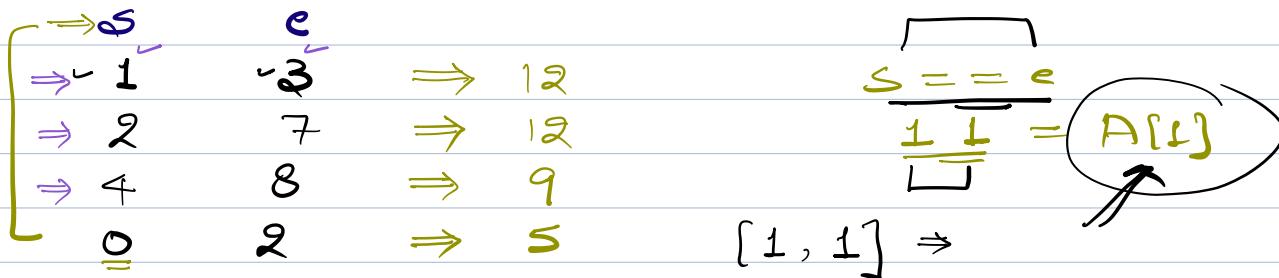
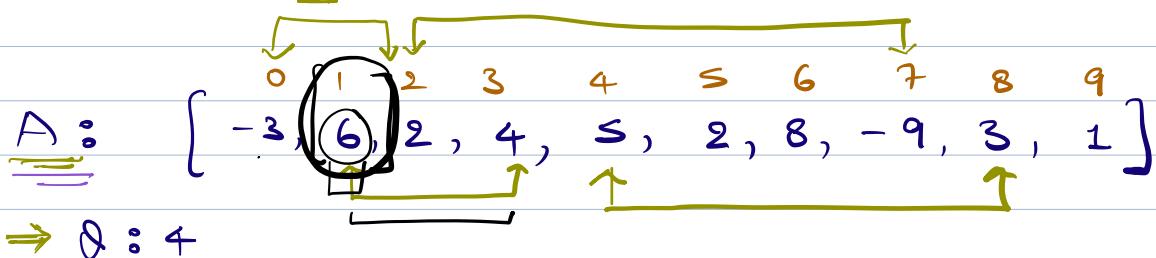


Amazon

Θ Given an array of size $N \approx 8$

δ queries of the format $\frac{s}{\text{start}} \in \frac{e}{\text{end}}$

Print the sum of elements from index s to index e



$$s=0, e=N-1 \Rightarrow N$$

Sol ① Brute force

\Rightarrow for every query, iterate from s to e & calculate sum.

$\text{int } Q;$

$i : [0, Q-1] = Q$

$\underline{Q} \Leftrightarrow \text{for } (i=0; i \leq \underline{Q}; i++) \ \underline{Q}$

$\swarrow \quad \nwarrow \quad \text{input } (s, e); \Rightarrow$

$\leftarrow \underline{\text{int sum} = 0;}$
 $\boxed{\begin{array}{l} \Rightarrow \text{for } (j = s; j \leq e; j++) \{ \\ \quad \text{sum} = \text{sum} + A[j]; \\ \quad \text{print (sum);} \end{array}}$
 $\boxed{O(N)}$

↓

$$\text{T.C.} = O(N)$$

$$\text{S.C.} = O(1) \Rightarrow$$

Given the scores of last 10 overs of a match.

\Rightarrow	$\boxed{41}$	$ $	$42, 43, 44, 45 $	$46, 47, 48, 49$
	$\xrightarrow{288},$	$ $	$312, 330, 349, \boxed{360} $	$383, 394, 406, 436,$
		$\xleftarrow{} \quad \xrightarrow{}$		$\boxed{383, 394, 406, 436,}$

$\underline{439}$
 $\underline{50}$

$$\begin{array}{ccc}
 \Downarrow & \Downarrow & \\
 \text{Runs scored in the last } s & = & 439 - 360 \\
 \text{overs } \underline{[46, 50]} & & \underline{R[50]} - \underline{R[45]}
 \end{array}$$

$$\begin{array}{ccc}
 \text{Runs scored in the } \underline{49^{\text{th}} \text{ over}} & = & 436 - 406 \\
 \Rightarrow \underline{[49, 49]} & & \underline{R[49]} - \underline{R[48]}
 \end{array}$$

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

Prefix Array \Rightarrow Every index should store sum of the elements from start to that index (including)

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

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

$PS : -3, 3, 5, 9$

$$\begin{aligned} PS[0] &= A[0] \\ PS[1] &= A[0] + A[1] = PS[0] + A[1] \\ PS[2] &= \underbrace{A[0] + A[1] + A[2]}_{PS[1]} + A[2] = PS[1] + A[2] \\ PS[3] &= \underbrace{A[0] + A[1] + A[2] + A[3]}_{PS[2]} + A[3] = PS[2] + A[3] \end{aligned}$$

$$PS[i] = PS[i-1] + A[i]$$

Code to create Prefix array.

int PS[N];

$\Rightarrow PS[0] = A[0];$

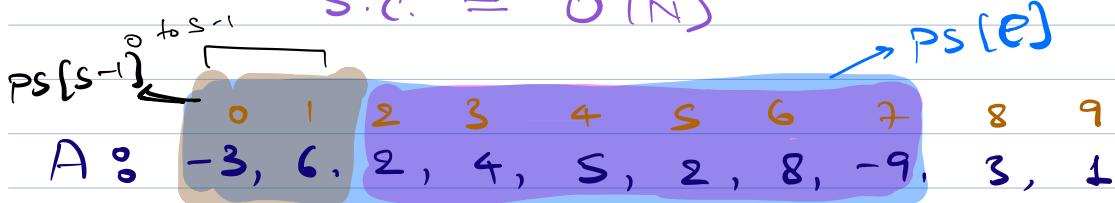
$PS[\underline{\underline{1}}] \times$

for ($i=1; i < N; i++$)
 $PS[i] = PS[i-1] + A[i];$

\$

T.C. = $O(N)$

S.C. = $O(N)$



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

① $\begin{matrix} s \\ 1 \\ 3 \end{matrix} \Rightarrow A[1] + A[2] + A[3]$

$\xrightarrow{\text{O}(1)}$

$$\underbrace{(A[0] + A[1] + A[2] + A[3])}_{\downarrow PS[3]} - \underbrace{(A[0])}_{\downarrow PS[0]}$$

$$= PS[3] - PS[0]$$

$$\textcircled{2} \quad 2 \quad \Rightarrow \quad A[2] + A[3] + A[4] + A[5] + A[6] + A[7]$$

$$\underbrace{(A[0] + A[1] + A[2] + \dots + A[7])}_{PS[7]} - \underbrace{(A[0] + A[1])}_{PS[1]}$$

$$[2, 7] \Rightarrow PS[7] - PS[1]$$

$$\text{sum}[s, e] \Rightarrow \text{ps}[e] - \text{ps}[s-1]$$

if $(\underline{s} == \underline{0}) \Rightarrow [0, e] \Rightarrow ps[e]$

Build PS answer & queries

$$\begin{aligned}
 T.C. &= \underline{O(N)} + O(\underline{\frac{1}{\epsilon} \times \underline{Q}}) \\
 &= O(N + Q)
 \end{aligned}$$

Range Sum \Rightarrow Prefix Sum

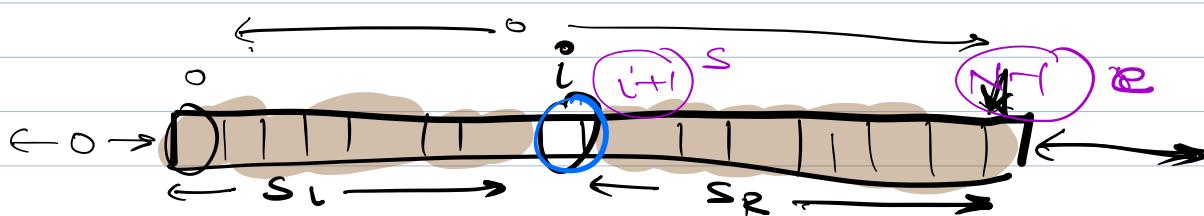
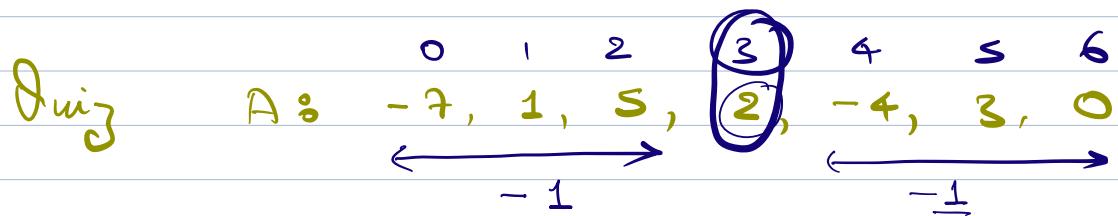
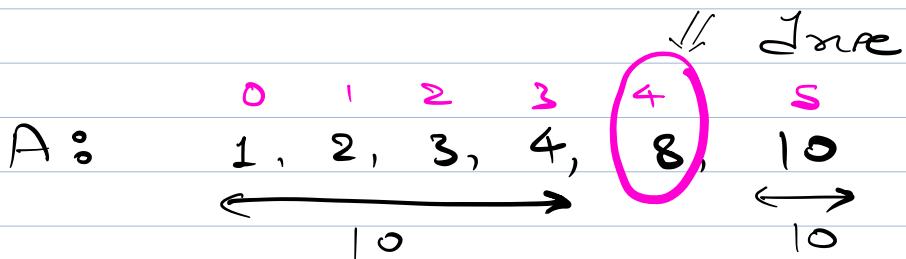
Direct

Θ Given an array of size N

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

EI \Rightarrow index for which

$\xleftarrow{\text{sum of all elements}}$ $\xrightarrow{\text{on left}}$ $= \xleftarrow{\text{sum of all elements}}$ $\xrightarrow{\text{on right.}}$



\rightarrow for index 0, $S_L = 0$] Edge cases
 \rightarrow for index $n-1$, $S_R = 0$

$$\begin{aligned} i &\Rightarrow S_L = \underbrace{\text{sum}[0, i-1]}_{\substack{\downarrow \\ 2 \text{ ranges}}} = \underline{\text{PS}[i-1]} \\ &S_R = \text{sum}[i+1, N-1] \end{aligned}$$

$$= \text{PS}[N-1] - \text{PS}[i]$$

Sol: At index i ,

check if $S_L == S_R$

Code

A : Given

PS : Prefix Sum array // $O(N)$

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

// $S_L \Rightarrow$ sum from 0 to $i-1$

if

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

// $S_R \Rightarrow$ sum from $i+1$ to $N-1$

if

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

if ($S_L == S_R$) {
 return true;
}

}

return false;

$$T.C. = O(N) + O(N)$$

$$= O(N)$$

$$S.C. = O(N)$$

Θ Given an array of size N

Given Θ queries

$s \ e \ o \Rightarrow$ sum of all odd indexed elements from s to e

$s \ e \ E \Rightarrow$ sum of all even indexed elements from s to e

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

$\Theta : 2$

$$\begin{array}{ccc} s & e & o/e \\ 3 & 6 & \underline{o} \end{array} \Rightarrow A[3] + A[5] = 7$$

$$1 \ 5 \ \underline{E} \Rightarrow A[2] + A[4] \\ 1 + 0 = 1$$

Range queries \Rightarrow Prefix Sum

$\Leftarrow \Rightarrow \text{for } (i=0; i < \Theta; i++) \{$

~~input (s, e); \Rightarrow $O/E = E$~~

~~int Sum = 0;~~

~~$\text{for } (j = s; j \leq e; j++) \{$
 $\quad \text{if } (j \% 2 == 0) \{$
 $\quad \quad \text{sum} = \text{sum} + A[j];$
 $\}$
 $\text{print} (\text{sum});$~~

 $\text{O}(N)$

\leftarrow \downarrow \downarrow \downarrow \downarrow
 $0 \quad 1 \quad 2 \quad 3 \quad 4 \quad 5 \quad 6 \quad 7$
 $A: \quad 2, 3, 1, -1, 0, 8, 5, 4$

$\text{PS}_e :$ 2, 2, 3, 3, 3, 3, 8, 8

$\hookrightarrow \text{PS}_e[i] \Rightarrow$ sum of all even indexed
 elements from 0 to i

$$\text{PS}[i] = \text{PS}[i-1] + \underline{A[i]} \times$$

Ques
 \downarrow
 $A: \quad 0 \quad 1 \quad 2 \quad 3 \quad 4$
 $\quad \quad 2, 4, 3, 1, 5$

$\text{PS}_e :$ 0, 4, 4, 5, 5

Ques
 $A: \quad 4, 1, \underline{0}, -2, 3, 2, 5$
 $\Rightarrow \text{PS}_e :$ 4, 4, 4, 4, 7, 7, 12

ArrayList {10} push

