

Problem E

Rectilinear Polygon Sizing Problem

Input File: *testdata.in*

Time Limit: 5 seconds

Problem Description

Polygon sizing is a fundamental and important issue in computational geometry. Rectilinear polygon sizing is a special problem that has been widely applied in engineering application. A rectilinear polygon (RP) is a polygon whose boundary edges are either vertical or horizontal lines. A RP can be represented by a sequence of RP's corner points. For instance, Fig. 1(b) shows a RP with 8 corner points, sequenced in counterclockwise order. When we traverse the sequenced corner points, each edge is assigned as a direction. One important thing during polygon corner point traverse is to determine the polygon shape, that is, which region is a polygon's interior zone. We can use the following rules to decide the interior zone.

- For a leftward edge, its lower area is in the interior zone.
- For a rightward edge, its upper area is in the interior zone.
- For an upward edge, its left area is in the interior zone.
- For a downward edge, its right area is in the interior zone.

For instance, in Fig. 1(a), $\langle 2,3 \rangle$ is a downward edge, thus the interior region is on its right hand side.

For an edge $e = \langle (x_1, y_1), (x_2, y_2) \rangle$ such that $x = \min(x_1, x_2)$, $X = \max(x_1, x_2)$, $y = \min(y_1, y_2)$, and $Y = \max(y_1, y_2)$, we say a rectangle R is obtained by *bloating* e by σ units if the 4 corners of R are $(x - \sigma, y - \sigma)$, $(x - \sigma, Y + \sigma)$, $(X + \sigma, y - \sigma)$, and $(X + \sigma, Y + \sigma)$. The polygon obtained by over-sizing a RP P by σ units has an interior region which is the union

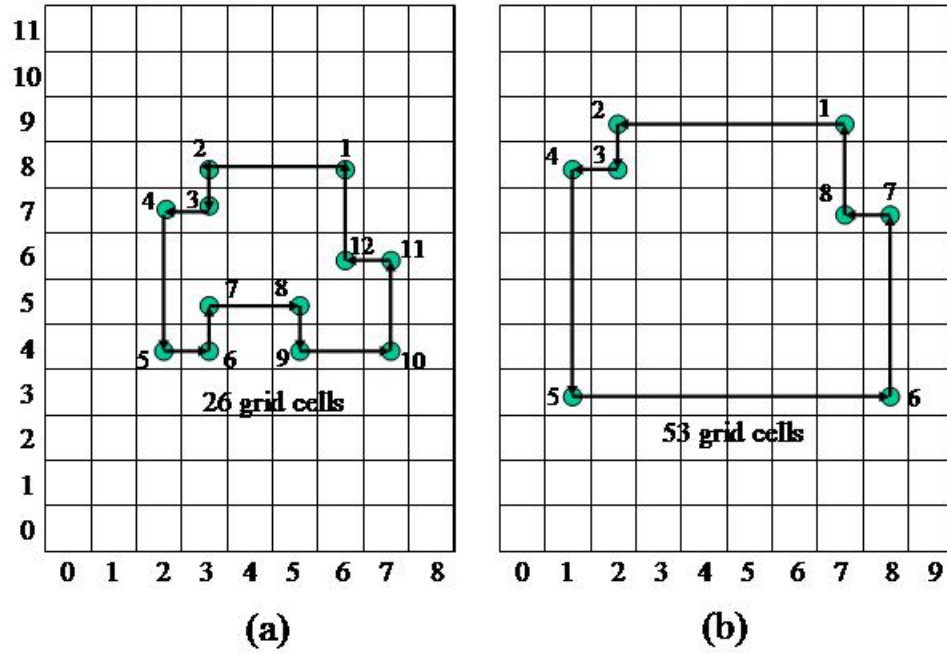


Figure 1: (a) original polygon; (b) over-sized polygon by one unit.

of the interior region of P and all the rectangles obtained by bloating edges of P by σ . For instance, the polygon in Fig. 1(b) is obtained by over-sizing the polygon in Fig. 1(a) by 1 unit.

To simplify the sizing problem, we assume each polygon is drawn on a rectangle plane of $n \times m$ grid cells. A polygon area is the total number of grid cells on the boundary edges and all interior zones. For instance, the polygon areas of the above two polygons are 26 and 53, respectively.

Technical Specifications

1. The dimension of the rectangle plane is under 50×50 .

2. The maximum number of corner points of a polygon is 80.
3. The origin is (0,0).

Input Format

The first line contains two number m and n to indicate the rectangle dimension. The over-sizing value is on the second line. The number of corner points of the sized polygon is on the third line. And each of the rest lines contains a corner points in counterclockwise order.

Output Format

For convenience, the coordinates of grid cells of the over-sized polygon should be reported from bottom to top and from left to right. Use one space character to separate two numbers in a row.

Sample Input

```
9 12
1
8
3 3
6 3
6 4
5 4
5 5
4 5
4 4
3 4
```

Sample Output

2 2
3 2
4 2
5 2
6 2
7 2
2 3
3 3
4 3
5 3
6 3
7 3
2 4
3 4
4 4
5 4
6 4
7 4
2 5
3 5
4 5
5 5
6 5
7 5
3 6
4 6
5 6
6 6