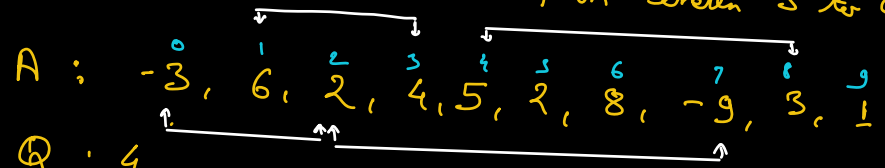
Q Given an array of size N & Q queries denoting a range from index s to e.

s → start, e → end

Return the sum of elements from index s to e



s	e	
1	3	⇒ 12
2	7	⇒ 12
4	8	⇒ 9
0	2	⇒ 5

```
for(i=0; i<Q; i++){

    // Scan (s, e)
    Sum = 0;
    for(j = s; j<= e; j++){
        Sum += a[j];
    }
    Print(sum);
}
```

O(N)

TC : O(QN)

SC : O(1)

Given the scores of last 10 overs of a match.

SA vs WI

ABD : 100 (31)

41	42	43	44	45	46	47	48	49	50
288,	312,	330,	349,	360,	383,	394,	406,	436,	439

Runs scored in last 5 overs from overs [46, 50]

$\Rightarrow R[50] - R[45] = 439 - 360 = 79$

$46^{th} - 49^{th}$

Runs scored in the last over from over [50, 50]

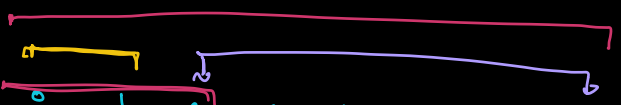
$\Rightarrow R[50] - R[49] = 439 - 436 = 3$

Runs scored in 49^{th} over from [49, 49]

$\Rightarrow R[49] - R[48] = 436 - 406 = 30$

Runs scored from 42^{nd} to 45^{th} from [42, 45]

$\Rightarrow R[45] - R[41] = 360 - 288 = 72$



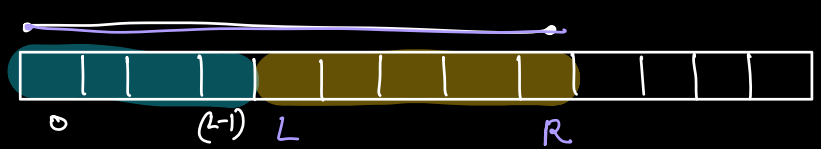
A : -3, 6, 2, 4, 5, 2, 8, -9, 3, 1

⇒ PS : -3, 3, 5, 9, 14, 16, 24, 15, 18, 19 ✓

Prefix Sum array

PS[i] ⇒ Sum of all elements from index 0 to i

	S	C			
O(1) ∈ 1		3	⇒	PS[3] - PS[0]	⇒ 9 - (-3) = 12
O(1) ∈ 2		7	⇒	PS[7] - PS[1]	⇒ 15 - 3 = 12
O(1) ∈ 4		8	⇒	PS[8] - PS[3]	⇒ 18 - 9 = 9
⇒	0	2	⇒	PS[2]	⇒ 5
	L	R	⇒	PS[R] - PS[L-1]	



Sum(0-R) = Sum(0, L-1) + Sum(L, R)

Sum(L, R) = Sum(0-R) - Sum(0, L-1)

Sum(L, R) = PS[R] - PS[L-1]

$$Sum(L,R) = \begin{cases} PS[R] - PS[L-1] & \text{if } L>0 \\ P[R] & \text{if } L=0 \end{cases}$$

$PS[0] = A[0]$

$PS[1] = A[0] + A[1] \Rightarrow P[0] + A[1]$

$PS[2] = A[0] + A[1] + A[2] \Rightarrow PS[1] + A[2]$

$PS[3] = A[0] + A[1] + A[2] + A[3] \Rightarrow PS[2] + A[3]$

$PS[4] = A[0] + A[1] + A[2] + A[3] + A[4] \Rightarrow PS[3] + A[4]$

$\vdots$

$PS[i] = A[0] + A[1] + A[2] \cdots A[i-1] + A[i] \Rightarrow PS[i-1] + A[i]$

```
PS[0] = A[0];
for(i=1; i<N; i++){
    PS[i] = PS[i-1] + A[i];
}
```

TC : O(N)
SC : O(N)

Overall TC

$O(N+Q)$

Zeta Q Given an array. Return true of there exists an equilibrium index.

EI ⇒ index for which,

Sum of all the no. on the left side = Sum of all the no. on the right side of it.

A: 1, 2, 3, 4, 8, 10 (10 | 10) ⇒ True

Quiz: -7, 1, 5, [2], -4, 3, 0 (-1 | -1)

```
for (i=0; i<N; i++) {
    // Calculate SL
    for (int j = 0; j<i; j++) {
        SL = a[j] + SL;
    }
    // Calculate SR
    for (int j = i+1; j<N; j++) {
        SR = a[j] + SR;
    }
    if (SL == SR) return true;
}
```

Range Sum for 0 to i-1 ⇒ $S_L = PS[i-1]$

Range Sum for i+1 to N-1 ⇒ $S_R = PS[N-1] - PS[i]$

TC: $O(N^2)$

TC: Build the PS + Find EI ⇒ $O(N)$

SC: $O(N)$

HW1:

TC : O(N)

Try to solve it without any extra space.

SC : O(1)

Without modifying the given array.

30 min

Break for 10 min 9:28 - 9:33

doubts

$$Sum(L,R) = PS[R] - PS[L-1]$$

$L = (i+1)$, $R = (N-1)$

$$Sum(L,R) = PS[N-1] - PS[(i+1)-1]$$

$$= PS[N-1] - P[i]$$

Q Given an array & Q queries of ranges from s to e & O/E

⇒ S, e, O ⇒ Sum of all the odd indexed elements from s to e

S, e, E ⇒ Sum of all the even indexed elements from s to e

	0	1	2	3	4	5	6	7
A :	2,	3,	1,	-1,	0,	8,	5,	4

3, 6, O ⇒ A[3] + A[5] = 7

1, 5, E ⇒ A[2] + A[4] = 1

3, 3, E ⇒ 0

Range Sum ⟹ Prefix Sum

$PS_e[i]$ ⇒ Sum of all **even** indexed elements fr 0 to i

$PS_o[i]$ ⇒ Sum of all **odd** indexed elements fr 0 to i

Quiz

	0	1	2	3	4
	2	4	3	1	5
PS_o :	0	4	4	5	5

Quiz

i	0	1	2	3	4	5	6
	4	1	0	-2	3	2	5
⇒	4	0	0	0	3	0	5
PS_e :	4	4	4	4	7	7	12

	0	1	2	3	4	5	6	7
A :	2	3	1	-1	0	8	5	4
PS_o :	0	3	3	2	2	10	10	14
PS_e :	2	2	3	3	3	3	8	8

3, 6, O ⇒ $PS_o[6] - PS_o[2] = 10 - 3 \Rightarrow 7$

1, 5, E ⇒ $PS_e[5] - PS_e[0] = 3 - 2 \Rightarrow 1$

3, 3, E ⇒ $PS_e[3] - PS_e[2] = 3 - 3 \Rightarrow 0$

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

Google
Direct-i
CodeNation

Q Given an array of size N.
Count no. of special indices in the array.

Special index : An index after removing which,

Sum of all the even indexed elements == Sum of all the odd indexed elements.

0	1	2	3	4	5
4	3	2	7	6	-2

Remove

i = 0 : 3 2 7 6 -2 → $S_e = 8$, $S_o = 8$ ✓

i = 1 : 4 2 7 6 -2 → $S_e = 9$, $S_o = 8$ ✗

i = 2 : 4 3 7 6 -2 → $S_e = 9$, $S_o = 9$ ✓

Quiz

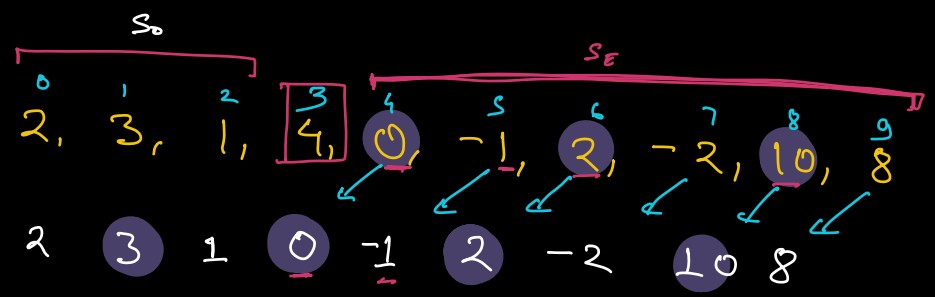
0	1	2	3	4	5
4,	1,	5,	3,	7,	10

4 1 3 7 10

Remove A[2] & Calculate S_o

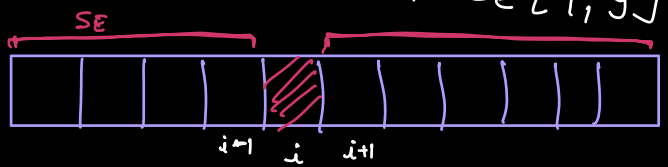
⇒ 8

Quiz



$\Rightarrow$ IS

$S_o = S_o[0, 2] + S_e[4, 9]$



After removal of i^{th} index

$S_E = S_E[0, i-1] + S_o[i+1, N-1]$

$S_o = S_o[0, i-1] + S_E[i+1, N-1]$

- $PS_o \rightarrow$ Odd indexed PS
- $PS_E \rightarrow$ Even indexed PS

$S_E[0, i-1] \Rightarrow PS_E[i-1]$

$S_o[0, i-1] \Rightarrow PS_o[i-1]$

$S_o[i+1, N-1] \Rightarrow PS_o[N-1] - PS_o[i]$ $\Leftarrow$ (N-2)

$S_e[i+1, N-1] \Rightarrow PS_E[N-1] - PS_E[i]$

// Build PS_E ⟶ O(N)

// Build PS_O ⟶ O(N)

Ans = 0;

for (i=0; i<N; i++) { ⟶ O(N)

// S_E → Sum of all even indexed elements after removal of index i.

Check for i=0

S_E = $PS_E[i-1]$ + ($PS_O[N-1]$ - $PS_O[i]$); // O(1)

// S_O → Sum of all odd indexed elements after removal of index i.

S_O = $PS_O[i-1]$ + ($PS_E[N-1]$ - $PS_E[i]$); // O(1)

if (S_E == S_O)

ans ++;

}

TC : O(N)

SC : O(N)

HW : After solving HW1.*

Try to think of an approach having

TC : O(N)

SC : O(1)

Without modifying the given array.

N x M

O(NM)