

Q MAX ABSOLUTE DIFF

Given an array!

$$|x| = \text{abs}(x)$$

Find the max value of

$$f(i, j) = |A_i - A_j| + |i - j| \quad \forall (i, j)$$

$$|x| = x : x \geq 0$$

$$-x : x < 0$$

$$|3| = 3$$

$$|-3| = -(-3) = 3$$

$$A: \begin{matrix} 0 & 1 & 2 \\ [1, & 3, & -1] \end{matrix}$$

$$f(0, 0) = |1 - 1| + |0 - 0| = 0$$

$$f(0, 1) = |1 - 3| + |0 - 1| = 3$$

$$f(0, 2) = |1 - (-1)| + |0 - 2| = 4$$

$$f(1, 0) = |3 - 1| + |1 - 0| = 3$$

$$f(1, 1) = |3 - 3| + |1 - 1| = 0$$

$$f(1, 2) = |3 - (-1)| + |1 - 2| = 5$$

$$f(2, 0) = |-1 - 1| + |2 - 0| = 4$$

$$f(2, 1) = |-1 - 3| + |2 - 1| = 5$$

$$f(2, 2) = |-1 - (-1)| + |2 - 2| = 0$$

MAX $\rightarrow 5$

1) B.F

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    maxE = 0;
    f(i = 0 → N-1) {
        f(j = 0 → N-1) {
            maxE = max(maxE, abs(Ai - Aj)
                        + abs(i - j));
        }
    }
    return maxE;

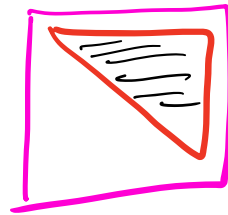
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TC = $O(N^2)$

④ Obs :

1) $f(i, i) = 0$

2) $f(i, j) = f(j, i)$
 $(i < j)$



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f(i = 0; i < N; i++) {
    f(j = i+1; j < N; j++) {

```


TC = $O(N^2)$

$$\textcircled{1} \quad f(i, j) = |A_i - A_j| + |i - j|$$

$$\boxed{i < j}$$

$$(i - j) < 0$$

$$f(i, j) = |A_i - A_j| + (j - i)$$

Case I: $A_i \geq A_j$

$$\begin{aligned} f(i, j) &= (A_i - A_j) + (j - i) \\ &= (A_i - i) - (A_j - j) \end{aligned}$$

$$f(i, j) = X_i - X_j$$

$$f(i, j) = X_{\max} - X_{\min}$$

$$X_k = A_k - k$$

Case II $A_i < A_j$

$$\begin{aligned} f(i, j) &= (A_j - A_i) + (j - i) \\ &= (A_j + j) - (A_i + i) \end{aligned}$$

$$f(i, j) = Y_j - Y_i$$

$$f(i, j) = Y_{\max} - Y_{\min}$$

$$Y_k = A_k + k$$

I & II

$$f(i, j) = \max(X_{\max} - X_{\min}, Y_{\max} - Y_{\min})$$

// A[], N


$$X_{\max} = Y_{\max} = -\infty$$

$$X_{\min} = Y_{\min} = +\infty$$

f(i = 0 ; i < N ; i++) {

$$x = A[i] - i;$$

$$y = A[i] + i;$$

A 

$$X_{\max} = \max(X_{\max}, x);$$

$$X_{\min} = \min(X_{\min}, x);$$

x;

y;

=

$$Y_{\max} = \max(Y_{\max}, y);$$

$$Y_{\min} = \min(Y_{\min}, y);$$

}

$$\text{ret } \max(X_{\max} - X_{\min}, Y_{\max} - Y_{\min});$$

$$\boxed{TC = O(N)}$$

$$\boxed{SC = O(1)}$$

Q FIRST MISSING INT
 Given an array. Find the first missing pos integer from the array!

$A: [8, 10, 1, -3, 2, -5]$

$1, 2, 3 \rightarrow \text{ANS}$

$A: [5, 11, 6, -5, 10]$

$1 \rightarrow \text{ANS}$

1) Sort!

$A: [8, 10, 1, -3, 2, -5]$

$\text{Sort}(A): [-5, -3, 1, 2, 8, 10]$
 $\underbrace{-5, -3}_{\leq 0 \text{ ignore}}$
 $\underbrace{1, 2, 3}_{\text{EXPECT}}$ $\rightarrow \text{ANS}$

$TC: O(N^2)$

$SC: O(1)$

DUPLICATES

$\rightarrow \text{Sort}(A): [-5, -3, 1, 1, 2, 3, 3, 3, 5]$
 $\underbrace{-5, -3}_{\leq 0}$
 $\text{curr} = 1 \xrightarrow{+1} 2 \xrightarrow{+1} 3 \xrightarrow{+1} 4 \rightarrow \text{ANS}$

II

Hash Set

A: [8, 10, 1, -3, 2, -5]

$O(N)$

f(1 \xrightarrow{i} ∞)

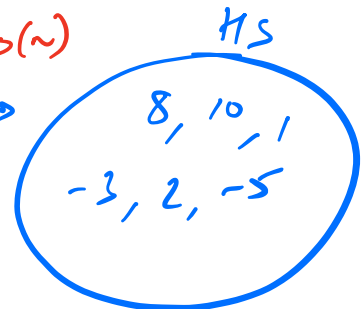
$O(N)$

if (hs.find(i) == False)

ANS \rightarrow i : break/ret

i++

✓ ✓ ✗
1 2 3



A: [_____]
10 1000

MAX ANS \rightarrow N+1

MIN ANS \rightarrow 1

ANS \in {1... N+1}

TC = $O(N)$

SC = $O(N)$

III)

A : [8, 10, 1, -3, 2, -5]

N = 6

val > 7

EXPECT:

1 2 - - - -

SEND HOME

A : [~~8~~, ~~10~~, ~~1~~, -3, ~~2~~, -5]

0 1 2 3 4 5

↓ ↓ ↓ X

1 2 3

3 — ANS

[1 - N]

[1 - 6]

A : [~~6~~, ~~8~~, ~~3~~, ~~1~~, ~~4~~, ~~2~~]

0 1 2 3 4 5

↓ ↓ ↓ ↓ ↓

2 3 4 5 6

1 2 3 4 5 6

7

ELEMENT HOME

A[i] → A[i]-1

[1 - 6]

ANS + 1 7

A : [~~8~~, ~~10~~, ~~2~~, ~~1~~, -1, 2, ~~8~~, ~~7~~, 9]

0 1 2 3 4 5 6 7 8

↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓

2 3 4 5 6 7 8

3 — ANS ✓

[1 - 9]

```

{ ( i = 0; i < N; i++ ) {
    if ( A[i] <= 0 || A[i] > N || A[i] - 1 == i
        || A[A[i] - 1] == A[i] ) continue;
    swap( A[i], A[A[i] - 1] );
    i--;
}

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}
{ ( i = 0; i < N; i++ ) {
    if ( i+1 != A[i] ) {
        ret( i+1 );
    }
}

```

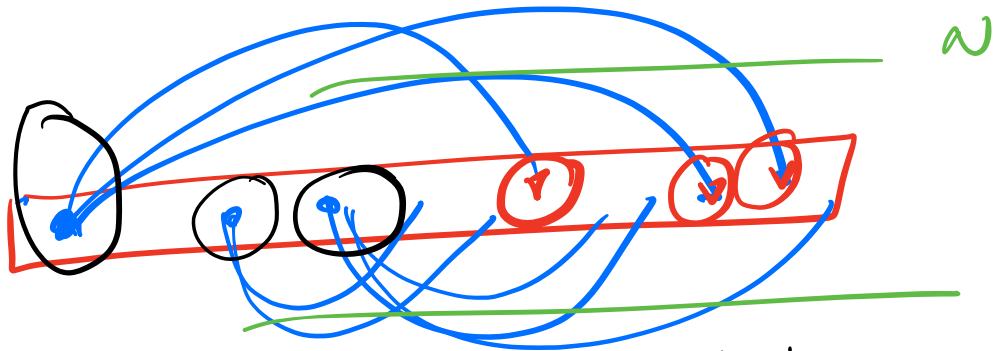
TC: $O(N)$

SC: $O(1)$

```

}
ret N+1;

```



→ If an element is sent at its home, nobody would send it home again!

TC: $O(N)$

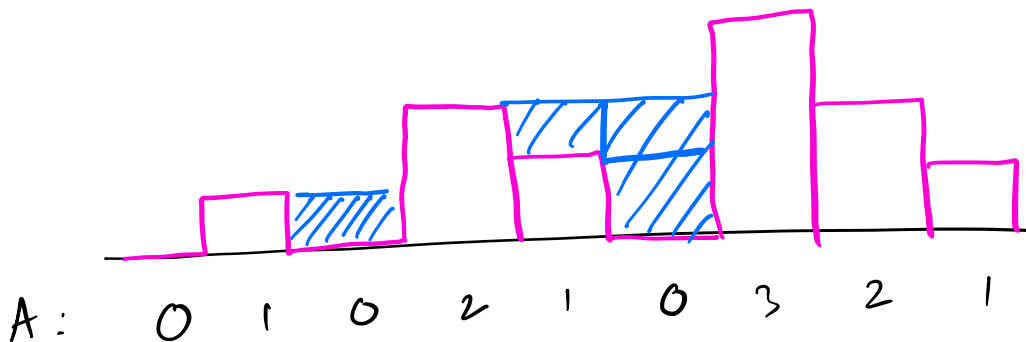
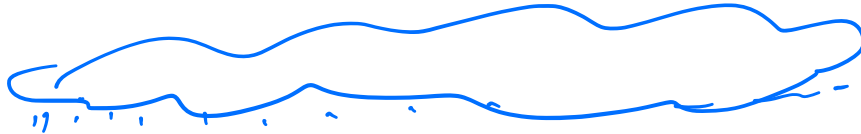
Q

RAIN WATER TRAPPING

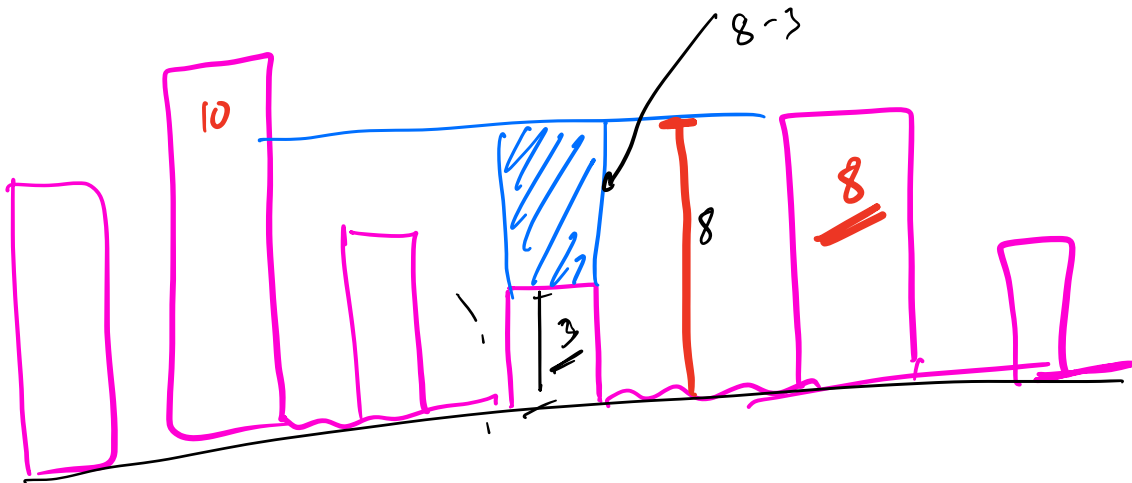
Given an array A.

$A[i] \rightarrow$ height of the wall at i^{th} index.

Find the total water trapped!



WATER TRAPPED = 4 UNITS



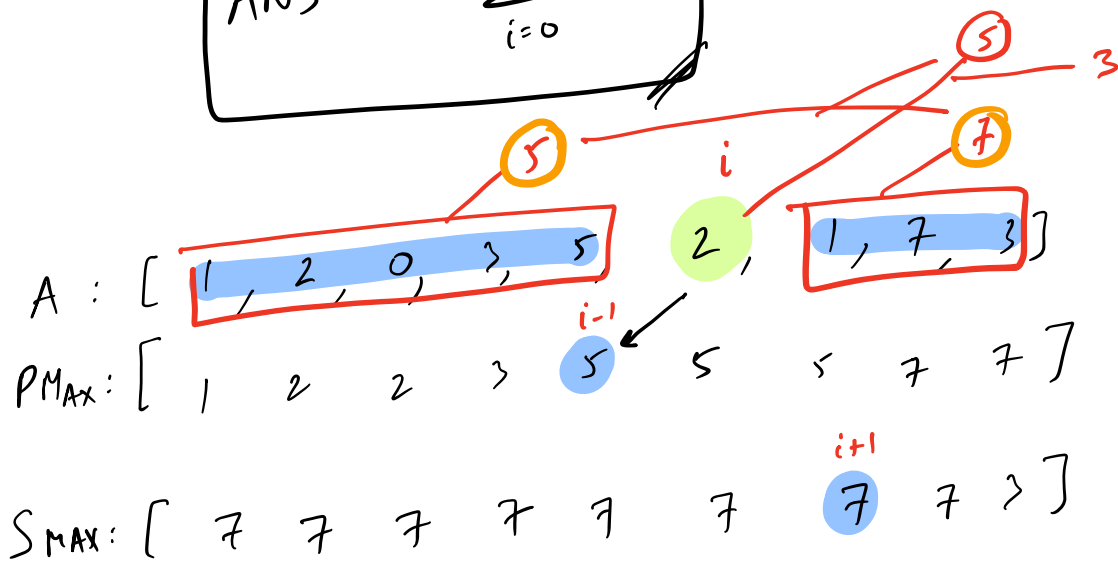
Obs (i) Get the MAX Height Wall from Left \rightarrow ML
Right \rightarrow MR

WATER LEVEL from GROUND on i th Wall

$$WL_i = \min(ML, MR)$$

$$\text{WATER on } i\text{th wall} \rightarrow W_i = WL_i - A_i$$

$$ANS = \sum_{i=0}^{N-1} W_i$$



$PM[N], SM[N];$

$PM[0] = A[0];$

$\{ (i=1 \rightarrow N-1) \}$
 $PM[i] = \max(PM[i-1], A[i])$

\sim

$\}$
 $SM[N-1] = A[N-1];$

\sim

$\{ (i=N-2 \rightarrow 0) \}$
 $SM[i] = \max(SM[i+1], A[i]);$

$\}$

$Water = 0;$

\sim

$\{ (i=1 \rightarrow N-2) \}$
 $ML = PM[i-1];$

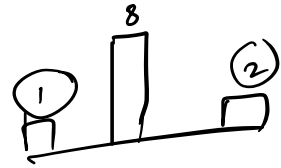
$MR = SM[i+1];$

$WL = \min(ML, MR);$

$Water += \max(0, WL - A[i]);$



$\rightarrow (2)$



$\}$

$TC = O(N)$

$SC = O(N)$