

# Problem F: Framing a Polygon

Advanced Algorithms for Programming Contests

## Restrictions

Time: 2 seconds

Memory: 512 MB

## Problem description

You just conceived of a stunningly beautiful simple polygon. Of course you already made it your desktop background, but it is clear to you that such beauty mustn't be confined to the digital realm. Thus you decided to print it, frame it and hang it up on your wall.

The printing shouldn't be a problem (you'll just need to buy some new toner cartridges, as usual), but the framing poses a challenge: Obviously such a perfect polygon also deserves perfect framing, but you don't know what kind of frame you will need for that. The only things you're sure about with regards to the frame are that it should be rectangular, the polygon should fit inside it (it may touch the frame's edges, but none of its area may lie outside the frame's confinements), its height shouldn't be larger than its width and its area should be minimal among all frames with these three properties.

## Input

The input consists of

- one line containing  $N$  ( $3 \leq N \leq 10^5$ ) – the number of corners in the polygon
- $N$  lines giving the corner coordinates in either clockwise or counter-clockwise order, with the  $i$ -th line containing two integers  $x_i$  and  $y_i$  ( $-10^8 \leq x_i, y_i \leq 10^8$ ) – the coordinates of the  $i$ -th corner.

## Output

Output the ideal height and width (in this order!) with an absolute or relative precision of  $10^{-3}$ . Of course the polygon can be rotated arbitrarily to fit the frame as described.

## Sample input and output

Input	Output
4 0 0 2 0 2 3 0 3	2.0000 3.0000
3 1 0 2 2 0 1	1.4142 2.1213
16 6 4 7 0 8 4 12 2 10 6 14 7 10 8 12 12 8 10 7 14 6 10 2 12 4 8 0 7 4 6 2 2	12.9987 12.9987

Visualizations of samples 2 & 3:

