

2009 Canadian Computing Competition

Day 1, Question 1

Problem A – Invasion of the Boxes

Input: from standard input

Output: to standard output

Source file: `boxes.{c, cpp, pas}`

Oh no! You are under attack by a swarm of boxes. The N ($0 \leq N \leq 1000$) boxes are all rectangular with sides perpendicular to the axes. To help you defend against these menacing boxes, you have a giant laser at your disposal.

The laser is located at the origin and shoots a single beam in some fixed specified direction. The beam, upon encountering a box, will destroy and reflect off of that box.

Beams are reflected so that if its first intersection point with a box is a horizontal segment of a box, the vertical component of the beam's direction is reversed. Similarly, the horizontal component is reversed when the beam hits a vertical segment. If the beam reflects off a corner of a box, both the horizontal and vertical components of its direction are reversed.

Output the indices of the destroyed boxes in the order that they are destroyed.

It is guaranteed that no two boxes will have a common point and that no box contains the origin in its interior or boundary.

Input Specification

The first line contains N , the number of boxes.

The second line contains two integers d_x and d_y ($-1000 \leq d_x, d_y \leq 1000$, not both zero), giving the direction in which the laser is pointed so that an unhindered beam fired from the origin will pass through (d_x, d_y) .

The next N lines each contain 4 integers: x_i y_i w_i and h_i (where $-1000 \leq x_i, y_i \leq 1000$ and $1 \leq w_i, h_i \leq 1000$) giving the description of the i th box which has lower left corner (x_i, y_i) and upper right corner $(x_i + w_i, y_i + h_i)$.

Sample Input

```
3
1 -1
1 0 90 20
1 -22 90 20
1 -44 90 20
```

Description of Sample Input

Three boxes: box 1 covering $(1, 0)$ to $(91, 20)$, box 2 covering $(1, -22)$ to $(91, -2)$ and box 3 covering $(1, -44)$ to $(91, -24)$. The laser points south-east.

Output Specification

Suppose there are k ($k \geq 0$) boxes that are destroyed. The output contains one number per line, with the i th line ($i \leq k$) containing the index of the box destroyed on the i th bounce. Notice that there is no output if $k = 0$.

Output for Sample Input

2
1
3

Description of Output for Sample Input

The beam bounces off the middle one (box 2), then into the top one (box 1) and finally destroying the bottom one (box 3).

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Day 1, Question 2

Problem B – Dinner

Input: from standard input

Output: to standard output

Source file: `dinner.{c, cpp, pas}`

On the way to dinner, the CCC competitors are lining up for their delicious curly fries. The N ($1 \leq N \leq 100$) competitors have lined up single-file to enter the cafeteria.

Doctor V, who runs the CCC, realized at the last minute that programmers simply hate standing in line next to programmers who use a different language. Thankfully, only two languages are allowed at the CCC: Gnold and Helpfile. Furthermore, the competitors have decided that they will only enter the cafeteria if they are in a group of at least K ($1 \leq K \leq 6$) competitors.

Doctor V decided to iterate the following scheme:

- He will find a group of K or more competitors who use the same language standing next to each other in line and send them to dinner.
- The remaining competitors will close the gap, potentially putting similar-language competitors together

So Doctor V recorded the sequence of competitors for you. Can all the competitors dine? If so, what is the minimum number of groups of competitors to be sent to dinner?

Note: Test cases worth 60% of the points have $K \leq 2$. Out of these, on test cases worth one third of the points (20% of the total points), $N \leq 10$.

Input Specification

The first line contains two integers N and K .

The second line contains N characters that are the sequence of competitors in line (H represents Helpfile, G represents Gnold)

Sample Input

```
7 2
GHHGHHG
```

Description of Sample Input

There are seven competitors: a Gnold programmer followed by two Helpfile programmers, followed by another Gnold programmer, followed by another two Helpfile programmers followed by a final Gnold programmer. Programmers want to goto dinner in pairs.

Output Specification

Output, on one line, the single number that is the minimum number of groups that are formed for dinner. If not all programmers can dine, output -1 .

Output for Sample Input

3

Description of Output for Sample Input

First send the first pair of H s to dinner, leaving $GGHHG$. Then send the second pair of H s to dinner, leaving GGG ; finally, send in the group of G s. It might be coincidental that the two pairs of Helpfile programmers entered the cafeteria successively.

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Day 1, Question 3

Problem C – Beware the Geoducks

Input: from standard input

Output: to standard output

Source file: `geoduck.{c, cpp, pas}`

After perfecting the art of converting water to working C++ code, Stan Velikiy is once again facing his arch-nemesis, Mario the Wabbit. At the moment, Stan is chasing Mario on a circuit and you, as the amused observer, are being asked to predict the outcome.

The circuit can be thought as of series of nodes connected by wires of specified length. Stan and Mario each start at one of the nodes and travel along the nodes in a predetermined plan. They visit the nodes according to the plan, travelling along the wires at a speed of one meter per second. Once their travel plans run out, they stay stationary at that node.

If Stan and Mario are ever in the same location, Stan will apprehend Mario. If Stan exceeds a time limit of t he gives up and goes back to converting more water into C++ code.

Unknown to either Stan or Mario, there is a series of geoducks sitting at various nodes of the circuit. Even though they look harmless, they are remnants of top-secret experiments on the Infinite Ambiguity Drive which causes whoever reaches them to disappear instantly. Once either Mario or Stan disappear, Stan can never find Mario. Note that if Stan finds Mario on a node with a geoduck, they both disappear and Stan never finds Mario.

Input Specification

The first line contains six integers: V , the number of nodes ($0 \leq V \leq 100$); E ($0 \leq E \leq 1000$), the number of wires; S and M ($1 \leq S, M \leq 1000$), the number of nodes in the routes taken by Stan and Mario, respectively; G ($0 \leq G \leq 100$), the number of geoducks; and t ($0 \leq t \leq 1000$), the time limit.

The next E lines contain 3 integers per line, specifying two nodes that a wire connects and the length l ($1 \leq l \leq 2000$) of the wire. No wire connects a node to itself and there is at most one wire between two nodes.

The next S lines contain one integer per line, which indicate the nodes of Stan's route in the order of being visited.

The next M lines contain one integer per line, the nodes of the Mario's route in the order of being visited.

The last G lines contain one integer per line, where each line indicates the location (node) where there is a geoduck.

Sample Input

```
3 1 2 2 1 3
1 2 6
```

1
2
2
1
3

Description of Sample Input

Stan travels from node 1 to 2 while Mario moves in the other direction. There is a geoduck on node 3.

Output Specification

On one line, output YES if Stan catches Mario before the time limit expires, NO otherwise.

Output for Sample Input

YES

Description of Output for Sample Input

Stan catches the Mario just as time expires, and fortunately none of them ever find a geoduck.