Q:) Given an array of 2n numbers, each no. from 1 to n is exactly twice. We say that the segment y is nested inside a segment x if both of the occurrences of y are between the occurrences of x. For each segment i, how many nested segments are there??

$n \le 10^5$

5 1 2 2 3 1 3 4 5 4

→ 1 0 0 0 3

i/p $\boxed{5}$ $\boxed{1}$ 2 2 3 $\boxed{1}$ 3 4 $\boxed{5}$ 4

o/p 1 0 0 0 3

n x n z z y x y

1 → right outside → No

2 → left outside but right inside → no

3 → left & right both inside → Yes

0	1	2	3	4	5	6	7	8	9
5	1	2	2	3	1	3	4	5	4
1	1	1	0	1	0	0	1	0	0

→ boolean

Sum segment tree

O(n log n)

we need a mapping that tells me whether we have encountered a left end or not

el	—	index (left)
5	—	0
1	—	1
2	→	2
3	—	4
4	—	7

2 3

5 — 3
3 — 0
2 — 0
1 → 1
4 — 0

when you find right end put a zero

and put 1 at always left point

(1) if we have not encountered the right point, we keep the value 0 in B in array

(2) when we encounter right end, we put 0 for right & 1 for left. Why? There can be a case that for some segment x, we have right point inside x but left outside.

Qn There was some permutation p_i of n elements. For each i we wrote a number a_i, (viz the no. of j such that $j < i$ & $p_j > p_i$. Restore the original permutation for given a_i

imp

(1 − n)

find original array

arr →

↳ 0 1 1 0 3 → inv count

$n = 5$

0 1 1 0 3

4 1 3 5 2

1	2	3	4	5
0	0	0	0	0

a[i] → find the (a[i] + 1)th 1 from right

O(n log n)

To find k^{th} one from left → Segment trees

1 0 1 1 0 1

Q. Given a rowwise & col wise sorted matrix.

find the K^{th} smallest element.

$$\begin{matrix} -1, & 0, & 2, & 7 \\ 6, & 8, & 9 & 10 \\ 13 & 14, & 20 & 25 \end{matrix}$$

$\boxed{K = 4}$

ans → 2

$(n \times m)$

(6, 8, 9, 7)

$6 \to 4^{th}$

$(-1) \to$ min

$(6, 0) \to 0 \to 2^{nd}$ min

$\to 6, 2, 8 \to 2 \to 3^{rd}$

$$\begin{tikzcd}[column sep=small]
 & (i, j) \arrow[dl] \arrow[dr] \arrow[r] & x^{th}\ \text{min} \\
(i+1, j) & & (i, j+1)
\end{tikzcd}$$

→ By deleting (i, j) I can get two candidates

→ $x - 1 + 2$ → $(x + 1) == k$

min heap

$O(k \log k)$

Q. We have a row wise sorted matrix.

find the k^{th} smallest element.

$k = 3$

$n \rightarrow$ min heap

2	4	6	8
-1	0	9	10
1	2	7	18

$(n \times m)$

$O(k \log n)$

$(i, j) \longrightarrow ((i, j+1) +$ all the elements whose first row $(i, j))$

Q. Given K sorted arrays. Merge all of them to make 1 single sorted array.

$O(nK \log K)$

Q. Given an integer array & a number k. We can do an operation to modify any element x to −x. We need to do this operation k times. Find the max sum of elements that we can get after k operations

Ex [9, 8, 8, 5]

$\boxed{k=3}$

heap

9, 8, 8, −5

$\boxed{20}$

ans → $\boxed{20}$

$\rightarrow \underbrace{9, \ -8, \ 8, \ 5}$

$\downarrow$

9 8 8 5

$\downarrow$

9 8 8 -5

9 8 8 5

$\hookrightarrow \boxed{30}$

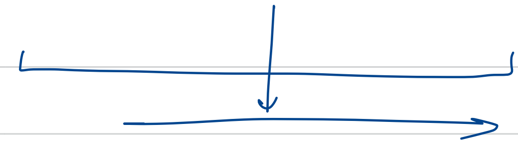
$k = 3$

$O(n \log n)$

if min $\rightarrow \boxed{0}$

Qn RMID 2 →

$\boxed{\text{median}}$



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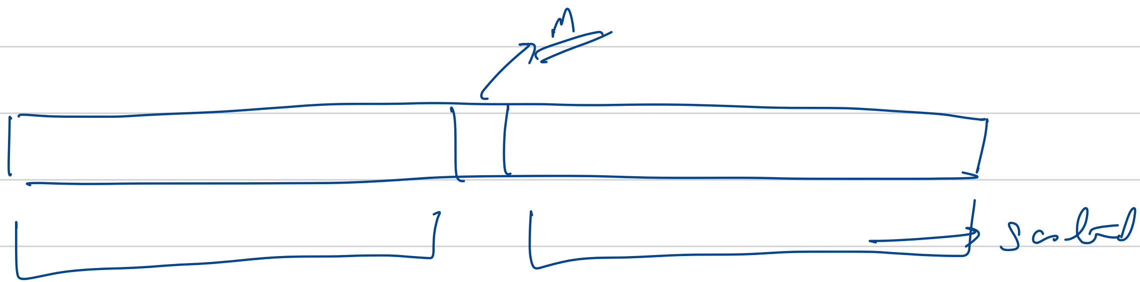

10

5

1 2 4 5 7 8 9 10 13 16

smaller need larger

Smaller

↓

max heap

large

↓

min heap

2 heaps

1 2 3 4 5

Smaller heap $\longrightarrow x$

larger heap $\longrightarrow y$

1. $x == y \longrightarrow$ med $\rightarrow$ largest from min heap

2. $x == y+1 \longrightarrow$ med $\rightarrow$ largest from max heap

med = 7

Input:
1 → Test cases
9 → 9
10 → 9
2 → 9
5 → 5
1 → 5
18 → 5
-1
-1 → 9
4 → 4
3
-1 → 3
8 → 4
7 → 7
-1 → 7
0

max heap

1, 2, 5, 7

smaller

min heap

10, 18, 8

larger

$O(\log n)$
$O(\log n)$
$O(\log n)$ → $O(n \log n)$