Problem B. Guess the Polygon 2

Input file: `standard input`
Output file: `standard output`

This is an interactive problem.

You are given a simple polygon, but before giving you the n vertices of the polygon, Little Q has shuffled them.

You can ask Little Q no more than $n - 2$ queries, each of which consists of three integers a, b ($-10^{15} \le a, b \le 10^{15}$, $a^2 + b^2 > 0$), and c ($-2 \times 10^{18} \le c \le 2 \times 10^{18}$). He will tell you the total length of the points on the line $ax + by + c = 0$ that lie inside or on the boundary of the polygon, which can be represented as $r\sqrt{a^2 + b^2}/s$ with two integers r and s ($r \ge 0, s \ge 1, \gcd(r, s) = 1$). Here $\gcd(r, s)$ is the greatest common divisor of r and s.

You need to find the polygon and then output the vertices in counter-clockwise order. You may start from any vertex.

The polygon and the shuffled order of the vertices are determined before the start of the interaction and do not depend on your queries. In other words, the interactor is not adaptive.

Input

The first line of the input contains an integer T ($1 \le T \le 200$), indicating the number of test cases. For each test case:

The first line contains an integer n ($3 \le n \le 200$), indicating the number of vertices of the polygon.

Then n lines follow, each containing two integers x and y ($0 \le x, y \le 1000$) that give the coordinates (x, y) of the vertices of the polygon in shuffled order.

The polygon is simple, i.e., its vertices are distinct and no two edges of the polygon intersect or touch, except that consecutive edges touch at their common vertex. In addition, no two consecutive edges are collinear.

It is guaranteed that the sum of n over all test cases does not exceed 200.

Interaction Protocol

If you want to ask a query, output one line. First output `?` followed by a space, then output three integers a, b ($-10^{15} \le a, b \le 10^{15}$, $a^2 + b^2 > 0$), and c ($-2 \times 10^{18} \le c \le 2 \times 10^{18}$). After flushing your output, your program should read two integers r and s ($r \ge 0, s \ge 1, \gcd(r, s) = 1$), which means the answer to your query is $r\sqrt{a^2 + b^2}/s$.

If you want to guess the polygon, output $n + 1$ lines. First output `!` in one line, then output n lines, each containing two integers x and y that give the coordinates (x, y) of the vertices of the polygon in counter-clockwise order. You may start from any vertex. After flushing your output, your program should continue processing the next test case, or exit immediately if there are no more test cases. Note that your guess does not count as a query.

To flush your output, you can use:

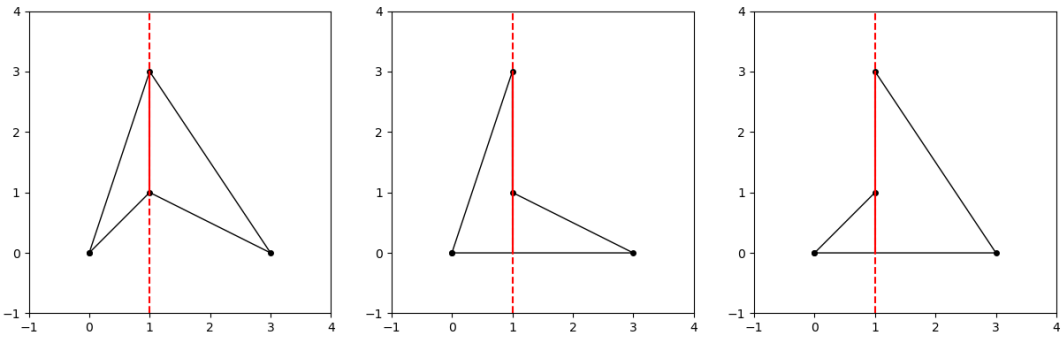
- `fflush(stdout)` (if you use `printf`) or `cout.flush()` (if you use `cout`) in C and C++.
- `System.out.flush()` in Java and Kotlin.
- `sys.stdout.flush()` in Python.

Example

standard input	standard output
2 4 0 0 1 3 1 1 3 0 2 1 3 0 0 999 1000 1000 999 1 1000000000000000000000000	 ? 1 0 -1 ! 1 1 3 0 1 3 0 0 ? 1000000000000 1000000000000 -1999 ! 0 0 1000 999 999 1000

Note

For the first sample case, there are three candidate polygons, shown in the figure below. Only the leftmost one meets the answer 2 to the query $1 \cdot x + 0 \cdot y + (-1) = 0$. The other two have the answer 3 to the query $1 \cdot x + 0 \cdot y + (-1) = 0$.



For the second sample case, the answer to the query $10^{12} \cdot x + 10^{12} \cdot y + (-1999) = 0$ is $\sqrt{2}/10^{12}$, and thus $r = 1$ and $s = 10^{24}$. There is only one candidate polygon.

Note that the order of the vertices shown in the sample case may not be consistent with the actual provided.

The blank lines in the sample case are added for readability. In your output, extra spaces or blank lines will be ignored.