



South African Computer Olympiad Training Camp 2, 2007 Day 2



Overview

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|---------------------|--------------------------------------|-----------------------------------|---|
| Problem | pmagic | trees | catalog |
| Source | pmagic.c pmagic.cpp pmagic.pas | trees.c trees.cpp trees.pas | catalog.c catalog.cpp catalog.pas |
| Input file | pmagic.in | trees.in | stdin |
| Output file | pmagic.out | trees.out | stdout |
| Time limit | 1 second | 1 second | 10 seconds |
| 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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Product Magic

Author

Keegan Carruthers-Smith

Introduction

Fred the manic store-keeper has started dabbling in magic to keep up with competition. He has learned how to transform a row of products into another row of products. He does this by repeatedly casting certain spells on the row, until the row has transformed into the desired row.

Task

Each time Fred casts a spell it costs him money. Fred would like to know the the minimum amount of spells to transform a product row into another. There are 3 spells that Fred can do.

- Insert - Insert a product anywhere at cost C_i
- Remove - Remove a product anywhere at cost C_r
- Substitute - Change any product into another at cost C_s

Example

Each product is denoted by a character. Uppercase characters represent different products to lowercase characters. Suppose Fred's costs are $C_i = 3$, $C_r = 1$ and $C_s = 2$ and he wants to convert the product "A B B C D" into "B E D E". He can do this by the following spells.

- Remove A (Cost 1)
- Remove the first B (Cost 1)
- Change C into E (Cost 2)
- Insert E after D (Cost 3)

So the minimal cost for Fred is 7. Note that there may be more than one way to get the minimal cost, but Fred is just interested in the minimal cost.

Input (pmagic.in)

The first line of input contains two integers, M and N . The number of products in the untransformed row is M . The number of products in the transformed row is N . The second line of input contains the integers C_i , C_r and C_s . The third line of input contains M space separated characters. These represent the products in order of the untransformed row. The fourth line of input contains N space separated characters. These represent the products in order of the transformed row.

Sample input

```
5 4
3 1 2
A B B C D
B E D E
```

Output (pmagic.out)

The output is a single positive integer T , the minimal cost of transforming the product row.

Sample output

```
7
```

Constraints

- $1 \leq M, N \leq 4000$
- $1 \leq C_i, C_r, C_s \leq 100$

50% constraints

- $1 \leq M, N \leq 6$

Time limit

1 second.

Scoring

A perfect solutions scores 100%. Otherwise you receive 0% for the testcase.



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Trees

Author

Migael Strydom

Introduction

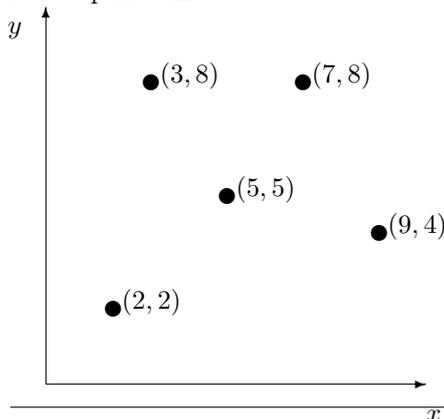
Farmer John has a large field full of trees scattered randomly. He takes a long rope and ties it to the southernmost tree in the field. Then, while holding on to the rope, Farmer John walks around the field until he is back to the tree where he started so that the rope stretches around all the trees in the field. The shape that the rope makes as it encloses all the trees is then a large polygon with some of the trees at its vertices. The area of this polygon is too large — Farmer John wants to use some of the field for something other than randomly-scattered trees. However, he is environmentally aware and only wants to remove one tree. You will help remove the one tree that will result in the resulting polygon having the minimum possible area.

Task

You will be given the x, y -coordinates of each tree in the field. Your task is to remove the one tree Farmer John needs to chop down that minimizes the area of the smallest polygon that encloses all the remaining trees.

Example

Suppose it is given that trees are planted with the coordinates $(2, 2)$, $(3, 8)$, $(5, 5)$, $(7, 8)$ and $(9, 4)$. This is shown in the figure. The rope around the trees would clearly go from $(2, 2)$ to $(9, 4)$, $(7, 8)$, $(3, 8)$ and finally back to $(2, 2)$. The point $(5, 5)$ is in the middle and is not touching the rope. The total area of the polygon traced out by the rope is 28 square units.



When the tree at $(2, 2)$ is removed and the rope is again tied so that it encloses the trees, it will go from $(9, 4)$ to $(7, 8)$, $(3, 8)$, $(5, 5)$ and back to $(9, 4)$. The area of the polygon it creates is 13 square units. This is the smallest such polygon that can be created by removing only one tree.

Input (trees.in)

The first line of input contains an integer N , the number of trees in the field.

The next N lines each contain two space separated integers, x_i and y_i , which are the x and y -coordinate of the i th tree.

Sample input

```
5
2 2
3 8
5 5
7 8
9 4
```

Output (trees.out)

The output should consist of one line containing a single integer that is 2 times the minimum area that can be created if a single tree is removed.

Sample output

```
26
```

Constraints

- $0 \leq x_i, y_i \leq 10000$
- $4 \leq N \leq 10000$

50% constraints

- $4 \leq N \leq 1000$

Time limit

1 second.

Scoring

For each correct answer, you will score 10 points. For an incorrect answer, you will score 0.



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Catalogue Galactica

Author

Max Rabkin

Introduction

The year is 2038, and the Earth has recently joined the Nibblonian trading empire. Most feeble earthlings are kicking and screaming, but Fred the Manic Storekeeper is embracing the opportunities of the second epoch open-armed and open-walleted. He has acquired “The Colossal Catalog of Almost Everything” on AntiDisc™.

“The Colossal Catalog of Almost Everything” is, in fact, quite colossal. Unfortunately, while the amount of entrepreneurship in the universe is limitless, the amount of creativity is not. This means that there are only a few different items in the catalog, but each may be available from thousands of different manufacturers, distributors, trans-dimensional smugglers, strange people on craigslist, etc.

Task

The catalog contains N entries numbered 1 to N describing M different products (M is unknown). Fred wants you to buy, on his behalf, one of each different product (the *cheapest* of each, of course). For ease of reference the catalog entries are sorted by product name (if two products are the same they will have the same name) and then by price. Write a program to interact with the catalog to find this information.

Example

Item 1 is the one-and-only John Cleese. Items 2–99 are dime-a-dozen Monty Python Imitators. Item 100 is the Holy Grail. Fred would want you to order items 1, 2 and 100.

Input/Output

The catalog program has four (case-sensitive) commands:

- **N**: query the Number of items in the catalog. The catalog program will return the number of items N .
- **X i** : eXamine the item with catalog number i . The catalog program will return the product name.

- **B i** : Buy the item with catalog number i .
- **E**: End the current shopping spree. After this command has been given, no further commands will be accepted.

Return values end with a newline. Commands which do not return anything do not even output a newline.

| Output | Input |
|--------|-----------------------|
| N | |
| X 1 | 100 |
| X 2 | john-cleese |
| B 1 | |
| B 2 | |
| X 50 | monty-python-imitator |
| X 100 | monty-python-imitator |
| X 99 | the-holy-grail |
| B 100 | monty-python-imitator |
| E | |

Constraints

- $1 \leq N \leq 10^{50}$
- $1 \leq M \leq 1000$
- $1 \leq \text{length of each name} \leq 40$

Each item name consists of lowercase ASCII letters (a-z) and hyphens.

50% constraints

- $1 \leq N \leq 1\,000\,000 = 10^6$

Time limit

10 seconds.

Testing

You can upload catalogs to the catalog program to test your solution. The first line of the catalog contains M , the second contains N ; these are followed by M lines, each containing an item name, and its first catalog number.

The items must be in alphabetical order, and the starting catalog number of the first item must be 1.



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Scoring

Perfect solutions score 100%. If the input or output is incorrectly formatted, or your program buys an item that isn't the cheapest, it scores 0%.

Otherwise, if you found m unique items out of M , you score $\frac{m}{2M} 100\%$.