



Unionville HS

Classroom code: slwprdp

Computer Club 2024-25

Competitive Programming

Lesson #4 Prefix Sum Arrays!
Google Classroom Code: slwprdp





Intuition

Given an array and Q queries find the sum from L_q to R_q for each query.

Example:

$[8, 5, 1, 6, 2]$

L: 3 R: 5 Ans: 9

L: 1 R: 2 Ans: 13

L: 4 R: 4 Ans: 12

L: 1 R: 5 Ans: 22



How can we
do this?

For each query
loop from L to
R in the array
and calculate
the sum



What if Q is
up to 10^5
and array
size is up
to 10^5 ?
 $O(QN)$ time
TOO SLOW!



CAN IT BE FASTER?



PREFIX SUM ARRAYS Joins the Battle!

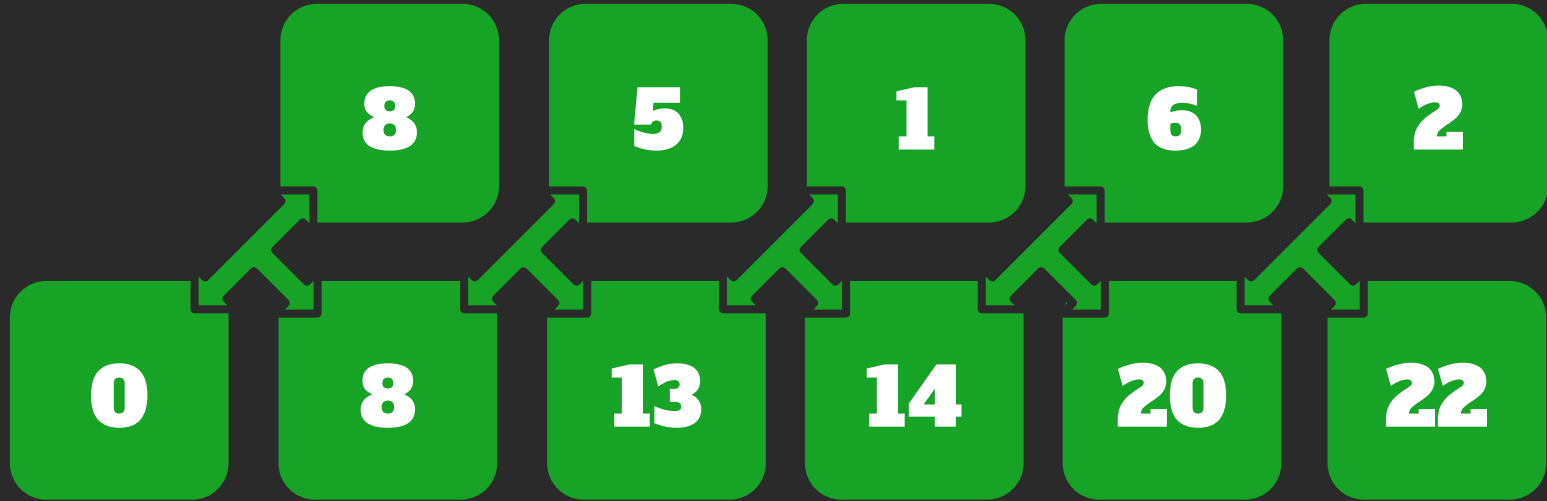




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Prefix Sum Array in Motion



How can we
use a PSA to
calculate
range sums?

Answer: PSA[~~13~~**i**]
contains the
sum of all
elements up
to index $i-1$
(0 indexed
array)



8

5

1

6

2

0

8

13

14

20

22

Example: Sum from `arr[0]` to `arr[1]`



How can we
use a PSA to
calculate
range sums?

Answer: A PSA [PSA] contains the sum of all elements up to index $i-1$ (0 indexed array)



Example: Sum from `arr[2]` to `arr[4]`



How can we
use a PSA to
calculate
range sums?

Answer: PSA[2]
contains the
sum of all
elements up
to index i-1
(0 indexed
array)



8

5

1

6

2

0

8

13

14

20

22

Example: Sum from arr[1] to arr[3]



WARNING!



Be careful of off by one errors due to
0-indexed arrays or 1-indexed queries
etc...





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Any Questions?





Using PSA Example

Example:

[8, 5, 1, 6, 2]

L: 3 R: 5

L: 1 R: 2

L: 4 R: 4

L: 1 R: 5

PSA

[0, 8, 13, 14, 20, 22]

PSA[5] - PSA[2]

PSA[2] - PSA[0]

PSA[4] - PSA[3]

PSA[5] - PSA[0]



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Tutorial Problem





```
1  import java.io.*;
2  import java.util.*;
3
4  public class Deforestation {
5      public static void main(String[] args) throws IOException {
6          BufferedReader br = new BufferedReader(new InputStreamReader(System.in));
7
8          StringTokenizer st;
9
10         int N = Integer.parseInt(br.readLine());
11
12         int[] massPSA = new int[N+1];
13         for (int i = 1; i < N+1; i++) {
14             massPSA[i] = massPSA[i-1] + Integer.parseInt(br.readLine());
15         }
16
17         int Q = Integer.parseInt(br.readLine());
18         for (int i = 0; i < Q; i++) {
19             st = new StringTokenizer(br.readLine());
20             int L = Integer.parseInt(st.nextToken())+1;
21             int R = Integer.parseInt(st.nextToken())+1;
22
23             System.out.println(massPSA[R] - massPSA[L-1]);
24         }
25     }
26 }
```



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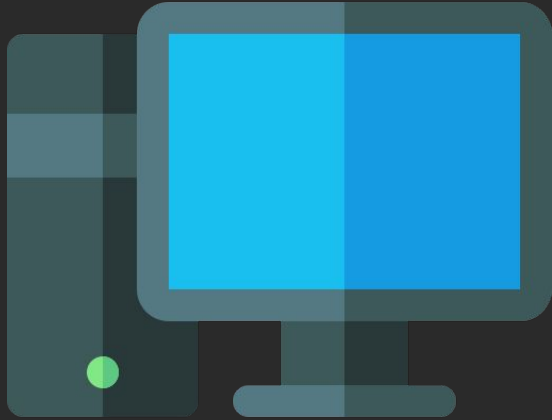
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CHALLENGE PROBLEM





Homework Practice



Easy
Medium
Hard
Hard





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Quiz/Mock Contest

November 1st



Quiz/Mock Contest Info

- Friendly Contest
- Can Form Groups
- Score purely on points
- Based on our Lessons

Scoring:

- 3 problems each worth 100 points.
- Partial points given



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SIGN UP FORM



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Bye



Please Leave...

Instagram: **unionvillecs2024**

Discord: [QWBUScbMzz](#)

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