Task: ZAM
Castle

UFAM Workshop, contest #5. Source file `zam.*` Available memory: 512 MB.

The treasure hunters have obtained a map of the castle, in the basement of which there is a huge treasure. The map is drawn on a square grid, the nodes of which have integer coordinates. The lower left corner (node) of the grid has the coordinates $(0, 0)$, and the opposite upper right corner has the coordinates (W, W). On the map, the castle has the shape of a polygon, the sides of which lie on the lines of the grid. The adjacent sides of a polygon are always perpendicular. The boundary of this polygon is a closed regular line, i.e. each vertex belongs to exactly two line segments, and every other point – to one. The sections of the lines forming the grid included in the polygon (including each side of the polygon) represent the sections of the underground corridors of the castle. In one of the nodes (i.e. the intersection of the grid lines) belonging to the polygon, the entry point to the dungeon is marked, and in another node (also belonging to the polygon) – the point where the treasure is hidden.

We want to calculate the length of the shortest path through the underground corridors of the castle (along the lines of the grid) from the point of entry to the underground to the point where the treasure is hidden.

In fact, the seekers have obtained more castle maps and do not know which one is true (each map has the same castle plan, but the entrances to the dungeons and the location of the treasure may differ). Someone else has been commissioned to study the originality of the maps, and in the meantime, the lengths of the roads have to be determined for each map.

Input

In the first line of the input there is given one even integer n ($4 \le n \le 100\,000$) denoting the number of vertices of the polygon describing the castle. In each of the following n lines there are two integers x, y ($0 \le x, y \le 10^8$) denoting the coordinates of the consecutive vertices of the polygon. The vertices are given in counterclockwise order (i.e. when walking around the edge of the polygon, we have its interior on the left).

The next line contains an integer q ($1 \le q \le 100\,000$) denoting the number of queries. Each of the following q lines contains one query; i-th of these lines contains four integers x_A, y_A, x_B and y_B ($0 \le x_A, y_A, x_B, y_B \le 10^8$), denoting the coordinates of the point with the entry to dungeon (x_A, y_A) and the point where the treasure (x_B, y_B) is hidden. Both of these points are inside or at the edge of the polygon.

Output

The output should be q lines containing responses to subsequent input queries. The answer is an integer – the length of the shortest path from the entry point to the underground (x_A, y_A) to the point where the treasure (x_B, y_B) is hidden.

Example

For the input data:

```
10
9 6
9 2
12 2
12 9
2 9
2 1
8 1
8 3
4 3
4 6
2
11 5 3 1
10 4 10 8
```

the correct result is:

```
14
4
```