



South African Computer Olympiad Training Camp 1, 2007 Day 1



Overview

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Problem	coins	warming	hole
Source	coins.java coins.c coins.cpp coins.pas	warming.java warming.c warming.cpp warming.pas	N/A
Input file	coins.in	warming.in	hole.in
Output file	coins.out	warming.out	hole.out
Time limit	1 second	2 seconds	N/A
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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Coin Counting

Author

Christopher de Kadt

Introduction

The shop assistants in the country of Zoon aren't particularly bright, and have great difficulty working out how many coins of each denomination to give customers in change. This is likely because of the strange Zoonian currency, but nonetheless: the Zoonian customers are growing tired of being given more coins than they need, and have enlisted your help to write a helpful program for the shop assistants.

Task

Given the values of coins available in the Zoonian currency, and the amount of change to be made up with these coins, determine the minimum number of coins needed to make exactly this amount of change.

Example

Suppose the Zoonians had a currency with 3 values of coins: 1, 7 and 12. If a customer needed change of 15, then the minimum number of coins needed is 3 (two coins of value 7, and one coin of value 1).

Input (coins.in)

The first line of input will contain two space-separated integers, N and M . N is the number of distinct values of coins in the Zoonian currency, and M is the amount of change to be made. The next N lines will each contain a single integer, V_i , which indicates the values of a coin in the currency. The V_i values will be given in ascending order, and no two coins have the same value.

Sample input

```
3 15
1
7
12
```

Output (coins.out)

Your program should output a single line containing a single integer, K , which is the minimum number of coins needed to make the change specified. It will always be possible to make up this amount for the given test data.

Sample output

```
3
```

Constraints

- $1 \leq N \leq 100$
- $1 \leq M \leq 10000$
- $1 \leq V_i \leq 10000$ for all V_i

50% constraints

- $1 \leq N \leq 10$
- $1 \leq M \leq 200$

Time limit

1 second.

Scoring

A correct answer will score 100%; an incorrect answer or incorrectly formatted output file will score 0%.



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Warming the pies

Author

USAICO 2006

Introduction

Fred the manic store-keeper is trying to keep his pies warm while they are on display, so that they are fresh when he serves them to customers. He has a hot-plate on which he can place them, but it is quite old and some parts do not get as warm as others. Since each pie belongs in a particular area in his display, he cannot just place pies on the warmest spots.

Task

The hot-plate is an $N \times N$ grid of heat cells, each of which has a particular temperature. For each pie, there is a square subsection of the grid (aligned to the sides) where it can be placed. You will be given a description of the grid and of the pie placements, and must return the maximum temperature at which each pie can be kept. It is possible to place as many pies as you like on the same heat cell.

Example

Suppose the temperatures are as shown in Figure 1. The first pie must be placed anywhere in the grid (highest temperature of 17), the second anywhere in the gray square (highest temperature of 7) and the third anywhere except on the edges (highest temperature of 11).

7	8	0	0	0	0	5	5
0	0	0	0	0	0	5	5
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	1	2	3	4
0	0	0	0	5	6	7	8
0	0	0	0	9	10	11	12
1	1	1	1	14	15	16	17

Figure 1: Temperatures of the hot-plate for the example.

Input (warming.in)

In order to keep the input files small, the temperatures are described in a number of blocks. Start by initialising all temperatures to 0. For each block that you read in, *add* the numbers in the block to the temperatures.

The first line of input contains three integers, N , P and H , separated by spaces. N is the size of the hot-plate, P is the number of pies and H is the number of blocks of input.

This is followed by H blocks. Each starts with a line of the form $r_1 c_1 r_2 c_2$, where the block covers the rectangle with corners (r_1, c_1) and (r_2, c_2) inclusive (all indices are from 1 to N). The next $r_2 - r_1 + 1$ lines each contain $c_2 - c_1 + 1$ integers, which should be added to the corresponding temperatures of the hot-plate (refer to the bottom row of the example to see how the temperatures are added).

The next P lines describe the pies. Each consists of three integers R , C and S , separated by spaces. The pie must lie within the square with corners (R, C) and $(R + S - 1, C + S - 1)$ inclusive.

Sample input

```
8 3 4
1 1 1 2
7 8
5 5 8 8
1 2 3 4
5 6 7 8
9 10 11 12
13 14 15 16
8 1 8 8
1 1 1 1 1 1 1 1
1 7 2 8
5 5
5 5
1 1 8
4 5 3
2 2 6
```

Output (warming.out)

The output consists of one line for each pie in the input. This line consists of a single integer, the temperature of the hottest cell on which the pie can be placed.

Sample output

```
17
7
11
```



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Constraints

- $1 \leq N \leq 500$
- $1 \leq P \leq 75000$
- $1 \leq H \leq 100$
- The blocks of input data will have at most 50000 entries in total.

50% constraints

- $1 \leq N \leq 200$
- $1 \leq P \leq 2500$

Time limit

2 seconds.

Scoring

A correct answer scores 100% and an incorrect one scores 0%.



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Searching for Black Holes

Author

Timothy Stranex

Introduction

Brahen, an astronomer, wants to study black holes but he doesn't know where to point his telescope. He knows that black holes are often found at the centre of galaxies. He was not able to find a list of galaxies but he has managed to find a list of star positions. This list does not indicate which galaxy each star belongs to. You must help Brahen to group the stars into galaxies. He knows that there are K galaxies in the list, and that there are up to M stars that do not belong to any galaxy.

Task

Since the problem is not well-defined, Brahen will try to find an optimal assignment based on a scoring function. The score for a potential galaxy is defined as follows: first, find the centroid of the galaxy. The X coordinate of the centroid is the average of the X coordinates of the stars in the galaxy, and similarly for Y and Z. The score is the sum of the squared distances of every star in the galaxy from the centroid. The squared distance between two points (x_a, y_a, z_a) and (x_b, y_b, z_b) is

$$(x_a - x_b)^2 + (y_a - y_b)^2 + (z_a - z_b)^2.$$

The score χ of a potential assignment is the sum of the scores for the K galaxies. Brahen is looking for the assignment with the lowest χ value. Remember that he can leave up to M stars unassigned to any galaxy.

For each input file, you must submit the output file containing the galaxy assignments. You do not submit the program you used to create these files.

Example

Suppose $N = 5$, $K = 2$, $M = 1$ and the stars' positions are as shown in Figure 2. One possible solution is use the two top-left stars for the first galaxy, the two bottom stars for the second galaxy and leave the remaining star unassigned. In this case, the centroid of the first galaxy is $(1.5, 8.5, 0)$ and the centroid of the second galaxy is $(7, 0, 0)$. This means that $\chi = (1.5^2 + 0.5^2 + 0^2) + (1.5^2 + 0.5^2 + 0^2) + (1^2 + 0^2 + 0^2) + (1^2 + 0^2 + 0^2) = 7$.

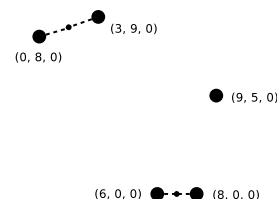


Figure 2: Example data. Large dots are stars and small dots are centroids.

Input (hole.in)

The first line of the input contains three space-separated integers N , K and M . The next N lines each contain three space-separated integers, the coordinates of each star in order: line $i + 1$ contains the integers x_i , y_i and z_i .

Sample input

```
5 2 1
0 8 0
3 9 0
9 5 0
6 0 0
8 0 0
```

Output (hole.out)

The output consists of N lines each containing a single integer. The integer on line i is the galaxy (between 1 and K) to which star i is assigned. If no galaxy is assigned then the integer must be 0.

Sample output

```
2
2
0
1
1
```

Constraints

- $1 \leq N \leq 1000$
- $1 \leq K \leq 100$
- $0 \leq M \leq N$
- $0 \leq x_i, y_i, z_i < 10000$



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50% constraints

In half of the test cases, the z coordinate of all the stars will be 0.

Scoring

Each test case you submit will first be verified to ensure that the solution is valid. If it is not valid, you will score 0%. Otherwise, you will be given a score depending on how well you minimized χ compared to the other contestants. If the smallest value of χ submitted for the test case by any contestant is χ' and your value is χ'' then you will receive $\chi'/\chi'' \times 100\%$ for the test case.

Note: validation is only done during evaluation. At the time you upload your solution, no check is done on your file and so it is entirely your responsibility to ensure that the formatting is correct.