

International Coding Hub Christmas 2020

ICH ADMINISTRATION

December 25-28, 2020

Contents

1	Shoe Selection	2
2	Rectangles	3
3	Maximum Segment	4
4	Farm Surveillance	5

§1 Shoe Selection

Joe is looking for a pair of shoes to wear. Since his house is disorganized, there are many shoes lying in the different rooms of the house, and each shoe in his house is distinct (he wears different shoes on his two feet). The rooms of the house can be represented by an array a , where a_i is the number of shoes in room i . He wants to select two shoes from his house, each being from a different room. How many ways are there of doing so?

Constraints

$0 \leq a_i \leq 1,000$ for $(1 \leq i \leq n)$

The first 5 cases satisfy $n \leq 1,000$

The remaining cases satisfy $n \leq 100,000$

Input Format

The first line has n — the number of rooms. The next line has $a_1, a_2 \dots, a_n$.

Sample Input

```
4
1 3 2 4
```

Sample Output

```
35
```

§2 Rectangles

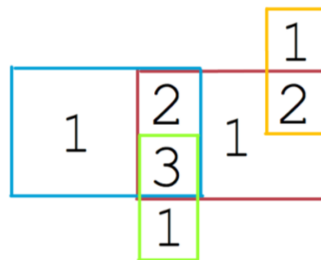
There are N distinct rectangles ($1 \leq N \leq 10,000$) placed on a coordinate plane, each defined by its bottom left and top right points (x_1, y_1) and (x_2, y_2) respectively.

$$-10^9 \leq x_1 < x_2 \leq 10^9$$

$$-10^9 \leq y_1 < y_2 \leq 10^9$$

$$x_1, y_1, x_2, y_2 \in \mathbb{Z}$$

Each rectangle has a unique color (N colors total). If a rectangle is completely engulfed inside another rectangle, the engulfed rectangle becomes transparent (colorless). If two rectangles are overlapping but one is not engulfed in the other, the overlapping region is considered to be colored with both colors. Find the number of distinct visible colors. Example:



The numbers denote how many colors are present in a particular area. There are 4 visible colors: blue, red, green, and yellow, and none of the rectangles are engulfed.

Input Format

The first line has N . The following N lines each have $i_{x_1}, i_{y_1}, i_{x_2}, i_{y_2}$ for each rectangle i .

Sample Input

```
4
0 0 3 2
2 0 5 2
2 0 3 1
4 1 5 3
```

Sample Output

```
3
```

This input is the same as the picture above, except the bottom half of the green rectangle is not present. Since the new 'green' rectangle is engulfed, it is transparent, leaving 3 visible colors.

§3 Maximum Segment

There is a necklace with beads, each with some value. What is the sum of the maximum sum segment of beads in the necklace.

Input Format

The first line has N , the number of beads in the necklace. The following line contains the values of the beads in the necklace.

Constraints

The value of each bead is an integer in the range $[-10,000, 10,000]$

$1 \leq N \leq 100,000$

The first 5 cases satisfy $N \leq 5,000$

Sample Input

```
4
1 -2 2 3
```

Sample Output

```
6
```

The maximum segment is 2 3 1, wrapping from the right side to the left.

§4 Farm Surveillance

Farmer John has a farm that consists of N pastures in a line, and he wants to install surveillance in each pasture. Since he is very busy, he employed some of his well-behaved cows, numbered 1 to M , to monitor his pastures. He initially assigned some (possibly none) pastures to each cow, with each pasture having exactly 1 cow assigned to it.

He was intending on giving a contiguous segment of pastures for each cow he employs, but unfortunately in his haste some assignments may not be contiguous. Fortunately his cows are well-behaved so he can tell pairs of cows to work together. Specifically, if he tells cow a and b to work together, cow a will now monitor a 's pastures as well as b 's pastures (call this a_{new}), and cow b will do the same. Then if he tells a and c to work together, a will monitor a_{new} and c 's pastures, and c will do the same.

Note that pairing up cows in this manner is inevitably going to create a contiguous segment of pastures for each cow to monitor. Farmer John wants to know the minimum number of pairings he has to make such that each cow has a contiguous segment of pastures to monitor.

Constraints

$$1 \leq N, M \leq 100,000$$

The first 3 cases satisfy $N, M \leq 20$.

Input Format

The first line has N and M . The second line represents the N pastures, with the i th number being the cow who is assigned to the i th pasture.

Sample Input

```
14 6
3 1 1 2 2 1 2 2 2 4 5 2 6 6
```

Sample Output

```
3
```

He can tell cows 4 and 5, then 1 and 2, then 2 and 5 to work together.