Problem A. Point Location Test

Time Limit 1000 ms
Mem Limit 524288 kB

There is a line that goes through the points $p_1 = (x_1, y_1)$ and $p_2 = (x_2, y_2)$. There is also a point $p_3 = (x_3, y_3)$.

Your task is to determine whether p_3 is located on the left or right side of the line or if it touches the line when we are looking from p_1 to p_2.

Input

The first input line has an integer t: the number of tests.

After this, there are t lines that describe the tests. Each line has six integers: x_1, y_1, x_2, y_2, x_3 and y_3.

Output

For each test, print "LEFT", "RIGHT" or "TOUCH".

Constraints

- $1 \le t \le 10^5$
- $-10^9 \le x_1, y_1, x_2, y_2, x_3, y_3 \le 10^9$
- $x_1 \neq x_2$ or $y_1 \neq y_2$

Example

Input	Output
3 1 1 5 3 2 3 1 1 5 3 4 1 1 1 5 3 3 2	LEFT RIGHT TOUCH

Problem B. Line Segment Intersection

Time Limit 1000 ms
Mem Limit 524288 kB

There are two line segments: the first goes through the points (x_1, y_1) and (x_2, y_2), and the second goes through the points (x_3, y_3) and (x_4, y_4).

Your task is to determine if the line segments intersect, i.e., they have at least one common point.

Input

The first input line has an integer t: the number of tests.

After this, there are t lines that describe the tests. Each line has eight integers x_1, y_1, x_2, y_2, x_3, y_3, x_4 and y_4.

Output

For each test, print "YES" if the line segments intersect and "NO" otherwise.

Constraints

- $1 \le t \le 10^5$
- $-10^9 \le x_1, y_1, x_2, y_2, x_3, y_3, x_4, y_4 \le 10^9$
- $(x_1, y_1) \neq (x_2, y_2)$
- $(x_3, y_3) \neq (x_4, y_4)$

Example

Input	Output
5 1 1 5 3 1 2 4 3 1 1 5 3 1 1 4 3 1 1 5 3 2 3 4 1 1 1 5 3 2 4 4 1 1 1 5 3 3 2 7 4	NO YES YES YES YES

Problem C. Polygon Area

Time Limit 1000 ms
Mem Limit 524288 kB

Your task is to calculate the area of a given polygon.

The polygon consists of n vertices (x_1, y_1), (x_2, y_2), $\ldots$, (x_n, y_n). The vertices (x_i, y_i) and (x_{i+1}, y_{i+1}) are adjacent for $i = 1, 2, \ldots, n-1$, and the vertices (x_1, y_1) and (x_n, y_n) are also adjacent.

Input

The first input line has an integer n: the number of vertices.

After this, there are n lines that describe the vertices. The ith such line has two integers x_i and y_i.

You may assume that the polygon is simple, i.e., it does not intersect itself.

Output

Print one integer: $2a$ where the area of the polygon is a (this ensures that the result is an integer).

Constraints

- $3 \le n \le 1000$
- $-10^9 \le x_i, y_i \le 10^9$

Example

Input	Output
4 1 1 4 2 3 5 1 4	16

Problem D. Point in Polygon

Time Limit 1000 ms
Mem Limit 524288 kB

You are given a polygon of n vertices and a list of m points. Your task is to determine for each point if it is inside, outside or on the boundary of the polygon.

The polygon consists of n vertices $(x_1, y_1), (x_2, y_2), \ldots, (x_n, y_n)$. The vertices (x_i, y_i) and (x_{i+1}, y_{i+1}) are adjacent for $i = 1, 2, \ldots, n-1$, and the vertices (x_1, y_1) and (x_n, y_n) are also adjacent.

Input

The first input line has two integers n and m: the number of vertices in the polygon and the number of points.

After this, there are n lines that describe the polygon. The ith such line has two integers x_i and y_i.

You may assume that the polygon is simple, i.e., it does not intersect itself.

Finally, there are m lines that describe the points. Each line has two integers x and y.

Output

For each point, print "INSIDE", "OUTSIDE" or "BOUNDARY".

Constraints

- $3 \le n, m \le 1000$
- $1 \le m \le 1000$
- $-10^9 \le x_i, y_i \le 10^9$
- $-10^9 \le x, y \le 10^9$

Example

Input	Output
4 3 1 1 4 2 3 5 1 4 2 3 3 1 1 3	INSIDE OUTSIDE BOUNDARY

Problem E. Polygon Lattice Points

Time Limit 1000 ms
Mem Limit 524288 kB

Given a polygon, your task is to calculate the number of lattice points inside the polygon and on its boundary. A lattice point is a point whose coordinates are integers.

The polygon consists of n vertices $(x_1, y_1), (x_2, y_2), \ldots, (x_n, y_n)$. The vertices (x_i, y_i) and (x_{i+1}, y_{i+1}) are adjacent for $i = 1, 2, \ldots, n-1$, and the vertices (x_1, y_1) and (x_n, y_n) are also adjacent.

Input

The first input line has an integer n: the number of vertices.

After this, there are n lines that describe the vertices. The ith such line has two integers x_i and y_i.

You may assume that the polygon is simple, i.e., it does not intersect itself.

Output

Print two integers: the number of lattice points inside the polygon and on its boundary.

Constraints

- $3 \le n \le 10^5$
- $-10^9 \le x_i, y_i \le 10^9$

Example

Input	Output
4 1 1 5 3 3 5 1 4	6 8

Problem F. Minimum Euclidean Distance

Time Limit 1000 ms
Mem Limit 524288 kB

Given a set of points in the two-dimensional plane, your task is to find the minimum Euclidean distance between two distinct points.

The Euclidean distance of points (x_1, y_1) and (x_2, y_2) is $\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$.

Input

The first input line has an integer n: the number of points.

After this, there are n lines that describe the points. Each line has two integers x and y. You may assume that each point is distinct.

Output

Print one integer: d^2 where d is the minimum Euclidean distance (this ensures that the result is an integer).

Constraints

- $2 \le n \le 2 \cdot 10^5$
- $-10^9 \le x, y \le 10^9$

Example

Input	Output
4 2 1 4 4 1 2 6 3	2

Problem G. Convex Hull

Time Limit 1000 ms
Mem Limit 524288 kB

Given a set of n points in the two-dimensional plane, your task is to determine the convex hull of the points.

Input

The first input line has an integer n: the number of points.

After this, there are n lines that describe the points. Each line has two integers x and y: the coordinates of a point.

You may assume that each point is distinct, and the area of the hull is positive.

Output

First print an integer k: the number of points in the convex hull.

After this, print k lines that describe the points. You can print the points in any order. Print all points that lie on the convex hull.

Constraints

- $3 \le n \le 2 \cdot 10^5$
- $-10^9 \le x, y \le 10^9$

Example

Input	Output
6 2 1 2 5 3 3 4 3 4 4 6 3	4 2 1 2 5 4 4 6 3

Problem H. Maximum Manhattan Distances

Time Limit 1000 ms
Mem Limit 524288 kB

A set is initially empty and n points are added to it. Calculate the maximum Manhattan distance of two points after each addition.

Input

The first line has an integer n: the number of points.

The following n lines describe the points. Each line has two integers x and y. You can assume that each point is distinct.

Output

After each addition, print the maximum distance.

Constraints

- $1 \le n \le 2 \cdot 10^5$
- $-10^9 \le x, y \le 10^9$

Example

Input	Output
5 1 1 3 2 2 4 2 1 4 5	0 3 4 4 7

Problem I. All Manhattan Distances

Time Limit 1000 ms
Mem Limit 524288 kB

Given a set of points, calculate the sum of all Manhattan distances between two point pairs.

Input

The first line has an integer n: the number of points.

The following n lines describe the points. Each line has two integers x and y. You can assume that each point is distinct.

Output

Print the sum of all Manhattan distances.

Constraints

- $1 \le n \le 2 \cdot 10^5$
- $-10^9 \le x, y \le 10^9$

Example

Input	Output
5 1 1 3 2 2 4 2 1 4 5	36

Problem J. Intersection Points

Time Limit 1000 ms
Mem Limit 524288 kB

Given n horizontal and vertical line segments, your task is to calculate the number of their intersection points.

You can assume that no parallel line segments intersect, and no endpoint of a line segment is an intersection point.

Input

The first line has an integer n: the number of line segments.

Then there are n lines describing the line segments. Each line has four integers: x_1, y_1, x_2 and y_2: a line segment begins at point (x_1, y_1) and ends at point (x_2, y_2).

Output

Print the number of intersection points.

Constraints

- $1 \le n \le 10^5$
- $-10^6 \le x_1 \le x_2 \le 10^6$
- $-10^6 \le y_1 \le y_2 \le 10^6$
- $(x_1, y_1) \neq (x_2, y_2)$

Example

Input	Output
3 2 3 7 3 3 1 3 5 6 2 6 6	2

Problem K. Line Segments Trace I

Time Limit 1000 ms
Mem Limit 524288 kB

There are n line segments whose endpoints have integer coordinates. The left x-coordinate of each segment is 0 and the right x-coordinate is m. The slope of each segment is an integer.

For each x-coordinate $0, 1, \ldots, m$, find the maximum point in any line segment.

Input

The first line has two integers n and m: the number of line segments and the maximum x-coordinate.

The next n lines describe the line segments. Each line has two integers y_1 and y_2: there is a line segment between points $(0, y_1)$ and (m, y_2).

Output

Print $m + 1$ integers: the maximum points for $x = 0, 1, \ldots, m$.

Constraints

- $1 \le n, m \le 10^5$
- $0 \le y_1, y_2 \le 10^9$

Example

Input	Output
4 5 1 6 7 2 5 5 10 0	10 8 6 5 5 6

Problem L. Line Segments Trace II

Time Limit 1000 ms
Mem Limit 524288 kB

There are n line segments whose endpoints have integer coordinates. Each x-coordinate is between 0 and m. The slope of each segment is an integer.

For each x-coordinate $0, 1, \ldots, m$, find the maximum point in any line segment. If there is no segment at some point, the maximum is -1.

Input

The first line has two integers n and m: the number of line segments and the maximum x-coordinate.

The next n lines describe the line segments. Each line has four integers x_1, y_1, x_2 and y_2: there is a line segment between points (x_1, y_1) and (x_2, y_2).

Output

Print $m + 1$ integers: the maximum points for $x = 0, 1, \ldots, m$.

Constraints

- $1 \le n, m \le 10^5$
- $0 \le x_1 < x_2 \le m$
- $0 \le y_1, y_2 \le 10^9$

Example

Input	Output
4 5 1 1 3 3 1 2 4 2 2 4 5 7 2 8 5 2	-1 2 8 6 6 7

Problem M. Lines and Queries I

Time Limit 1000 ms
Mem Limit 524288 kB

Your task is to efficiently process the following types of queries:

1. Add a line $ax + b$
2. Find the maximum point in any line at position x

Input

The first line has an integer n: the number of queries.

The following n lines describe the queries. The format of each line is either "1 a b" or "2 x ".

You may assume that the first query is of type 1.

Output

Print the answer for each query of type 2.

Constraints

- $1 \le n \le 2 \cdot 10^5$
- $-10^9 \le a, b \le 10^9$
- $0 \le x \le 10^5$

Example

Input	Output
6 1 1 2 2 1 2 3 1 0 4 2 1 2 3	3 5 4 5

Problem N. Lines and Queries II

Time Limit 1000 ms
Mem Limit 524288 kB

Your task is to efficiently process the following types of queries:

1. Add a line $ax + b$ that is active in range $[l, r]$
2. Find the maximum point in any active line at position x

Input

The first line has an integer n: the number of queries.

The following n lines describe the queries. The format of each line is either "$1\ a\ b\ l\ r$" or "$2\ x$".

Output

Print the answer for each query of type 2. If no line is active, print `NO`.

Constraints

- $1 \le n \le 2 \cdot 10^5$
- $-10^9 \le a, b \le 10^9$
- $0 \le x \le 10^5$
- $0 \le l \le r \le 10^5$

Example

Input	Output
6 1 1 2 1 3 2 3 2 4 1 0 4 1 5 2 3 2 4	5 NO 5 4

Problem O. Area of Rectangles

Time Limit 1000 ms
Mem Limit 524288 kB

Given n rectangles, your task is to determine the total area of their union.

Input

The first line has an integer n: the number of rectangles.

After that, there are n lines describing the rectangles. Each line has four integers x_1, y_1, x_2 and y_2: a rectangle begins at point (x_1, y_1) and ends at point (x_2, y_2).

Output

Print the total area covered by the rectangles.

Constraints

- $1 \leq n \leq 10^5$
- $-10^6 \leq x_1 < x_2 \leq 10^6$
- $-10^6 \leq y_1 < y_2 \leq 10^6$

Example

Input	Output
3 1 3 4 5 3 1 7 4 5 3 8 6	24

Problem P. Robot Path

Time Limit 1000 ms
Mem Limit 524288 kB

You are given a description of a robot's path. The robot begins at point $(0, 0)$ and performs n commands. Each command moves the robot some distance up, down, left or right.

The robot will stop when it has performed all commands, or immediately when it returns to a point that it has already visited. Your task is to calculate the total distance the robot moves.

Input

The first line has an integer n: the number of commands.

After that, there are n lines describing the commands. Each line has a character d and an integer x: the robot moves the distance x to the direction d. Each direction is U (up), D (down), L (left), or R (right).

Output

Print the total distance the robot moves.

Constraints

- $1 \le n \le 10^5$
- $1 \le x \le 10^6$

Example

Input	Output
5 U 2 R 3 D 1 L 5 U 2	9