}{\cancel{}} 7 \underset{3}{\cancel{}} 6\} \quad 12 \quad 10$$

Ans = 2

Obs 1 → Deleting ele from the array

Shift all the RHS ele by 1

Idea 1

- Delete a particular index, create a  $cp[0:n-1]$
- Iterate on  $cp[0:n-1]$  &  $s_e$  and  $s_o$
- if ( $s_e == s_o$ ) count += 1

int specialIndex (int [] arr)

count = 0

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

// i+idx is one to delete → create  $cp[0:n-1]$

arr [] = {  $a_0 a_1 a_2 \dots a_{i-1}$  a<sub>i</sub>  $a_{i+1} \dots a_{n-1}$  }

$cp[] = \{ a_0 a_1 a_2 \dots a_{i-1} \quad a_{i+1} \dots a_{n-1} \}$

Iterate on  $cp[]$  & figure out  $s_o = \text{sum of odd indexed ele}$

$s_e = \text{sum of even indexed ele}$

if ( $s_o == s_e$ ) { count++; }

return count;

TC = O(n<sup>2</sup>)

SC = O(n)

## Idea 2

$$a\pi[12] = \{ 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 \}$$

0 1 2 3 4 5 6 7 8 9 10 11

$$c_p[11] = \{ 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12 \}$$

0 1 2 3 4 5 6 7 8 9 10

$$S_e = c_p S_e [0-10] = \{ 1, 3, 5, 8, 10, 12 \}$$

0 2 4 6 8 10

$$c_p S_e [0-4] + c_p S_e [5-10]$$

$$S_e = c_p S_e [0-4] + c_p S_e [5-10]$$

$$S_e = a\pi S_e [0-4] + a\pi S_o [6-11]$$

$$\underline{S_o} = c_p S_o [0-10] = c_p S_o [0-4] + c_p S_o [5-10]$$

$$S_o = a\pi S_o [0-4] + a\pi S_e [6-11]$$

deleting 1<sup>st</sup> index

$$arr[12] = \{ 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 \}$$

○ 1 2 3 4 5 6 7 8 9 10 11

$$cp[11] = \{ 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 \}$$

○ 1 2 3 4 5 6 7 8 9 10

$$Se = CpSe[0-10] = CpSe[0-0] + CpSe[1-10]$$

$$Se = arrSe[0-0] + arrSo[2-11]$$

Generalisation

$$arr[n] = \{ a_0, a_1, a_2, \dots, a_{i-1}, \underline{a_i}, a_{i+1}, \dots, a_{n-1} \}$$

$$cp[n-1] = \{ a_0, a_1, a_2, \dots, a_{i-1}, a_{i+1}, a_{i+2}, \dots, a_{n-1} \}$$

○ 1 2 i-1 i i+1 n-2

$$Se Cp[0-(n-2)] = Se Cp[0-(i-1)] + \underline{Se Cp[i-(n-2)]}$$



$$Se = arrSe[0-(i-1)] + arrSo[i+1-(n-1)]$$

$$Se = arrSe[0-(i-1)] + arrSo[(i+1)-(n-1)]$$

$$So = arrSo[0-(i-1)] + arrSe[(i+1)-(n-1)]$$

→ Create peven & podd array

$$S_e = p_{even}[i-1] + \{ p_{odd}(n-1) - p_{odd}(i) \}$$

$$S_o = p_{odd}[i-1] + \{ p_{even}(n-1) - p_{even}(i) \}$$

```
int special_index (int []arr) {
```

TC : O(N)

SC : O(N)

```
    count = 0
```

```
// Create peven & podd array
```

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

```
        // deleting the i+ idx
```

$$S_e = p_{odd}[n-1] - p_{odd}[i]$$

$$\text{if } (i > 0) \{ S_e += p_{even}[i-1] \}$$

$$S_o = p_{even}[n-1] - p_{even}[i] :$$

$$\text{if } (i > 0) \{ S_o += p_{odd}[i-1] \} :$$

```
    if (Se == So) count++;
```

```
}
```

```
return count;
```

Ready for another mind boggling question

Q2. Given N arr elements. Find majority ele without modifying array.



$$T.C = O(n)$$
$$S.C = O(1)$$

An ele with  $> \frac{N}{2}$  freq

$$\text{arr}[6] = \{ 1, 2, 1, 6, 1, 1 \}$$

0 1 2 3 4 5

$$\text{count} = 1 \rightarrow 1 > \frac{6}{2} .$$

$$\text{count} = 2 \rightarrow 1 > \frac{6}{2} \times$$

$$\text{count} = 6 \rightarrow 1 > \frac{6}{2} \times$$

Majority element = 1

$$\text{arr}[ ] = \{ 3, 4, 3, 6, 1, 3, 2, 5, 3, 3, 3 \}$$

0 1 2 3 4 5 6 7 8 9 10

$$\frac{N}{2} = \frac{11}{2} \Rightarrow 5$$

Majority ele = 3

$$3 \rightarrow \underline{\underline{\text{count}}} \quad 6 > 5$$

$$4 \rightarrow 1$$

$$6 \rightarrow 1$$

$$5 \rightarrow 1$$

$$1 \rightarrow 1$$

$$2 \rightarrow 1$$

03

$$\text{arr[ ]} = \{ 4 \ 6 \ 5 \ 3 \ 4 \ 5 \ 6 \ 4 \ 4 \ 4 \}$$

0 1 2 3 4 5 6 7 8 9

unique ele      frequency       $\frac{n}{2} \Rightarrow 5$

|   |   |   |     |   |
|---|---|---|-----|---|
| 4 | → | 5 | > 5 | x |
| 6 | → | 2 | > 5 | x |
| 5 | → | 2 | > 5 | x |
| 3 | → | 1 | > 5 | x |

No majority  
ele

Idea 1 → Check the frequency for each &  
every ele & check if freq  $> \frac{n}{2}$

and

Two nested loops



TC:  $O(n^2)$

SC:  $O(1)$

```

for (i=0; i<n; i++)
    // count the freq for "i" idx ele
    count = 0
    for (j=0; j<n; j++) {
        if (arr[i] == arr[j]) count++;
    }
    if (count > n/2) ans = arr[i];
}

```

## Idea 2

At max, how many majority ele can be there  $\Rightarrow 1$

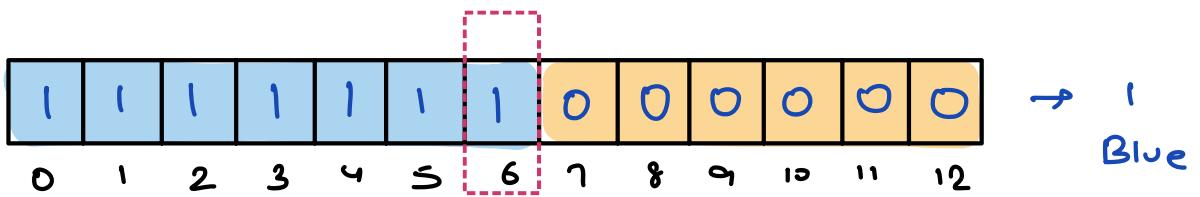
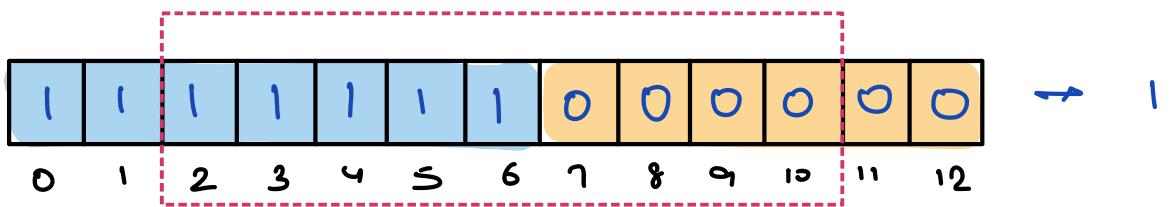
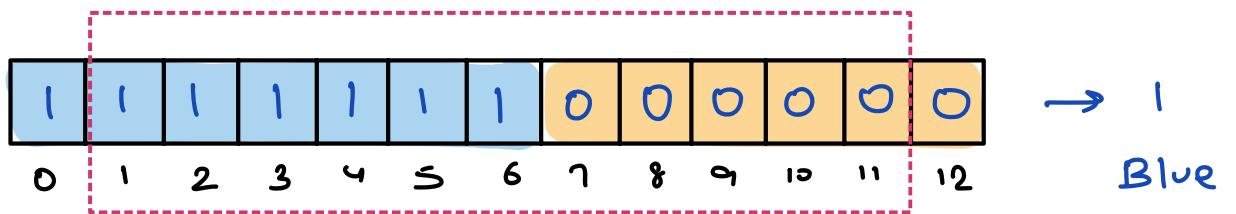
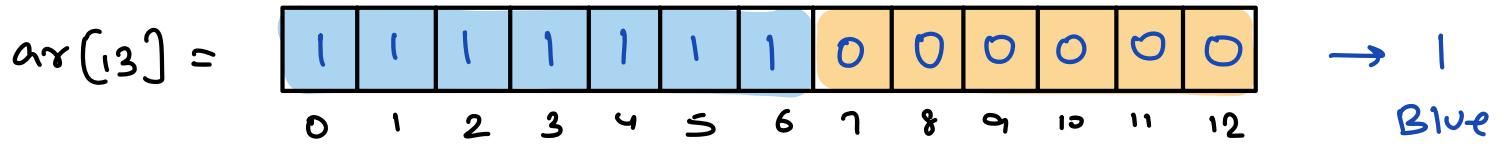
Let say we have two majority ele  $\{m_1, m_2\}$

$$\text{freq}(m_1) > n/2$$

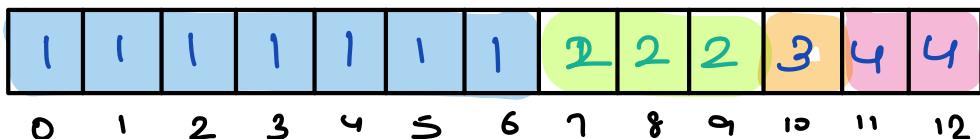
$$\text{freq}(m_2) > n/2$$


---

$$\text{freq}(m_1) + \text{freq}(m_2) > n \rightarrow \text{This is not possible}$$



If you have a majority ele & you are deleting one ele from both the sides then also your majority is always going to remain same  $> \frac{n}{2}$ .



Obs → If one majority ele is removed with  
one non-majority element then also  
majority ele remains same

→ Remove ~~two~~ some element

~~removing both majority ele~~

{ removing both non-majority ele }

\* Remove two distinct ele

↳ remove one majority & non majority

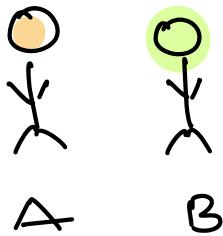
↳ remove two non-majority distinct

$\text{arr}[] = \{ \cancel{3}, \cancel{4}, \cancel{3}, \cancel{6}, \cancel{1}, \cancel{3}, \cancel{2}, \cancel{5}, 3, 3, 3 \} \Rightarrow 3$

$\text{arr}[] = \{ 1, \cancel{1}, \cancel{1}, \cancel{0}, \cancel{0} \}$

$$\text{arr}[6] = \{ \underset{0}{\cancel{X}}, \underset{1}{\cancel{2}}, \underset{2}{1}, \underset{3}{\cancel{6}}, \underset{4}{\cancel{1}}, \underset{5}{1} \} \Rightarrow 1$$

2 candidates



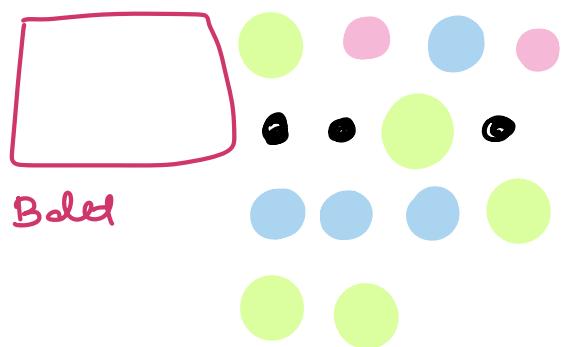
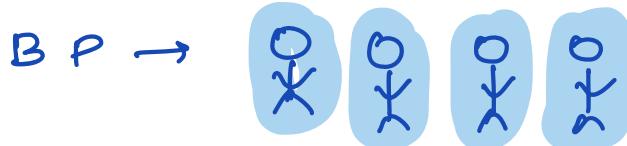
A  
B



Ballot box

+  
∅  
+  
2  
+  
1  
X  
X  
O

\* — \* — + — \* — — \* — — +



GP

Blue

Black

Blue

Green

x o

x o

x 2 x 2 x 0

x o

x 2 3

... 6

$$\text{arr}[] = \{ 3, 4, 3, 6, 1, 3, 2, 5, 3, 3, 3 \}$$

0 1 2 3 4 5 6 7 8 9 10

majorle = 3

|                                  |          |          |          |
|----------------------------------|----------|----------|----------|
| $\text{count} = x \emptyset x o$ | $ $<br>1 | $ $<br>2 | $ $<br>3 |
|                                  | $x o$    | $x o$    | $x 2 3$  |

Ans = 3

$$\text{arr}[6] = \{ 1, 2, 1, 6, 1, 1 \}$$

0 1 2 3 4 5

ME

1

Ans = 1

count

x o x o x 2

Boyer - Moore Voting Algo

```

int majority_ele (int [] arr)
{
    maj = arr[0], freq = 1

    for (i=1; i<n; i++)
    {
        if (freq == 0)
        {
            maj = arr[i], freq = 1
            3
        }
        else if (arr[i] == maj)
        {
            freq++;
            3
        }
        else
        {
            freq--;
            3
        }
        3
    }

    int count = 0
    for (i=0; i<n; i++)
    {
        if (arr[i] == maj) count++;
        3
    }

    if (count > n/2) return maj;
    else return -1;
}

```

2

$$\text{arr[ ]} = \{ 4 \downarrow 6 \downarrow 5 \downarrow 3 \downarrow 4 \downarrow 5 \downarrow 6 \downarrow 4 \downarrow 4 \downarrow 4 \downarrow \}$$

0 1 2 3 4 5 6 7 8 9

|             |     |      |     |      |     |      |     |      |
|-------------|-----|------|-----|------|-----|------|-----|------|
| $maj = 4$   | $ $ | $5$  | $ $ | $4$  | $ $ | $6$  | $ $ | $4$  |
| $freq = xo$ | $ $ | $xo$ | $ $ | $xo$ | $ $ | $xo$ | $ $ | $x2$ |

$maj = 4$  ~~X~~

|                                       |
|---------------------------------------|
| 1   1   1   1   2   2   2   2   5   5 |
| 0 1 2 3 4 5 6 7 8 9                   |

$\text{maj ele} > \frac{n}{3} = 3$



We can have two answers