



## 2993 - Carl the Ant

World Finals - Prague - 2003/2004

Ants leave small chemical trails on the ground in order to mark paths for other ants to follow. Ordinarily these trails follow rather straight lines. But in one ant colony there is an ant named Carl, and Carl is not an ordinary ant. Carl will often zigzag for no apparent reason, sometimes crossing his own path numerous times in the process. When other ants come to an intersection, they always follow the path with the strongest scent, which is the most recent path that leads away from the intersection point.

Ants are 1 centimeter long, move and burrow at 1 centimeter per second, and follow their paths exactly (bending at right angles when moving around corners). Ants cannot cross or overlap each other. If two ants meet at the exact same instant at an intersection point, the one that has been on Carl's path the longest has the right of way; if they don't arrive at the same time at the intersection point, the ant that has been waiting the longest at the intersection will move first.

Carl burrows up from the ground to start at the origin at time 0. He then walks his path and burrows back down into the ground at the endpoint. The rest of the ants follow at regular intervals. Given the description of Carl's path and when the other ants start the path, you are to determine how long it takes the entire set of ants to finish burrowing back into the ground. All the ants are guaranteed to finish.

### Input

Input consists of several test cases. The first line of the input file contains a single integer indicating the number of test cases .

The input for each test case starts with a single line containing three positive integers  $n$  ( $1 \leq n \leq 50$ ),  $m$  ( $1 \leq m \leq 100$ ), and  $d$  ( $1 \leq d \leq 100$ ). Here,  $n$  is the number of line segments in Carl's path,  $m$  is the number of ants traveling the path (including Carl), and  $d$  is the time delay before each successive ant's emergence. Carl (who is numbered 0) starts at time 0. The next ant (ant number 1) will emerge at time  $d$ , the next at time  $2d$ , and so on. If the burrow is blocked, the ants will emerge as soon as possible in the correct order.

Each of the next  $n$  lines for the test case consists of a unique integer pair  $x y$  ( $-100 \leq x, y \leq 100$ ), which is the endpoint of a line segment of Carl's path, in the order that Carl travels. The first line starts at the origin (0,0) and the starting point of every subsequent line is the endpoint of the previous line.

For simplicity, Carl always travels on line segments parallel to the axes, and no endpoints lie on any segment other than the ones which they serve as an endpoint. Input line segments will only intersect orthogonally. Every pair of segments can have at most one common point. The common point will be strictly inside both segments.

### Output

The output for each case is described as follows:

Case C:

Carl finished the path at time  $t_1$

The ants finished in the following order:

$a_1 a_2 a_3 \dots a_m$

The last ant finished the path at time  $t_2$

Here,  $C$  is the case number (starting at 1),  $a_1, a_2, a_3, \dots, a_m$  are the ant numbers in the order that they go back underground, and  $t_1$  and  $t_2$  are the times (in seconds) at which Carl and the last ant finish going underground. You should separate consecutive cases with a single blank line.

## Sample Input

```
2
4 7 4
0 4
2 4
2 2
-2 2
4 7 2
0 4
2 4
2 2
-2 2
```

## Sample Output

```
Case 1:
Carl finished the path at time 13
The ants finished in the following order:
0 2 1 3 4 5 6
The last ant finished the path at time 29

Case 2:
Carl finished the path at time 13
The ants finished in the following order:
0 4 1 5 2 6 3
The last ant finished the path at time 19
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**Tests-Setter:** Rujia Liu

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