Problem A. Segment Intersection

Input file: `segments.in`
Output file: `segments.out`

Given several pairs of segments. Each segment is defined by coordinates of its endpoints. For each given pair determine how many points they have in common.

Input

The first line of the input file contains number of segment pairs N ($1 \le N \le 160\,000$). Each of the following N lines contain eight integers each: $X_s^1\ Y_s^1\ X_t^1\ Y_t^1\ X_s^2\ Y_s^2\ X_t^2\ Y_t^2$ — the coordinates of the endpoints of the first and the second segment.

All coordinates are integers and do not exceed 10^9 by absolute value.

Output

For each segment pair output 0 if they do not intersect, 1 if they have one common point, and 2 if they have infinitely many common points.

Sample input and output

segments.in	segments.out
3 0 0 1 0 0 1 1 1 0 0 1 1 0 1 1 0 0 0 1 1 0 0 1 1	0 1 2

Problem B. Area of a Polygon

Input file: area.in
Output file: area.out

Given a polygon. Compute its area.

Input

The first line of the input file contains number of vertices of a polygon N ($3 \le N \le 500\,000$). In the following N lines the coordinates of the vertices are given in either clockwise or counterclockwise order.

All coordinates are integers and do not exceed 10^9 by absolute value.

Output

Output the area of the polygon with the precision of at least 10^{-9}. Exponential notation is not allowed in this problem.

Sample input and output

area.in	area.out
3 0 0 0 1 1 0	0.5

Problem C. Convex Hull

Input file: `convex.in`
Output file: `convex.out`

Given a set of points. Find its convex hull.

Input

The first line of the input file contains number of points N ($1 \le N \le 500\,000$). In the following N lines the coordinates of the points are given. All coordinates are integers and do not exceed 10^9 by absolute value.

Output

In the first line output H — the number of points in the convex hull. In the next H lines output the coordinates of the points X_i, Y_i separated by space. The points should be listed in the counterclockwise order. No three points in the output should be collinear.

Sample input and output

convex.in	convex.out
9 0 0 0 1 0 2 1 0 1 1 1 2 2 0 2 1 2 2	4 0 0 2 0 2 2 0 2

Problem D. Minimum Bounding Box

Input file: `minimum.in`
Output file: `minimum.out`

A *bounding box* of the polygon is a rectangle which contains the polygon.

Given a convex polygon. Find the minimum area of its bounding box and the minimum perimeter of its bounding box.

Input

The first line of the input file contains number of vertices of the polygon N ($3 \le N \le 150\,000$). In the following N lines the coordinates of the vertices of the polygon are given. The polygon is convex, and the vertices are given in the counterclockwise order.

All coordinates are integers and do not exceed 10^9 by absolute value.

Output

In the first line output the minimum area of the bounding box of the given polygon. In the second line output the minimum perimeter of the bounding box of the given polygon. The relative error of the answers must not exceed 10^{-9}.

Sample input and output

minimum.in	minimum.out
3 0 0 1 1 0 2	2.0 5.65685424949238

Problem E. Common Tangents 1

Input file: `tangents.in`
Output file: `tangents.out`

Given two convex polygons which do not have common points. Find their inner and outer tangents.

An *outer tangent* is a line which touches both polygons such that these polygons are on the same side of the line. For any two polygons with nonzero square and no common points there are exactly two such lines.

An *inner tangent* is a line which touches both polygons such that these polygons are on different sides of the line. For any two polygons with nonzero square and no common points there are exactly two such lines.

Input

The first line of the input file contains number of vertices of the first polygon N_1 ($3 \le N_1 \le 80\,000$). In the following N_1 lines the coordinates of the vertices of the first polygon are given. The polygon is convex, and the vertices are given in the counterclockwise order.

After that, the description of the second polygon is given using the same format and with the same constraints.

All coordinates are integers and do not exceed 10^9 by absolute value.

Output

In the first line output the coordinates of the vertices of the polygons (first polygon, then second polygon) through which the first outer tangent passes. In the second line output the vertices for the second outer tangent, in the third line output the vertices for the first inner tangent, in the fourth line output the vertices for the second inner tangent.

If a tangent touches more than one vertex of a polygon (or of both polygons), you should output the most distant pair of points that line on a tangent (see the second test for clarity).

Sample input and output

tangents.in	tangents.out
3 0 0 1 1 0 2 3 3 2 2 1 3 0	0 2 3 2 0 0 3 0 0 2 3 0 0 0 3 2
4 0 0 1 0 1 1 0 1 4 0 2 1 2 1 3 0 3	0 0 0 3 1 0 1 3 0 1 1 2 1 1 0 2

Problem F. Polygon and Lines

Input file: `lines.in`
Output file: `lines.out`

Given a convex polygon and a number of query lines. For each query lines determine whether it has common points with the polygon.

Input

The first line of the input file contains number of vertices of the polygon N ($3 \le N \le 150\,000$). In the following N lines the coordinates of the vertices of the polygon are given. The polygon is convex, and the vertices are given in the counterclockwise order.

The next line contains Q ($1 \le Q \le 150\,000$) — the number of query lines. In the next Q lines for each query line the coordinates of two points that lie on it are given.

All coordinates are integers and do not exceed 10^9 by absolute value.

Output

For each query line output 0 if it does not have common points with the polygon, 1 if it has at least one common point with the polygon. For i-th query line the answer should be printed in the i-th line of the output file.

Sample input and output

lines.in	lines.out
4 0 1 1 0 2 1 1 2 5 -1 1 1 -1 -1 1 1 0 -1 1 1 1 -1 1 1 2 -1 1 1 3	0 1 1 1 0

Problem G. Polygon and Points

Input file: `points.in`
Output file: `points.out`

Given a convex polygon and a number of query points. For each query point determine its location relative to the polygon.

Input

The first line of the input file contains number of vertices of the polygon N ($3 \le N \le 150\,000$). In the following N lines the coordinates of the vertices of the polygon are given. The polygon is convex, and the vertices are given in the counterclockwise order.

The next line contains Q ($1 \le Q \le 150\,000$) — the number of query points. In the next Q lines the coordinates of the query points are given.

All coordinates are integers and do not exceed 10^9 by absolute value.

Output

For each query point output 0 if the point lies outside the polygon, 1 if it lies on the boundary of the polygon, and 2 if it lies strictly inside the polygon. For i-th query point the answer should be printed in the i-th line of the output file.

Sample input and output

points.in	points.out
4 0 1 1 0 2 1 1 2 4 0 0 1 0 2 0 1 1	0 1 0 2

Problem H. Triangulation

Input file: `triangulate.in`
Output file: `triangulate.out`

Given a polygon. Find its triangulation.

Input

The first line of the input file contains number of vertices of the polygon N ($3 \le N \le 5\,000$). In the following N lines the coordinates of the vertices of the polygon are given. The vertices are given in the counterclockwise order.

All coordinates are integers and do not exceed 10^6 by absolute value.

Output

In the first line output T — the number of triangles in the triangulation. Note that this number does not depend on the algorithm used to build the triangulation.

In the next T lines output the coordinates of vertices of triangles, separated by spaces. Each triangle should be output in a separate line.

Sample input and output

triangulate.in	triangulate.out
4 0 0 -1 -1 1 0 -1 1	2 0 0 1 0 -1 -1 -1 1 1 0 0 0

Problem I. Circle Intersection

Input file: `circles.in`
Output file: `circles.out`

There are two circles on the plane. Your task is to find all points of their intersection.

Input

The first line of the input file contains number of test cases k ($1 \le k \le 10\,000$). Each test case consists of two lines: the first line contains the description of the first circle, and the second one contains the description of the second one. The description of each circle is written in the form x, y, r ($-1000 \le x, y \le 1000$, $0 < r \le 1000$). All numbers are integer.

Output

The first line of the output file must contain q — the number intersection points. The follow q lines must contain intersection points. If there are infinitely many intersection points, print $q = -1$. Points must be accurate up to 10^{-9}.

Separate output for different test cases with a single blank line.

Sample input and output

circles.in	circles.out
2 0 0 2 4 0 2 0 0 2 5 0 2	1 2 0 0

Problem J. Common Tangents 2

Input file: `circles2.in`
Output file: `circles2.out`

There are two circles on the plane. Your task is to find all their common tangents.

Input

The first line of the input file contains number of test cases k ($1 \le k \le 10\,000$). Each test case consists of two lines: the first contains the description of the first circle, and the second one contains the description of the second circle. The description of each circle is written in the form x, y, r ($-1000 \le x, y \le 1000$, $0 < r \le 1000$). All numbers are integer.

Output

The first line of each output block must contain the number of common tangents n of the circles from the corresponding test case. The following n lines must contain tangent descriptions in form a b c. a, b and c are coefficients of $ax + by + c = 0$, where $a^2 + b^2 = 1$, $a \ge 0$, and if $a = 0$ then $b > 0$. Also the tangents must be written in lexicographical order. Output blocks must be separated by a single blank line. If there is infinite number of tangents, output a single number -1. Output a, b and c as precisely as you can.

Sample input and output

circles2.in	circles2.out
2 0 0 1 0 1 1 0 0 1 0 0 1	2 1 0 -1.0 1 0 1 -1