South African Computer Olympiad
Camp 3, 2008
Day 2

Overview

Author	**Julian Kenwood**	**Keegan Carruthers-Smith**	**Keegan Carruthers-Smith**
Problem	**mining**	**tworect**	**teleport**
Source	mining.c mining.cpp mining.pas	tworect.c tworect.cpp tworect.pas	teleport.c teleport.cpp teleport.pas
Input file	stdin	stdin	stdin
Output file	stdout	stdout	stdout
Time limit	10 seconds	1 second	1 second
Number of tests	10	10	10
Points per test	10	10	10
Total points	**100**	**100**	**100**

The maximum total score is 300 points.

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Data Mining

Author

Julian Kenwood

Introduction

Bruce and Carl have gone into business together to take on the world of software. Brucarl was created to make software that caters for everyone, or at least as many people as possible. Bruce and Carl, having locked themselves in a room for a few days, have created a number of software products for the masses.

As a leading salesperson for Brucarl, it is your job to decide which product is the best product to sell. Being a rather devious individual, you have secretly obtained information about a large group of people, mined from various computers in the community, which you will use to base your decision on.

Task

You will be given the details of N people and K products.

Each person has unique characteristics described by a tuple, $C_i = (C_1, C_2, C_3)$. You will also be given the details of K products that Brucarl sells. No two people will have the same characteristics.

Each of these products is described by two tuples, $min_i = (min_1, min_2, min_3)$ and $max_i = (max_1, max_2, max_3)$. Bruce and Carl have determined that a product is suitable for a person if every element in C is greater than or equal to its corresponding element in min and less than or equal to its corresponding element in max.

Your task is to determine the best product to develop and how many people it is suitable for. The best product is the one that is suitable for the most people.

Example

Consider the problem of two people, (3, 4, 2) and (4, 3, 7) and two products, (1, 1, 1) to (3, 3, 3) and (2, 2, 2) to (7, 7, 7).

The first product is not suitable for anyone, while the second product is suitable for both people and as such is the best product.

Input (stdin)

The first line of input contains N, the number of people. The following N lines contains three space-separated integers, the characteristics, C_1, C_2 and C_3, of a person. The next line contains K, the number of products. The following K lines contains six space-separated integers, the details, min_1, min_2, min_3, max_1, max_2 and max_3, of a product.

Sample input

```
2
3 4 2
4 3 7
2
1 1 1 3 3 3
2 2 2 7 7 7
```

Output (stdout)

The output contains two space-separated integers. A, the number of people the best product is suitable for and B the number of the best product. If multiple best products exist, then B is the number of the product that occurs first in the input.

Sample output

```
2 2
```

Constraints

- $1 \leq N \leq 225\,000$
- $1 \leq K \leq 10\,000$
- $0 \leq C_1, C_2, C_3 \leq 2^{30}$
- $0 \leq min_1, min_2, min_3, max_1, max_2, max_3 \leq 2^{30}$

Additionally, for 30% of the test cases:

- $1 \leq N \leq 100\,000$
- $1 \leq K \leq 5\,000$

Time limit

10 seconds.

Detailed feedback

Detailed feedback is enabled for this problem.

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Scoring

A correct solution will score 100%, while an incorrect solution will score 0%.

Two Rectangles

Author

Keegan Carruthers-Smith

Introduction

Due to all the recent power failures, Carl has decided to buy two solar power panels to supplement his power use. Carl has data for how much sun each part of his garden receives. He needs you to work out where to place his two panels to maximise the power generated.

Task

Carl has a rectangular garden. The amount of sun received is stored in a $M \times N$ grid (M rows, N columns). The size of the 2 panels are $R \times C$ (R rows high, C columns wide). The panels are placed parallel to the sides of the garden. You must maximise the amount of combined sun the panels receive. The panels may not intersect.

Example

In the sample input the rectangle with bottom right corner $(2, 7)$ has a sum of 21. The rectangle with bottom right corner $(4, 3)$ has a sum of 20. These 2 rectangle do not overlap and the sum of there 2 sums, 41, is the maximum possible sum. Refer to Figure 1.

2	1	3	3	1	5	5
2	3	2	3	3	2	5
5	5	1	4	4	3	2
3	5	1	4	2	2	5
3	3	4	2	1	2	5

Figure 1: The grid from the sample input. The rectangles in bold have a combined sum of 41.

Input (stdin)

The first line of the input contains two space-separated integers, M and N. The next line contains two space-separated integers, R and C. The next M lines each contain N integers, $v_{m,n}$, representing the amount of sun received at row m, column n.

Sample input

```
5 7
2 3
2 1 3 3 1 5 5
2 3 2 3 3 2 5
5 5 1 4 4 3 2
3 5 1 4 2 2 5
3 3 4 2 1 2 5
```

Output (stdout)

Output the maximum possible sum described above.

Sample output

```
41
```

Constraints

- $1 \leq M, N \leq 800$
- $1 \leq R, C \leq 100$
- $1 \leq v_{m,n} \leq 100$
- You will always be able to place 2 non-overlapping rectangles.

Additionally, in 30% of the test cases:

- $1 \leq M, N \leq 100$
- $1 \leq R, C \leq 10$

Time limit

1 second.

Scoring

A correct solution for a test case will score 100%. You will receive 0% for a testcase otherwise.

Teleporting

Author

Keegan Carruthers-Smith

Introduction

Bruce was getting frustrated having to walk everywhere, since his Segway broke. He ended up building a teleportation device which can teleport him to any other teleportation device $\sqrt{T}$ meters away. Unfortunately the larger T is, the more energy it requires, making the device more expensive to use.

Task

Bruce has given you a list of integer coordinates, each coordinate representing a teleportation device. Each device must be able to directly teleport to any other device. Every device has the same value for T. You need to minimise T.

Example

With $T = 317$, every device can teleport directly with every other one. 317 is also the minimal such value that allows this.

Input (stdin)

The first line of the input contains a single integer N. The next N lines each contain two space-separated *integers*, x and y. (x, y) represents a point. Points are unique (a point will only appear once in the list).

Sample input

```
6
0 1
0 10
10 0
3 5
11 15
9 7
```

Output (stdout)

A single *integer* $T_{\min}$, the minimal value for T.

Sample output

```
317
```

Constraints

- $2 \leq N \leq 200000 = 2 \times 10^5$
- $0 \leq x, y \leq 30000$

30% constraints

- $2 \leq N \leq 5000$

Time limit

1 second.

Scoring

You will score 100% for a correct test case, 0% otherwise.