Today's Content 3 → 2 classes

→ Prefix Sum Introduction

→ Problems based on Prefix Sum

Quote

I wanted the reward and not the struggle.
I wanted the result and not the process.
I was not in love with the fight but only the victory.

And life doesn't work that way.

Ques Given N array elements & Q queries in same array.

for each query calculate sum of all elements in Given range.

	0	1	2	3	4	5	6	7	8	9
arr[10] =	-3	6	2	4	5	2	8	-9	3	1

Q = 6

L	R	
4	8	: 9
3	7	: 10
1	3	: 12
0	4	: 14
6	9	: 3
7	7	: -9

idea :-

for all queries, iterate over L-R & get Sum

Pseudo code

```
// Given arr[N]
for(j=0; j<Q; j++){
    Read L & R
    int sum=0
    for(i=L; i<=R; i++){
        sum = sum + arr[i]
    }
    Print(Sum)
}
```

T.C → O(Q * N)

S.C → O(1) → Constant

// Given Indian Team Scores for first 10 overs of Batting After every current Score given.

Overs :	1	2	3	4	5	6	7	8	9	10
Scores	2	8	14	29	31	49	65	79	88	97

↳ cumulative sum

(1) Total no. of runs scored in last overs → 97-88 = 9

(2) Total runs scored in last 5 overs = 97-31 = 66

(3) Total runs made in 7th over = 65-49

(4) Total runs made from [3-6] over ⇒ 49-8

(5) Total runs scored from [1-5] over → 31

(6) Total runs scored from [4-8] over ⇒ 79-14

	0	1	2	3	4	5	6	7	8	9
arr[10] =	-3	6	2	4	5	2	8	-9	3	1
pf[10] =	-3	3	5	9	14	16	24	15	18	19

pf[10] → Prefix array

pf[3] = 9 ⇒ Sum of all elements from [0-3]

pf[5] = 16 ⇒ Sum of all elements from [0-5]

L R

Sum[4-8] = arr[4] + arr[5] + arr[6] + arr[7] + arr[8]

Add Sum[0 3] on both sides

→ Sum[0 3] + Sum[4-8] =

arr[4] + arr[5] + arr[6] + arr[7] + arr[8]
+ arr[0] + arr[1] + arr[2] + arr[3]

= pf[8]

→ Sum[0 3] + Sum[4 8] = pf[8]

→ pf[3] + Sum[4 8] = pf[8]

→ Sum[4 8] = pf[8] - pf[3]

* $sum[3-7] = pf[7] - pf[2]$

* $sum[5-9] = sum[0-9] - sum[0-4]$

$sum[5-9] = pf[9] \quad pf[4]$

* $sum[2-6] = sum[0-6] - sum[0-1]$

$sum[2-6] = pf[6] - pf[1]$

$l <= R$

* $sum[L-R] = sum[0-R] - sum[0-L-1]$

$sum[L-R] = pf[R] - pf[L-1]$

$sum[0-2] = pf[2] - pf[-1]$

[1]

$pf[2]$

-1

array out of bound exception

$L-R \Rightarrow sum[L-R] \Rightarrow$ { if ($L == 0$) : $pf[R]$; else : $pf[R] - pf[L-1]$ }

Sum[s-5] = pf[5] - pf[4].

Given ar[n] → pf[n]

pf[0] = ar[0]

pf[1] = ar[0] + ar[1]

pf[2] = ar[0] + ar[1] + ar[2]

↓

pf[2] = pf[1] + ar[2]

pf[5] = pf[4] + ar[5]

pf[i] = pf[i-1] + ar[i].

pf[0] = pf[-1] + ar[0].

→ out of bound.

→ given ar[n].

```
int pf[n]
pf[0] = ar[0].
for (i=1; i<n; i++) {
    pf[i] = pf[i-1] + ar[i]
}
```

```
          0  1  2  3  4
arr =     5, 4, 3, 2, 10
pf        5  9  12 14 24

i = 0, 1, 2, 3
```

// Sum of 0 queries

// Given arr[N]

given arr[N].

```
int pf[n]
pf[0] = arr[0];
for (i=1; i<N; i++) {
    pf[i] = pf[i-1] + arr[i]
}
```

Read Q. → L & R

```
for (i=0; i<Q; i++) {
    if (L==0) { Print(pf[R])
    else {
        Print(pf[R]-pf[L-1])
    }
}
```

T.C → O(O+N)

S.C → O(N)

10:30 → 10:40pm

Ques) Equilibrium Index

Given N array elements, count no of equilibrium Index ?

An index i is said to be equilibrium index if ?

Sum of all elements Before ith index = Sum of all elements after ith index

Sum[0 i-1] = Sum[i+1, N-1]

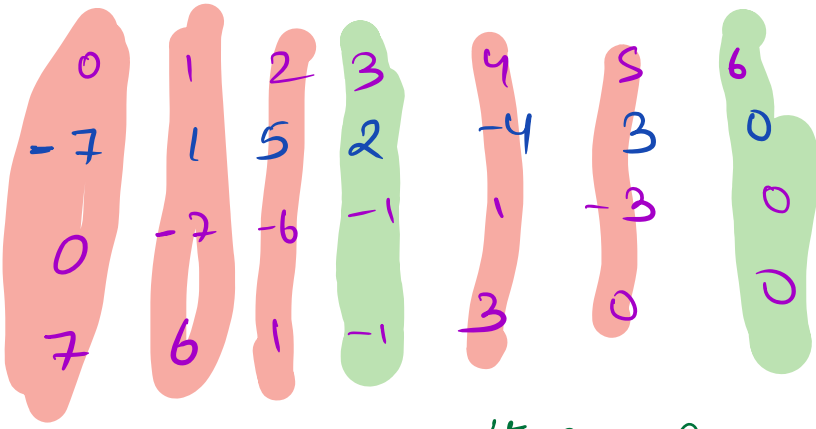
Note :- if i==0, left=0, if i== N-1, right=0

Ex :- arr[4] =

	0	1	2	3
	-3	2	4	-1
left =	0	-3	-1	3
right =	5	3	-1	0

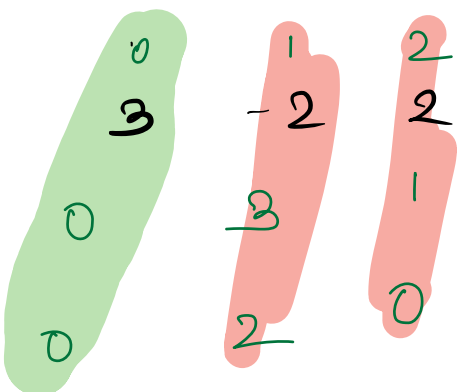
ans = 1

Ex 2:-



ans = 2

Ex 3:- arr[] =



Ans = 1

idea :- check if every index is equilibrium or not

```
int countEquilibrium(int arr[]) {
    int n = arr.length;
    int c = 0;
    int pf[n]; { Initialize value Todo }
    for(i=0; i<n; i++) {
        // if index i is equilibrium index
        // left = Sum[0 i-1] = pf[i-1]
        int left = 0
        if(i>0) { left = pf[i-1] }
```

```
        // right = sum[i+1 ... n-1] => pf[n-1] - pf[i]
        int right = pf[n-1] - pf[i];
        if (left == right) { c = c + 1; }
    }
    return c;
}
```

T.C → $O(n + n) = O(n)$

S.C → $O(n)$

19:05 pm → revise it