

Armaan

Q Given an array of size N.

& Q queries of the format $\frac{s}{\downarrow} \& \frac{e}{\downarrow}$
Start end

Return the sum of elements from index s to e.

A : $\begin{matrix} 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 \\ -3, & 6, & 2, & 4, & 5, & 2, & 8, & -9, & 3, & 1 \end{matrix}$

Q : 4

S	e	
1	3	$\Rightarrow 12$
2	7	$\Rightarrow 12$
4	8	$\Rightarrow 9$
0	2	$\Rightarrow 5$

for ($i=0$; $i < Q$; $i+1$) {

 Scan (s, e) {

 Sum = 0;

 for ($j=s$; $j \leq e$; $j+1$) {

 Sum = Sum + a[j];

 }

$s=0, e=n-1$

$O(N)$

TC: $O(QN)$

SC: $O(1)$
(Extra)

}

Given the scores of last 10 overs of a match.

$$\underline{288}, \underline{\underline{312}}, \underline{\underline{330}}, \underline{\underline{349}}, \underline{\underline{360}}, \underline{\underline{383}}, \underline{\underline{394}}, \underline{\underline{406}}, \underline{\underline{436}}, \underline{\underline{439}}$$

$$\text{Runs scored in last 5 overs} = 439 - 360 \\ [46, 50] \quad R[50] - R[45]$$

$$\text{Runs scored in 50th over} = 439 - 436 \\ [50, 50] \quad R[50] - R[49]$$

$$\text{Runs scored in 49th over} = 436 - 406 \\ [49, 49] \quad R[49] - R[48]$$

$$\text{Runs scored from 42^{nd} to 45^{th}} = 360 - 288 \\ [42, 45] \quad R[45] - R[41]$$

$$A B D \Rightarrow 100^*(31) \\ 150^*$$

Prefix Array \Rightarrow Every index should store

Sum of all elements from start till
that index.

$PS[i] \Rightarrow$ sum of elements from index $0 \rightarrow i$

$$A : \begin{matrix} \downarrow \\ -\underline{3}, \ 6, \ 2, \ 4, \ 5, \ 2, \ 8, \ -9, \ 3, \ 1 \end{matrix}$$

$$\underline{PS} : \underline{-3, 3, 5, 9, 14, 16, 24, 15, 18, 19}$$

$$\left| \begin{array}{l}
 PS[0] = A[0], \\
 PS[1] = \underbrace{A[0] + A[1]}_{PS[0]}, \\
 PS[2] = \underbrace{A[0] + A[1] + A[2]}_{PS[1]} \Rightarrow PS[1] + A[2], \\
 PS[3] = \underbrace{A[0] + A[1] + A[2] + A[3]}_{PS[2]} \Rightarrow PS[2] + A[3], \\
 \vdots \\
 PS[i] = \underbrace{A[0] + A[1] + \dots + A[i-1] + A[i]}_{PS[i-1]} \Rightarrow PS[i-1] + A[i]
 \end{array} \right.$$

$$\left[\begin{array}{l}
 PS[0] = \underline{A[0]}, \\
 \text{for } (i=1; i < N; i++) \{ \\
 \quad PS[i] = PS[i-1] + A[i], \\
 \}
 \end{array} \right. \quad \begin{array}{l}
 \# \text{ of iterations} = N \\
 TC : O(N) \\
 SC : \underline{O(1)}
 \end{array}$$

$$A : \underline{-3}, \underline{6}, \underline{2}, \underline{4}, \underline{5}, \underline{2}, \underline{8}, \underline{-9}, \underline{3}, \underline{1}$$

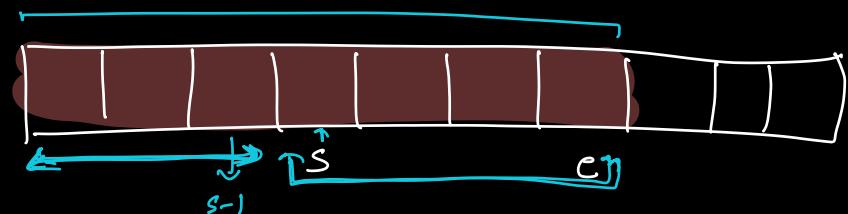
\uparrow \downarrow
 \uparrow \downarrow

$$\underline{P.S} : \underline{-3}, \underline{3}, \underline{5}, \underline{9}, 14, 16, 24, 15, \underline{18}, 19$$

\uparrow \downarrow

$$S \quad e \Rightarrow PS[e] - PS[S-1]$$

$$\left. \begin{array}{lll} 1 & 3 & \Rightarrow 9 - (-3) \Rightarrow 12 \\ 2 & 7 & \Rightarrow 15 - 3 \Rightarrow 12 \\ 4 & 8 & \Rightarrow 18 - 9 \Rightarrow 9 \\ 0 & 2 & \Rightarrow 5 - 0 \Rightarrow 5 \end{array} \right\}$$

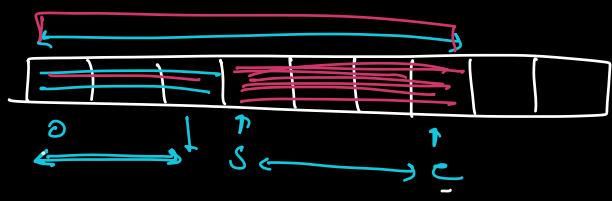


$$\text{Sum}(S-e) = \underline{PS[e]} - PS[S-1]$$

$$\begin{array}{ll} S & e \\ 0 & 2 \Rightarrow PS[e] \\ 0 & 4 \end{array}$$

$$\text{Build } PS + \text{Ans } Q \text{ open}$$

$$TC : O(N) \quad O(Q)$$



$$\text{Sum}(0-e) = \text{Sum}(0, S-1) + \text{Sum}(S, e)$$

$$PS[e] = PS[S-1] + \text{Sum}(S, e)$$

$$\Rightarrow \boxed{\text{Sum}(S, e) = PS[e] - PS[S-1]}$$

$$\underline{PS[e]} \quad (\because S=0)$$

$$\boxed{TC : O(N+Q)}$$

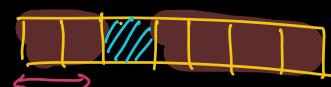
Range Sum \Rightarrow Prefix Sum

Direct - i

Q Given an array. Return true if there exists an equilibrium index in the array.

EI \Rightarrow index for which,

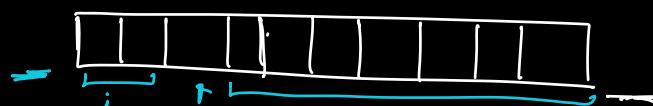
Sum of all the no. left side = Sum of all the no. on right side



A : $\underbrace{1, 2, 3, 4}_{10}, \boxed{8}, \underbrace{10}_{10} \Rightarrow \underline{\text{True}}$

Quiz

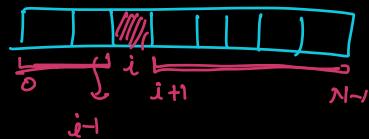
$\underbrace{-7, 1, 5}_{-1}, \boxed{2}, \underbrace{-4, 3, 0}_{-1}$



for index 0 $\rightarrow S_L = 0$

for index (n-1) $\rightarrow S_R = 0$

for every index i



check if $\in [0, (i-1)] = = \in [(i+1), (N-1)]$

set true;

$PS[N]$ // Build $PS O(N)$

$\Rightarrow f_n (i=0; i < N; i++) \{$

Range Sum // $S_L = \text{Sum from } 0 \text{ to } (i-1);$ // for $i=0, S_L=0$

$S_L = PS[i-1];$ // $O(1)$

// $S_R = \text{Sum from } (i+1) \text{ to } (N-1);$ // for $i=N-1, S_R=0$

$S_R = PS[N-1] - PS[i];$ // $O(1)$

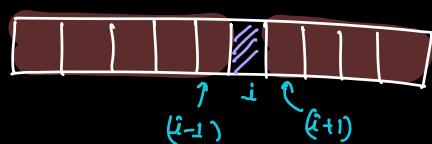
$\nexists (S_L == S_R)$

set true;

}

TC : Build PS + Find EI
 $O(N)$ $O(N)$

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



HW: $\begin{cases} \text{Solve without using any extra space.} \\ O(1) \rightarrow SC \end{cases}$ Without Modify the given array.

30 min

$\boxed{\text{TC Should remain same}}$

Q Given an array. Given Q queries.

s e . O \Rightarrow sum of all the odd indexed elements) from index s to e
s e . E \Rightarrow sum of all the even indexed element) from index s to e

A : $\begin{matrix} 0 & 1 & 2 & 3 \\ 2 & 3 & 1 & -1 \end{matrix}$ $\begin{matrix} 4 & 5 & 6 & 7 \\ 0 & 8 & 5 & 4 \end{matrix}$

Q : 2

3 ~~2~~ 5 ~~4~~

s e O/E

~~3~~ ~~2~~ ~~5~~ ~~4~~

3 6 O $\Rightarrow A[3] + A[5] = 7$

1 5 E $\Rightarrow A[2] + A[4] = 1$

Range Sum \iff Prefix Sum

A : $\begin{matrix} 0 & 1 & 2 & 3 & 4 & 5 \\ 2 & 3 & 1 & 6 & 4 & 5 \end{matrix}$

s e

1 5

PS_c : 2, 2, 3, 3, 7, 7

\hookrightarrow PS_c[i] \Rightarrow sum of all even indexed elements from 0 to i.

PS_c[s] - PS_c[0]

7 - 2 = 5

Qwiz A : 2, 4, 3, 1, 5

PS_o : 0, 4, 4, 5, 5

Qwiz

A : 4, 1, 2, -2, 3, 2, 5

PS_e : 4, 4, 4, 4, 7, 7, 12

TC : $O(N) + O(Q) \approx O(N+Q)$

SC : $O(N)$

Direct-i Q Given an array. Count the no. of
CodeNation Special indices in the array.

Google
JP Morgan

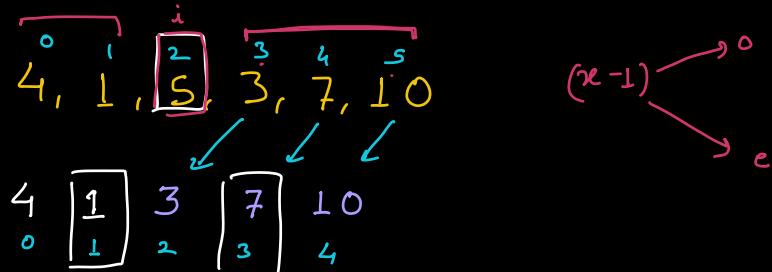
Special Index : An index after removing
which,

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

in the resulting array.

Remove	4 3 2 7 6 -2	
i=0	3 2 7 6 -2	$\rightarrow S_e = 8 \quad \quad S_o = 8 \checkmark$
i=1	4 2 7 6 -2	$\rightarrow S_e = 9 \quad \quad S_o = 8 \times$
i=2	4 3 7 6 -2	$\rightarrow S_e = 9 \quad \quad S_o = 9 \checkmark$

Quiz



Quiz

$$\begin{array}{c}
 S_0 \\
 \overbrace{\quad \quad \quad}^0 \quad \overbrace{\quad \quad \quad}^1 \quad \overbrace{\quad \quad \quad}^2 \quad \boxed{3} \\
 2, 3, 1, 4
 \end{array}
 \quad
 \begin{array}{c}
 S_e \\
 \overbrace{\quad \quad \quad}^4 \quad \overbrace{\quad \quad \quad}^5 \quad \overbrace{\quad \quad \quad}^6 \quad \overbrace{\quad \quad \quad}^7 \quad \overbrace{\quad \quad \quad}^8 \quad \overbrace{\quad \quad \quad}^9 \\
 0, -1, 2, -2, 10, 8
 \end{array}$$

$$S_0 = S_0[0, 2] + S_e[4, 9]$$

Because after removal of index 3
all indices in this range will toggle.

Quiz

$$\begin{array}{c}
 S_e \\
 \overbrace{\quad \quad \quad}^0 \quad \overbrace{\quad \quad \quad}^1 \quad \overbrace{\quad \quad \quad}^2 \quad \boxed{3} \\
 2, 3, 1, 4
 \end{array}
 \quad
 \begin{array}{c}
 S_0 \\
 \overbrace{\quad \quad \quad}^4 \quad \overbrace{\quad \quad \quad}^5 \quad \overbrace{\quad \quad \quad}^6 \quad \overbrace{\quad \quad \quad}^7 \quad \overbrace{\quad \quad \quad}^8 \quad \overbrace{\quad \quad \quad}^9 \\
 0, -1, 2, -2, 10, 8
 \end{array}$$

$$S_e = S_e[0, 2] + S_0[4, 9]$$

After removal of index i

$$S_E = S_E[0, i-1] + S_0[i+1, N-1]$$

$$S_0 = S_0[0, i-1] + S_e[i+1, N-1]$$

$PS_E \rightarrow$ Even indexed elements

$$S(s, e) = PS(e) - PS(s-1)$$

$PS_0 \rightarrow$ Odd indexed elements

$$S_E[0, i-1] = PS_E[i-1]$$

$$S_0[0, i-1] = PS_0[i-1]$$

$$S_0[i+1, N-1] = PS_0[N-1] - PS[i]$$

$$S_e[i+1, N-1] = PS_e[N-1] - PS[i]$$

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// Build PSE           ————— O(N)
// Build PSO           ————— O(N)
ans = 0;
for (i=0; i < N; i++) {
    // SE => Sum of even indexed elem after removal of index i
    SE = PSE[i-1] + (PSO[N-1] - PSO[i]);
}

```

// S_O => Sum of 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++;

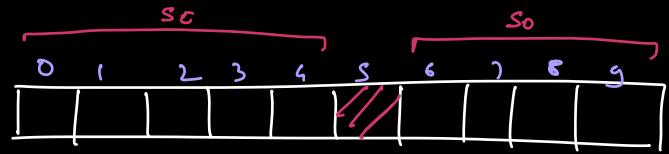
}

}

TC : O(N) $\leftarrow \begin{cases} O(N) \rightarrow \underline{\underline{PS_E}} \\ O(N) \rightarrow \underline{\underline{PS_O}} \\ O(N) \rightarrow \text{Count Special index} \end{cases}$

SC : O(N)
(Extra)

Doubt



rene 4

$$S_E = \underbrace{S_E(0-3)}_{\text{blue}} + \underbrace{S_0(5-9)}_{\text{blue}}$$

$$\therefore S_E = \underbrace{S_E(0-4)}_{\text{blue}} + \underbrace{S_0(6-9)}_{\text{blue}}$$

↓