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Advanced Content : Pseudocode language independent

↳ Convert in your language of choice

Today's Content:

10:23 <sup>10m</sup> → 10:33pm

- a) Zero Querses
- b) Water logging
- c) Max Subarray sum
- d) Flip, if time permits

18) Given an array  $arr[N]$ , initially  $arr[] = 0$ , return the final array after performing all the queries, {All Q Queries}

Queries  $(i, n)$  = Add  $n$  to all the numbers from  $arr[i]$  to  $arr[N-1]$

$arr[7] = \{0\}$

Ex:  $A = [0, 0, 0, 0, 0, 0, 0]$   $(i, n) : 3 \text{ Queries}$

	0	1	2	3	4	5	6	
	0	0	0	0	0	0	0	
		3	3	3	3	3	3	$\rightarrow (1, 3)$
				4	4	4	4	$\rightarrow (4, 2)$
					4	2	2	$\rightarrow (3, 1)$

$A = [0, 3, 3, 4, 2, 2, 2]$

$arr[7] = \{0\}$

Ex:  $A = [0, 0, 0, 0, 0, 0, 0]$   $(i, n) \rightarrow \text{Queries}$

	0	1	2	3	4	5	6	
	0	0	0	0	0	0	0	
			6	6	6	6	6	$\rightarrow 2, 6$
	-1	-1	5	5	5	5	5	$\rightarrow 0, -1$
			7	7	7	7	7	$\rightarrow 3, 2$
					11	11	11	$\rightarrow 5, 4$

$A = [-1, -1, 5, 7, 7, 11, 11]$

Idea: For every query  $[i, n]$  iterate from  $arr[i] \rightarrow arr[N-1]$

& add  $n$

$\rightarrow TC: Q * N : O(QN) \quad SC: O(1)$

Idea2:

Ex:  $A = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$

Apply Pf =  $\begin{bmatrix} 0 & 3 & 3 & 4 & 2 & 2 & 2 \end{bmatrix}$

$(i, n) : 3 \text{ Queries}$

$$\begin{array}{l} (1 \ 3) \\ (4 \ -2) \\ (3 \ 1) \end{array} \left| \right.$$

Ex:  $A = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$

Apply Pf =  $\begin{bmatrix} -1 & -1 & 1 & 3 & 3 & 3 & 3 \end{bmatrix}$

$(i, n) \rightarrow \text{Queries}$

$$\begin{array}{l} \begin{array}{cc} 2 & 6 \\ \hline \checkmark 0 & -1 \\ \checkmark 3 & 2 \\ \checkmark 2 & -4 \end{array} \end{array} \left| \right.$$

Cross check:

$A = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$

$\begin{array}{l} 0 \ -1 \\ 3 \ 2 \\ 2 \ -4 \end{array} \left| \right. \begin{array}{cccccc} -1 & -1 & 1 & 3 & 3 & 3 & 3 \\ & & & 1 & 3 & 3 & 3 & 3 \end{array}$

$A = \begin{bmatrix} -1 & -1 & 1 & 3 & 3 & 3 & 3 \end{bmatrix}$

```
int modify(int arr[], int n, int Q, int mat[a][2]) {
    for a query: i = n
```

Step 1: Iterate m queries update array

```
l = 0; l < Q; l++) {
```

```
    i = mat[l][0]  x = mat[l][1]
```

```
    arr[i] += x
```

```
}
```

Step 2: Apply pf sum on modified arr[]

3

TC:  $Q * O(1) + O(N) \rightarrow O(N + Q)$

SC: prefix in arr[]  $\rightarrow$  sc:  $O(1)$  ] TODO

$\rightarrow$  // modifying arr[] directly

prefix u n pf[]  $\rightarrow$  sc:  $O(N)$

$\rightarrow$  // Taking extra extra to apply pf[]

$ar[N] = 0$  { Perform all Q Queries & return final array }

Queries  $\rightarrow (i, j, n)$  = Add  $n$  to all numbers from  $A[i] \rightarrow A[j]$

$A[] = [0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0]$      $i \ j \ n$   
 $2 \ 2 \ 2 \rightarrow [1 \ 3 \ 2]$   
 $8 \ 8 \ 8 \ 3 \rightarrow [2 \ 5 \ 3]$   
 $4 \ 4 \ 2 \rightarrow [2 \ 4 \ -1]$   
 $A[] = [0 \ 2 \ 4 \ 4 \ 2 \ 3 \ 0]$

Ideas: for every query  $(i, j, n)$ , add  $n$  for all elements  $[i-j]$

$\rightarrow$  TC:  $Q \times N$     SC:  $O(1)$  // modifying  $ar[] = 0$

Hint:

$(i, j, n)$ :

0   1   2   ...   i   i+1   ...   j   j+1   j+2   ...   N-1

$[Add \ n \ i, N-1]$  =  $n \ n \ \dots \ n \ n \ n \ \dots \ n$

$[Add \ -n \ j+1, N-1]$      $-n \ -n \ \dots \ -n$

$(i, j, n) = [Add \ n \ from \ i, N-1] \ [Add \ -n \ j+1 \ N-1]$

=  $Query(i, n)$

$Query(j+1, -n)$

=  $ar[i] += n$

$ar[j+1] -= n$

$$A[] = \begin{bmatrix} 0 & 1 & 2 & 3 & 4 & 5 & 6 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 2 & 3 & -2 & -3 & & & \end{bmatrix} \quad i \quad j \quad n \quad \begin{cases} ar[i] += n \\ ar[j+1] -= n \end{cases}$$

$$\begin{matrix} & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \end{matrix} \quad \begin{matrix} [1 & 3 & 2] \\ [2 & 5 & 3] \\ [2 & 4 & -1] \end{matrix}$$

$$A[] = 0 \quad 2 \quad 2 \quad 0 \quad -2 \quad 1 \quad -3 \quad [2 \quad 4 \quad -1]$$

$$\text{Apply pf[]} = 0 \quad 2 \quad 4 \quad 4 \quad 2 \quad 3 \quad 0$$

$$A[] = \begin{bmatrix} 0 & 1 & 2 & 3 & 4 & 5 & 6 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 4 & 6 & 2 & -4 & -6 & & \end{bmatrix} \quad i \quad j \quad n \quad \begin{cases} ar[i] += n \\ ar[j+1] -= n \end{cases}$$

$$A[] = [0 \quad 4 \quad 6 \quad 2 \quad -4 \quad -6 \quad 0]$$

$$\text{pref} = [0 \quad 4 \quad 10 \quad 12 \quad 8 \quad 2 \quad 2]$$

$ar[7] = \text{out of bounds}$   
no need to Subtract

int modify(int ar[], int N, int Q, int mat[Q][3]) {  
    Ques: [i j n]

Step1: update all queries

l=0; l < Q; l++ {

    i = mat[l][0], j = mat[l][1], n = mat[l][2]

    ar[i] += n

    if (j+1 < N) {

        ar[j+1] -= n

    }

Step2: Apply pf[] on modified ar[]

TC:  $O(Q + N) \Rightarrow O(N + Q)$  SC:  $O(1)$ ,  $O(N)$   
    if we modify given ar[]  
    if we take extra ar[]

2Q) Given  $ar[N]$ ,

Construct PfM[N] s.t,  $PfM[i] = \text{max of all elements } [0, i]$

$$ar[6] = \begin{matrix} & 0 & 1 & 2 & 3 & 4 & 5 \\ \{ & 1 & -6 & 3 & 2 & 8 & 7 \} \end{matrix}$$

$$PfM[6] = \{ 1 \quad 1 \quad 3 \quad 3 \quad 8 \quad 8 \}$$

$$ar[5] = \begin{matrix} & 0 & 1 & 2 & 3 & 4 \\ \{ & 3 & -2 & 6 & 2 & 8 \} \end{matrix}$$

$$PfM[5] = \{ 3 \quad 3 \quad 6 \quad 6 \quad 8 \}$$

TODO: Construct PfM[]  $\rightarrow$  TC:  $O(N)$

3Q) Given  $ar[N]$ ,

Construct sfm[N] s.t,  $sfm[i] = \text{max of all elements } [i, N-1]$

$$ar[7] = \begin{matrix} & 0 & 1 & 2 & 3 & 4 & 5 & 6 \\ \{ & 3 & 10 & 6 & 7 & 0 & 2 & -1 \} \end{matrix}$$

$$sfm[7] = \{ 10 \quad 10 \quad 7 \quad 7 \quad 2 \quad 2 \quad -1 \}$$

$$ar[5] = \begin{matrix} & 0 & 1 & 2 & 3 & 4 \\ \{ & 4 & 8 & -1 & 6 & 3 \} \end{matrix}$$

$$sfm[5] = \{ 8 \quad 8 \quad 6 \quad 6 \quad 3 \}$$

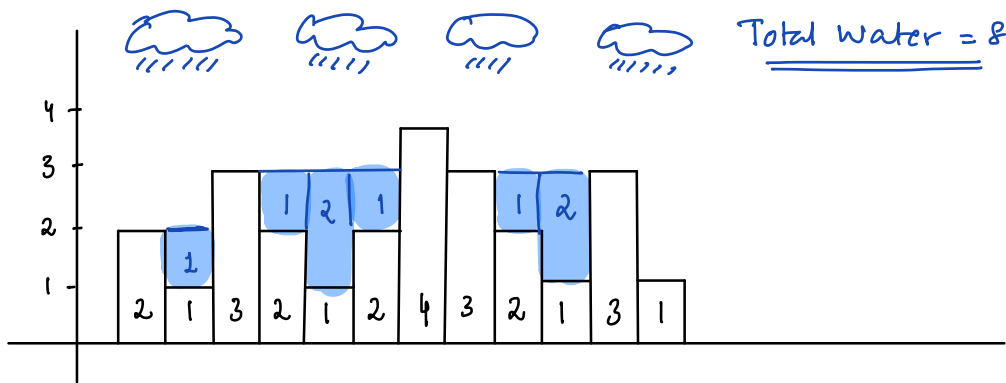
TODO: Construct sfm[]  $\rightarrow$  TC:  $O(N)$

## 48) Rain water trapped ?

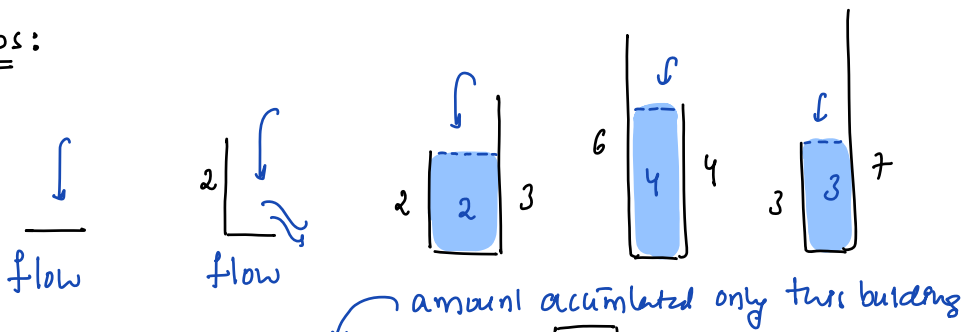
Given  $arr[N]$  elements, where  $arr[i]$  represents height of the building, return amount of water trapped in all buildings

Note: Width of each building is 1

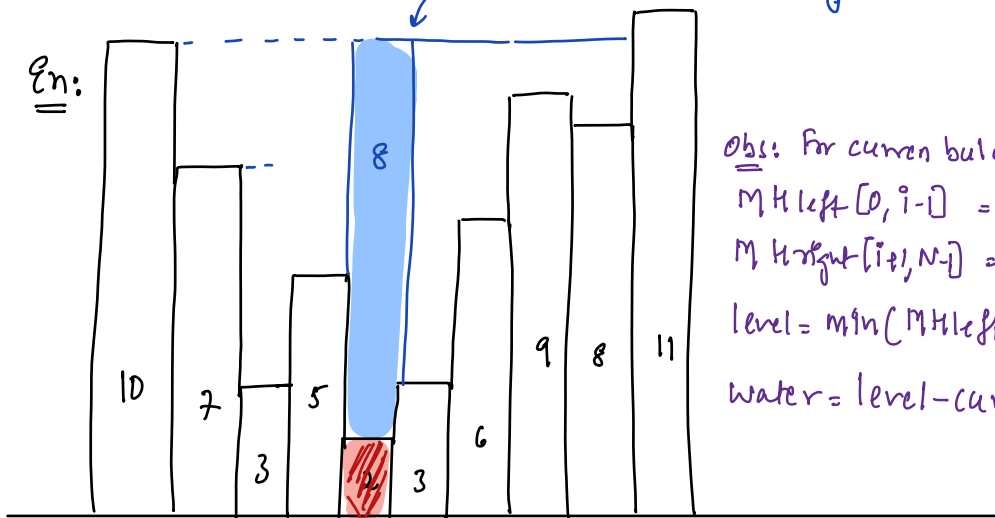
$arr[] = \{ 2, 1, 3, 2, 1, 2, 4, 3, 2, 1, 3, 1 \}$



obs:



Ex:



obs: For current building  $i$

$MH_{left}[0, i-1] = 10$

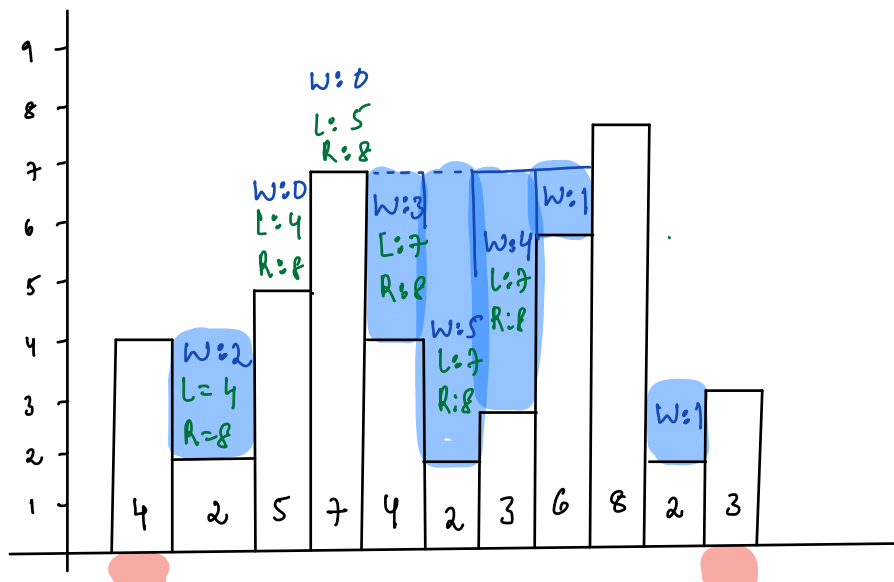
$MH_{right}[i+1, N-1] = 11$

$level = \min(MH_{left}, MH_{right})$

$water = level - currHeight$



E<sub>n</sub>:



Lman : 4 4 5 7 7 7 7 7 8

Rman : 8 8 8 8 8 8 8 3 3

Level : 4 4 5 7 7 7 7 3 3

Water : 2 -1 -2 3 5 4 1 -5 1 = water = 16

if -ve consider: 0

obs: skip corners, because water cannot be acamlatz

int Water(int H[], int N) { TC:  $O(N+N+N) \Rightarrow O(N)$

SC:  $O(N+N) \Rightarrow O(N)$

int ans = 0

int pfm[n] // Construct  $\rightarrow O(N)$

int sfm[n] // Construct  $\rightarrow O(N)$

i = 1; i < n-1; i++ // We neglect i=0 & i=n-1  $\rightarrow O(N)$    
  $\rightarrow$  no water in corners

// for i<sup>th</sup> building

Lman = max of arr from [0, i-1] = pfm[i-1]

Rman = max of arr from [i+1, n-1] = sfm[i+1]

level = min(Lman, Rman)

water = level - H[i] // level water can rta - current

if (water > 0) { ans = ans + water; }   
  $\rightarrow$  height of building

}

return ans;

All my reminders in What's app

1) Slack/What's-app

2) Interviews

- a) Advanced DSA
- b) HW/CW
- c) Previously asked interview question of that company / leetcode /

3) SDE-1  $\Rightarrow$  DSA

SDE-3 : less DSA + More Design   
  $\swarrow \searrow$    
 LLD HLD

4) SDE-2  $\Rightarrow$  DSA + Design (LLD)

4) Duration: 55 Sessions: 4 1/2