



Unionville HS

Classroom code: slwprdp

Computer Club 2024-25

Competitive Programming

Lesson #5 Difference Arrays!
Google Classroom Code: slwprdp





Reminders

Chill Quiz/Mock Contest Next Meeting

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Intuition

Given an array and Q queries increase elements from L_Q to R_Q by D_Q .

Example:

[8, 5, 1, 6, 2]

L: 1 R: 5 D: 2

[10, 7, 3, 8, 4]

L: 2 R: 4 D: -3

[10, 4, 0, 5, 4]



How can we
do this?

For each query
loop from L to
R and update
the array



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



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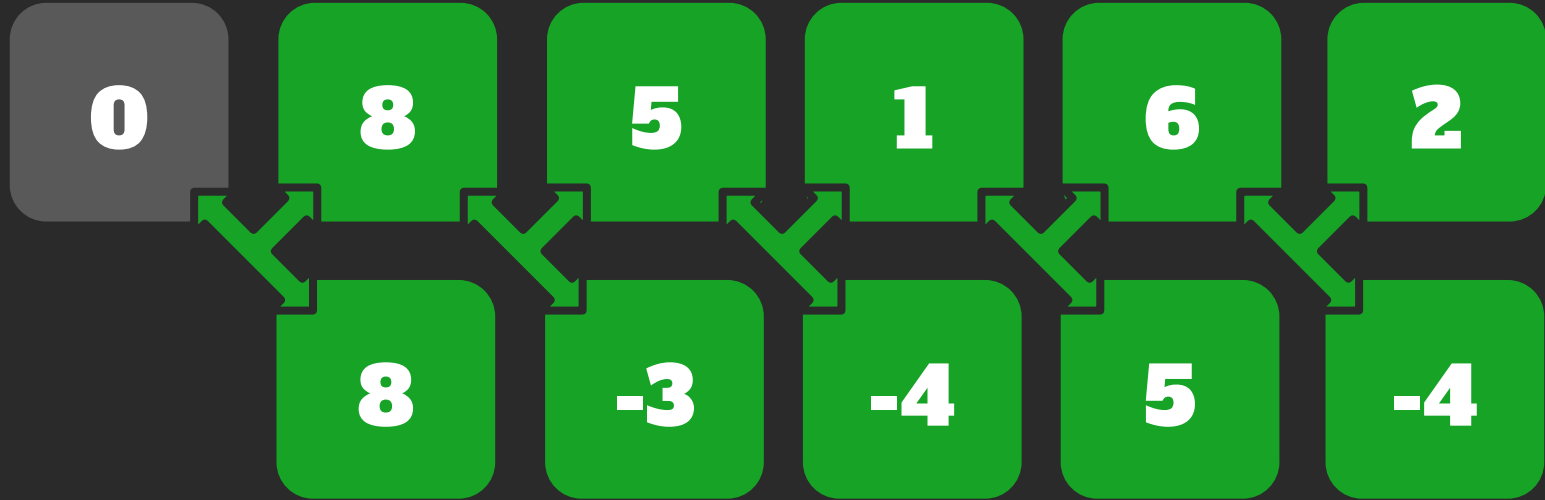
CAN IT BE FASTER?



DIFFERENCE ARRAYS

Joins the Battle!

2	8	1	-3	2	-1	3
2	6	-7	-4	5	-3	4



Difference Array in Motion



Using Difference Array

- The PSA of a difference array will give the original array!
- We can update the difference array in $O(1)$ time per query, and then compute a PSA once to get the final array



Using Difference & Prefix Sum Array

ARR**0****8****5****1****6****2****DIF****8****-3****-4****5****-4****PSA****0****8****5****1****6****2**



How can we
use a
difference
array to
update
ranges?

Hint:
Difference
arrays and
PSA's are
both used!

ARR

8

5

1

6

2

DIF

8

-3

-4

5

-4

PSA

11

8

1

6

2

Example: Increase `arr[0]` to `arr[1]` by 3



How can we
use a
difference
array to
update
ranges?

Hint:
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ARR

8

5

1

6

2

DIF

8

~~-3~~~~-4~~

5

~~-6~~**PSA**

8

7

3

8

2

Example: Increase `arr[1]` to `arr[3]` by 2



How can we
use a
difference
array to
update
ranges?

Hint:
Difference
arrays and
PSA's are
both used!

ARR**8****5****1****6****2****DIF****16****-3****-4****5****-4****PSA****16****13****9****14****10**

Example: Increase `arr[0]` to `arr[4]` by 8



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Any Questions?





Implementation Example (C++/Java)



```
1  diff[0] = 0;
2  for(int i = 1; i < N; i++){
3      diff[i] = arr[i] - arr[i-1];
4  }
5  psa[0] = 0;
6  for(int i = 1; i <= N; i++){
7      psa[i] = diff[i] + psa[i-1];
8  }
```

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



Using Difference Array Example

Example:

[8, 5, 1, 6, 2]

L: 3 R: 5

L: 1 R: 2

L: 4 R: 4

L: 1 R: 5

Diff

[0, -3, -4, 5, -4]

Diff[2]++ Diff[5]--

Diff[0]++ Diff[2]--

Diff[3]++ Diff[4]--

Diff[0]++ Diff[5]--



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How can we
use a
difference
array to
update
ranges?

Hint:
Difference
arrays and
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IND	0	1	2	3	4	5
ARR	-3	3	4	-2	-5	1
DIF	-3	6	-3	-6	-3	10
PSA	-3	3	0	-6	-9	1

Example: Decrease arr[2] to arr[4] by 4



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Tutorial Problem



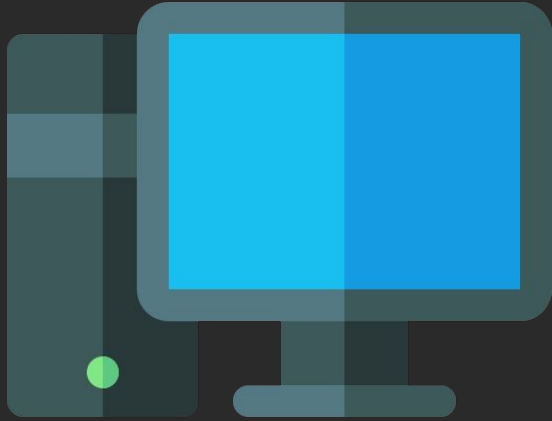


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Homework Practice



Medium
Hard





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Bye 🖐️

Please Leave...

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Discord: [QWBUScbMzz](#)

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