Jumper

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Problem Description

A professional jumper wants to explore the very steep Andes Mountains but he is very peculiar in his jumping technique. He only jumps perpendicular to the slope he is currently on and refuses to walk anywhere. He also doesn't carry any sleeping gear when he jumps so he wants to make sure he can get back to where he started. For simplicity, the mountains are divided into discrete positions where the jumper can stand, each having a specific slope. The slope of each possible position is specified by a list of integer pairs x_i, y_i which can be used to calculate the slope $m_i = \frac{y_i}{x_i}$.

The possible jump distance from position i is given by

$$d_i = -\frac{2m_i v^2}{g(1+m_i^2)}$$

in the same direction as x_i (i.e. if $x_i > 0$ then the jump is in the $+x$ direction).

Following the above rules, count the number of jumps required to return to the initial position, index 0. Right is the $+x$ direction and negative indices are not allowed.

Inputs

The input is specified as follows:

1. The first line specifies two space-separated integers: velocity v and the number of possible positions n
2. The next n lines each have two space-separated integers x_i and y_i which define the slope $m_i = \frac{y_i}{x_i}$ of position i

The following constraints are placed on the variables:

- $0 < v \leq 400$
- $0 < n \leq 400$
- $-80000 \leq y_i \leq 80000$
- $-80000 \leq x_i \leq 80000$
- $x_i \neq 0$
- $g = 10$ (an integer approximation of the standard $9.81\ m/s^2$)

Desired Output

The number n_j of jumps taken to return to the initial position 0 is the only output. This number will be calculated by following the rules specified in the problem description. Note that $n_j > 0$ even though the jumper begins on position 0 because the problem is concerned with the number of jumps required to **return** to position 0.

Samples

Several sample inputs and their corresponding outputs are shown. In Sample 0, the jump angle is so small that the first jump lands the jumper back at the start location. Thus the number of jumps is 1.

In Sample 1, there are two positions and the jumper lands on both. The first jump distance is given by

$$-\frac{2(-32/5)(7)^2}{10(1+(-32/5)^2)} \approx 1.49$$

which truncates to a movement of 1 space. The second jump works similarly and lands the jumper back at the start position.

Sample 2 is another slightly larger sample.

Sample 0

7 4 1 −20 −1 7 23 22 −48 31	1

Sample 1

7 2 32 −5 39 2	2

Sample 2

10 9 47 −6 21 −5 17 −46 28 36 −34 15 21 5 −32 2 10 19 17 46	5