Arrays 1

Thursday, 21 October 2021 8:57 PM

Q **Max. Absolute Diff.** 8

For the given integer array, find the MAX value of

$f(i,j) = |A[i] - A[j]| + |i-j|$ $\forall (i,j)$ $f(i,j)$

A = [1, 3, -1]

5 ✓

i	j		
0	0	|1-1| + |0-0| =	0
0	1	|1-3| + |0-1| =	3
0	2	|1-(-1)| + |0-2| =	4
1	0	|3-1| + |1-0| =	3
1	1	|3-3| + |1-1| =	0
1	2	|3-(-1)| + |1-2| =	5
2	0	|-1-1| + |2-0| =	4
2	1	|-1-3| + |2-1| =	5
2	2	|-1-(-1)| + |2-2| =	0

5 0

Brute force: $\forall (i,j)$ $\boxed{TC: O(N^2)}$ $\boxed{SC: O(1)}$

Obs

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

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

Ans = 0

$|i-j| = -(i-j) = j-i$

$|x| \to x$ if $x \geq 0$; $-x$ if $x < 0$

⊙ Consider cases: $i < j$ $|i-j|$

$f(i,j) = |A[i] - A[j]| + (j-i)$

Case 1: $A[i] \leq A[j]$

$f(i,j) = (A[j] - A[i]) + (j-i) = (A[j]+j) - (A[i]+i)$

Case 2: $A[j] < A[i]$

$f(i,j) = (A[i] - A[j]) + (j-i) = (A[i]-i) - (A[j]-j)$

Ans = max((A[j]+j) - (A[i]+i) , (A[i]-i) - (A[j]-j))

Case 1 $f(i,j) = (A_j + j) - (A_i + i)$

$X_k = A_k + k$

$\boxed{f(i,j) = X_j - X_i}$ max

i, j X

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

Case 2 $f(i,j) = (A_i - i) - (A_j - j)$

$Y_k = A_k - k$

$\boxed{f(i,j) = Y_i - Y_j}$

Y

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

A : 0 1 2 / 1 3 -1

X : 1 4 1 → 4 - 1 = 3

Y : 2 -1 → 2 - (-1) = 5 → max → 5 ✓

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

SC: ~~O(N)~~ O(1)

```
A
Xmax = Ymax = -∞ ;
Xmin = Ymin = +∞ ;
f ( i = 0;  i < n;  i++ ) {
    x = Ai + i ;
    y = Ai - i ;
    Xmax = max( Xmax, x );
    Xmin = min( Xmin, x );
    y
    y
}
ans = max( Xmax - Xmin,  Ymax - Ymin );
```

Q **First Missing Integer** 7

Find the first missing +ve integer in an array.

A : [8, 10, 1, -3, 2, -5] → 3

Ans min = 1

<= N Ans max = N+1

N+1

[1 2 3 4 5 - - - N]

0 1 2 3 4 5

1 2 3 4 5 6 N = 6 → 7

① A : [8, 10, 1, -3, 2, -5] N = 6

Present [✓ ✓ _ _ _ _] 1 2 3 4 5 6 1 ... N

TC : O(N) SC : O(N)

② Sort [-5 -3 1 2 8 10] Ans = 3

$\boxed{TC: O(n \log n)}$ $\boxed{SC: O(1)}$

Consider only 1 ... N

③ A : [8, 10, 2, 1, -1, 2] N = 6

1 2 3

A : [-3, 1000, 3, 5, 1, 6, 2, 22] N = 8

1 2 3 4 - - - N

0 1 2

A : [1 3 1 1]

f(i = 0 -- N-1)

if (Ai != (i+1))

i+1 → Ans !

N

$\boxed{TC: O(N)}$ $\boxed{SC: O(1)}$

1 2 3 4

1 2 3

1 9 8 3 7 4 2 6 1 N

0 1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 8 9 10

Q **Merge Intervals** 5

Given a sorted set of non-overlapping intervals. Insert a new interval s.t. final list is also sorted & non-overlapping.

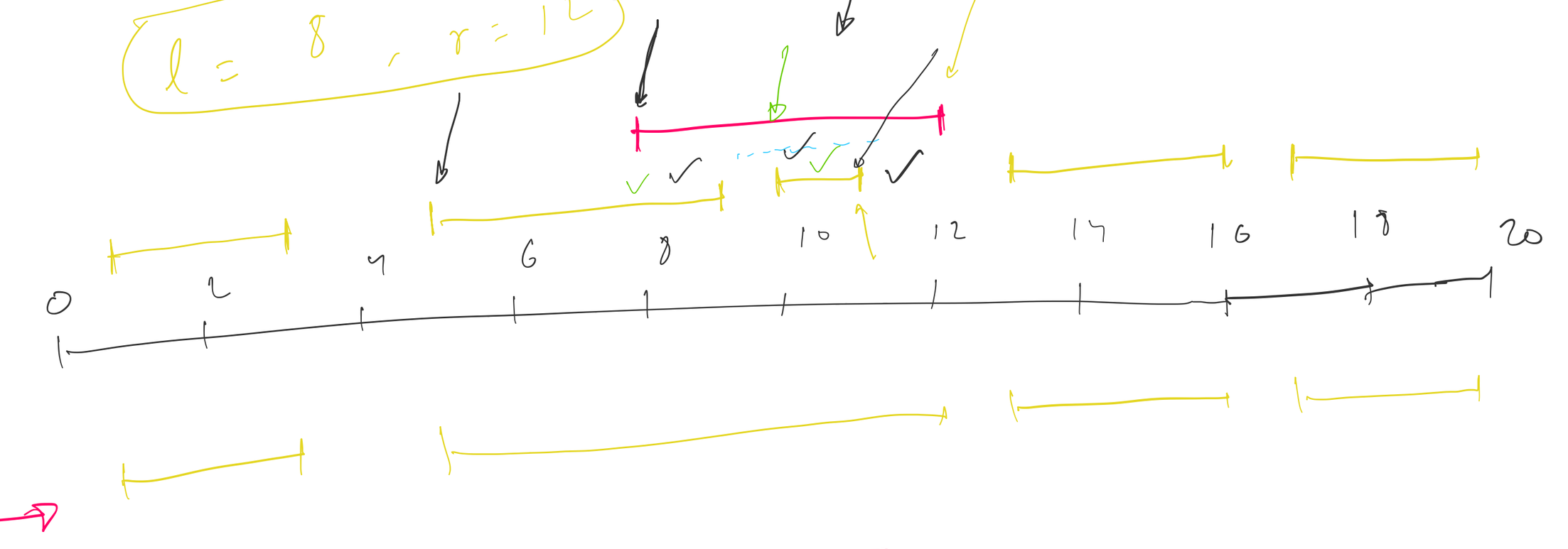
S : [1 5 10 13 17]

E : [3 9 11 16 20]

$S_i <= E_i$

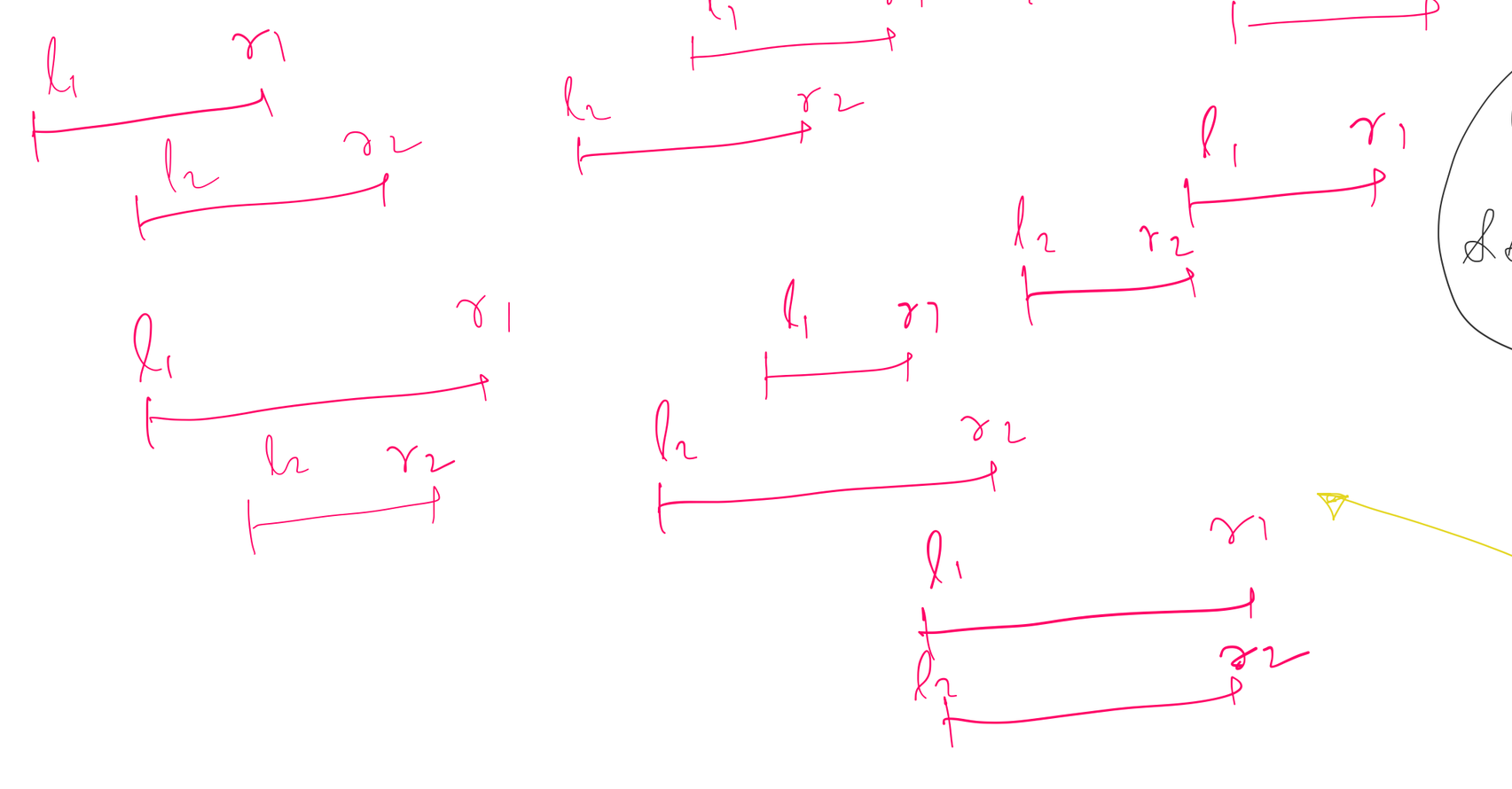
$E_i < S_{i+1}$

$l = 8, r = 12$



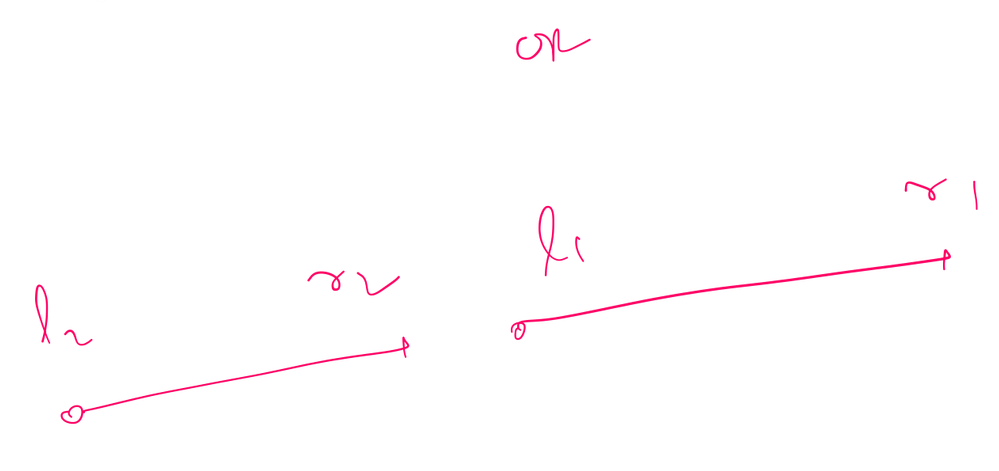
S [1 5 13 17]

E [3 12 16 20]



overlap

$l_1 \leq r_2$ && $l_2 \leq r_1$



non-overlap

$r_1 < l_2$ || $r_2 < l_1$

! (non-ovl) → overlap

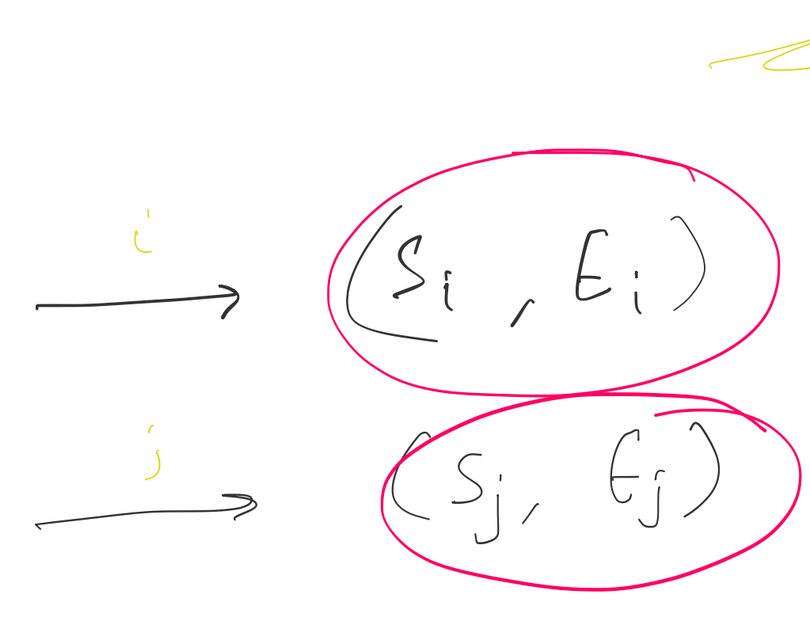
(l, r)

First intersecting interval → i → (S_i, E_i)

Last ——— → j → (S_j, E_j)

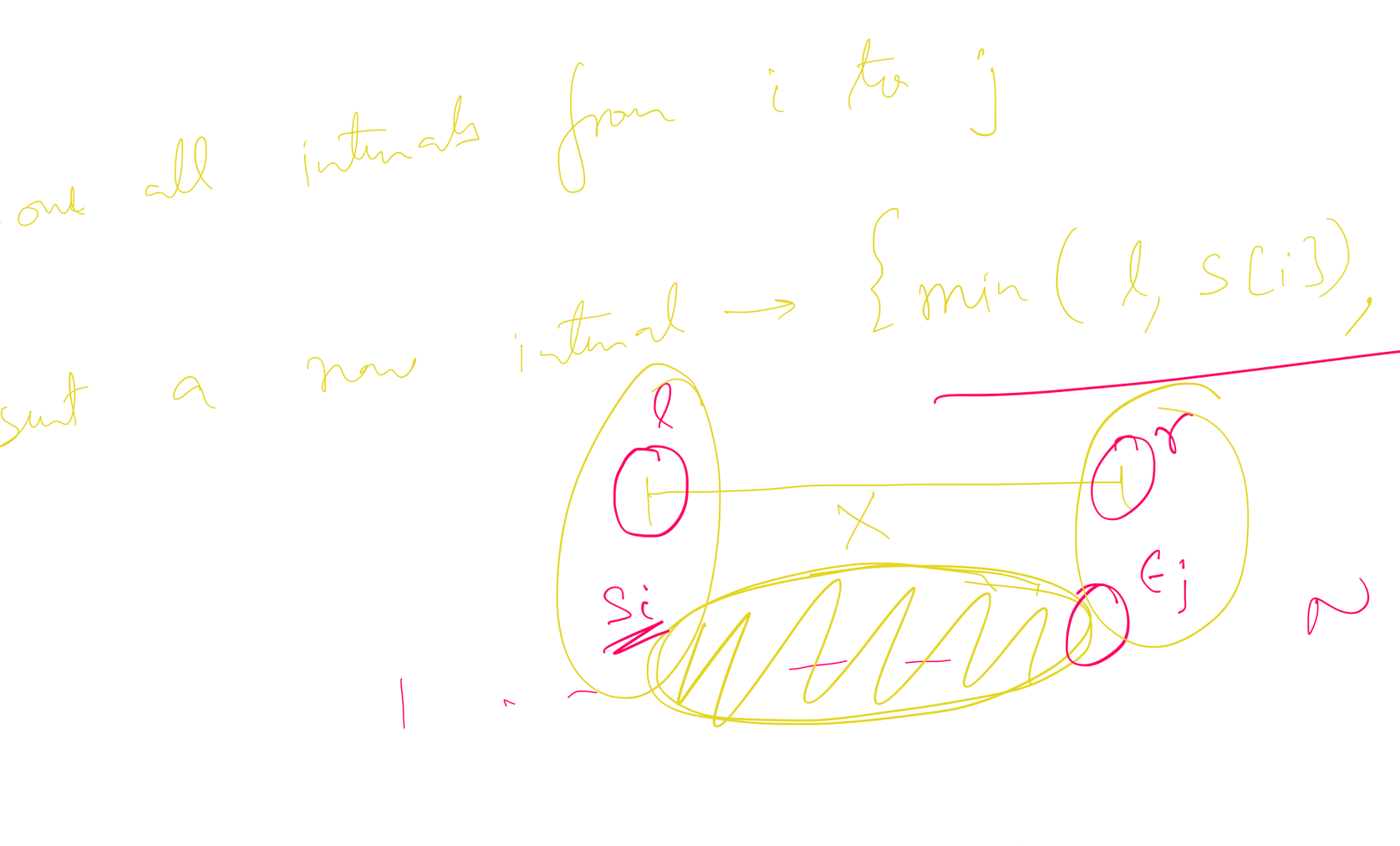
Remove all intervals from i to j

Insert a new interval → { min(l, S[i]), max(r, E[j]) }



$\boxed{TC: O(N)}$ $\boxed{SC: O(1)}$

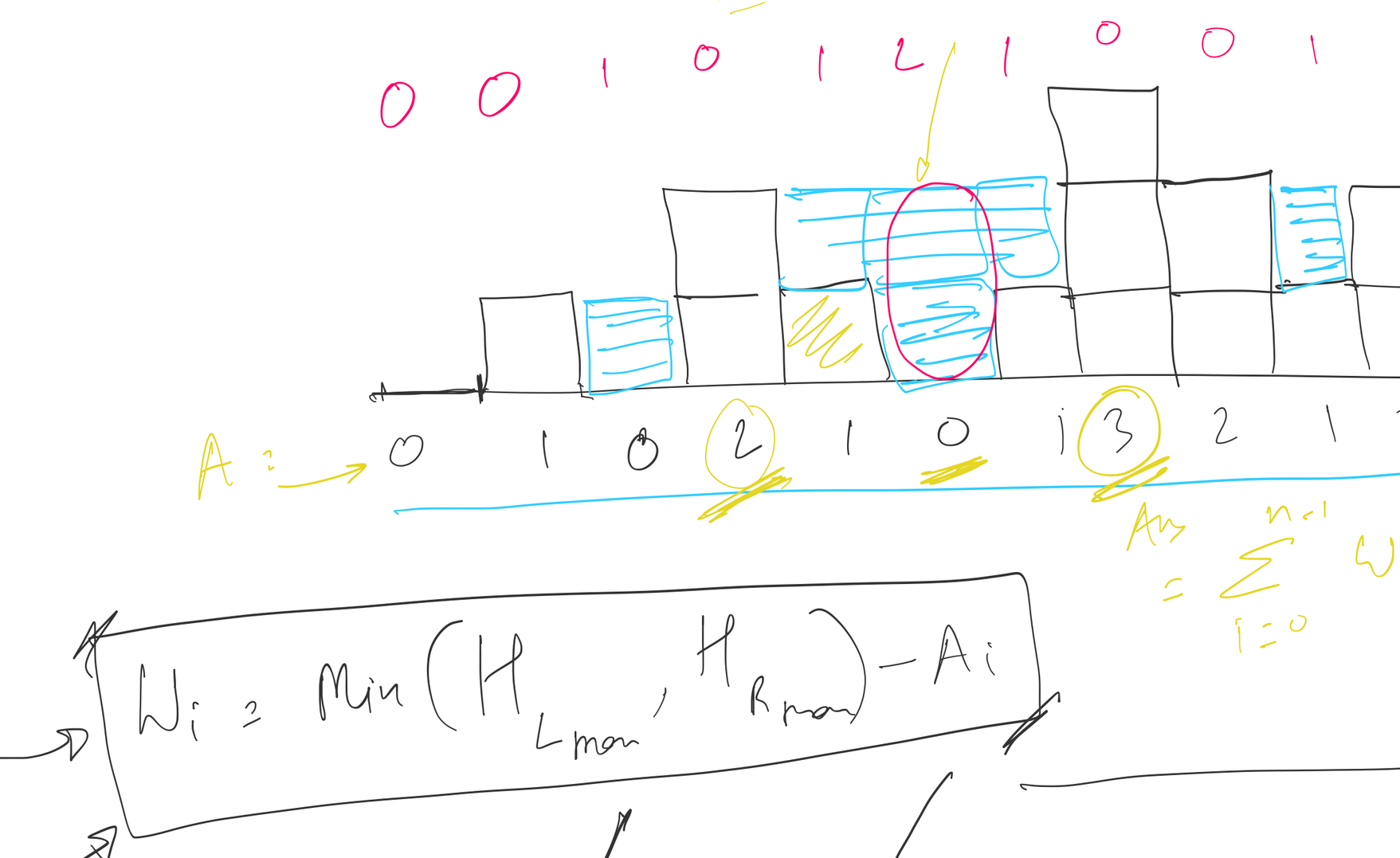
Q **Rain Water Trapping** 6



A : 0 1 0 2 1 0 1 3 2 1 2 1

$Ans = \sum_{i=0}^{n-1} W_i$

$\boxed{W_i = Min(H_{Lmax}, H_{Rmax}) - A_i}$



A 3 2 5 1 10 11 3 1 2

MaxL 3 3 5 5 10 11 11 11 11 O(N)

O(N)

O(N)

MaxR

O(N)

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

$\boxed{SC: O(N)}$

maxL[0] = A0

f (i = 1 ... n-1)

maxL[i] = max(maxL[i-1], Ai);