ACM North Central North America Programming Contest
November 10, 2001

Problem 3: House of Mirrors

A "fun house" designer is seeking to determine the effect of the placement of mirrors. She'd like to have a program which allows her to specify the placement and size of the mirrors, and then determine the effect of introducing a beam of light into the collection of mirrors at a given angle from a given location. For the purposes of this experiment, she is content to assume the light beam is coherent (that is, it effectively follows a straight line). The mirrors are double-sided, which means they reflect on each side. And, as usual, the light beam is reflected by each mirror at an angle equal to the angle of incidence of the beam.

Let's consider an example. The figure below shows three mirrors (the long, thin rectangles), the light source (the "dot"), and the path the light will take (the dotted line). Although not drawn to scale, the

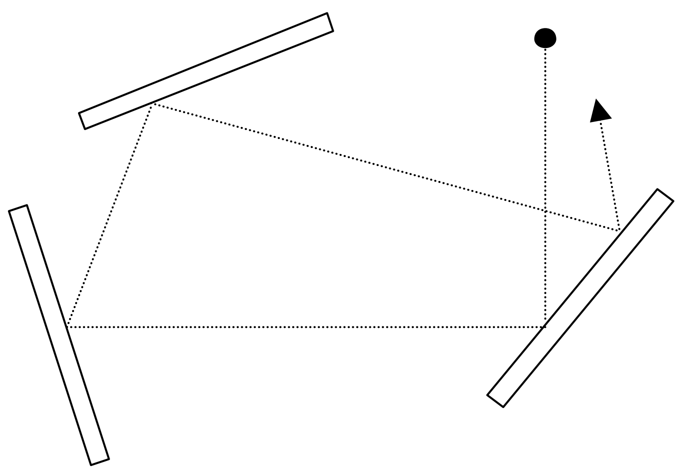

figure makes it easy to understand our fun house designer's goal. Given information about the placement of the double-sided mirrors and the location and direction of the coherent light beam, determine the location and direction of the last light beam leaving a mirrored surface.

Input

The input will contain multiple cases. The input for each case begins with an integer *m* (never larger than 10) that specifies the number of mirrors in the case. This is followed by 2*m* pairs of real numbers (that is, 4*m* real numbers). The first pair give the x and y coordinates (in a Cartesian coordinate system) of one end of the first mirror, and the second pair give the x and y coordinates of the other end of the same mirror. The placement of the other mirrors is given by the remaining numbers in a similar manner. (We assume that mirrors are arbitrarily thin, so we don't need to know their thickness.) The input data for each case will conclude with three real numbers specifying, in order, the x and y coordinates of the coherent light source and the angle (in degrees) with which the light leaves the source. Zero degrees is to the right (parallel to the x axis), 90 degrees is vertical (parallel to the y axis); angles increase as the beam is rotated counterclockwise. The input for the last case will be followed by a single integer zero. The origin of the coherent light source will not be on a mirror, and can be assumed to be transparent (thus light returning to the source will pass through it without effect). There will be no cases in which the light is reflected from the same point of the same side of any mirror more than once.

Output

For each input case, display the case number (they are numbered sequentially starting with one), the number of mirrors from which the beam is reflected, the x and y coordinates of the point on the last mirror from which the beam is reflected, and the angle the beam takes from that point. The angle should be greater than or equal to zero degrees, but less than 360 degrees, and use the same scheme as employed in the input (that is, 0 degrees is to the right, 90 degrees is vertical, and so forth). The coordinates and the angle should be rounded to and displayed with two fractional digits. If the light beam is not reflected from any mirror at all, then the output should just indicate that fact.

Sample Input

```
2
4 -1 6 1
4 4 6 2
0 0 0

1
4 -1 8 1
0 0 0

1
4 -0.577350 6 0.577350
0 0 0

0
```

Expected Output

```
Case 1:  The beam is reflected from 2 mirrors, leaving the last mirror
         at (5.00,3.00) with an angle of 180.00 degrees.

Case 2:  The beam is reflected from 1 mirror, leaving the last mirror
         at (6.00,0.00) with an angle of 53.13 degrees.

Case 3:  The beam is reflected from 1 mirror, leaving the last mirror
         at (5.00,0.00) with an angle of 60.00 degrees.
```