

Problem 2: The Fault in Our Bricks

4+5 Points

Problem ID: `circle`

Rank: 1+3

Introduction

Big Ben has fallen headfirst into a passionate, borderline concerning [obsession](#) with the cosmos. One fateful Saturday at 3:47 AM, armed with nothing but a telescope made of [PVC pipe](#) and [unearned confidence](#), he declared that he had discovered a brick in the night sky. Not a star. Not a planet. [A brick](#). Suspended in the void. Naturally, he concluded that it must be part of a massive interstellar construction project. You know what else is massive? Determined to reverse-engineer the space brick from its scattered surface reflections, he enrolls in [ASTRON C10](#) at UC Berkeley over the summer.

Problem Statement

There is a rectangle located somewhere in 2D space. You are given a set of N points by their decimal (not necessarily integer) coordinates $(X_1, Y_1), (X_2, Y_2), \dots, (X_N, Y_N)$ sampled **uniformly at random** from the **perimeter** of the rectangle.

Furthermore, the following information is guaranteed:

- The sampled points uniquely describe a single rectangle. In other words, there does not exist a different rectangle from which these exact points could have been sampled.
- The sampled points have coordinate values between -10^3 and 10^3 .
- The edges of the rectangle have a length between 1 and 10^3 .
- For the main test set only, the rectangle will always be [axis-aligned](#). For the bonus test set, the rectangular may not be axis-aligned.

Using this information, find the area of the rectangle.

*Note: Templates are available for this problem—and **all other problems in this contest**—in Python, Java, and C++! Find them in the [contest.zip provided at the start of the contest](#). Templates handle input and output for you, so you can just fill out a single function!*

Input Format

The first line of the input contains a single integer T denoting the number of test cases that follow. For each test case:

- The first line contains a single integer N denoting the total number of points sampled.
- The next N lines each contain 2 space-separated decimals $X_i Y_i$ denoting the i^{th} sampled point on the rectangle.

Output Format

For each test case, output a single decimal denoting the area of the rectangle described by the given points.

Your answer will be considered correct if it has an [absolute or relative error](#) less than 10^{-5} from the actual answer.

Constraints

Time Limit: **1 Second**

Memory Limit: **1024 MB**

$$1 \leq T \leq 100$$

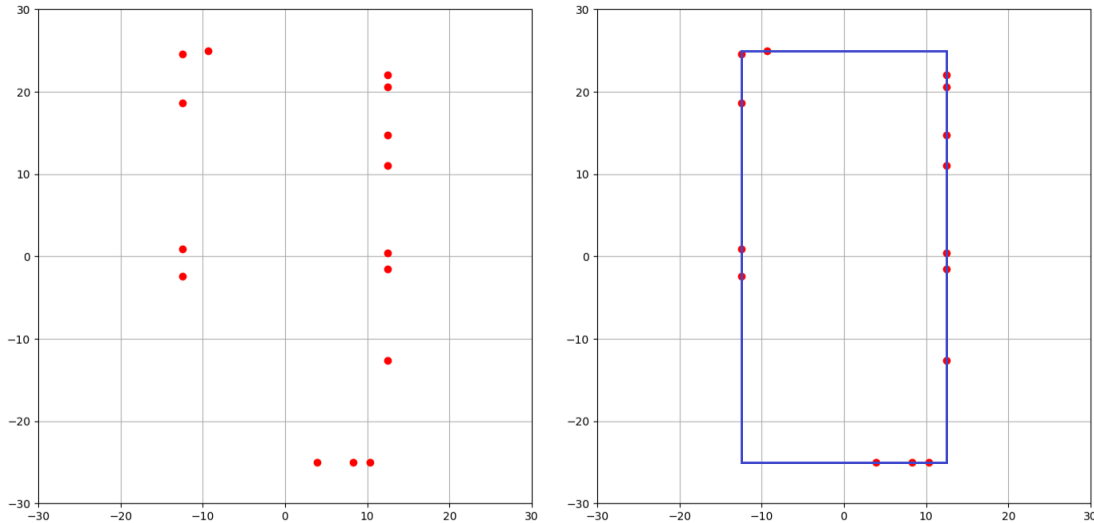
$$15 \leq N \leq 1000$$

$$-10^3 \leq X_i \leq 10^3 \text{ for all } i$$

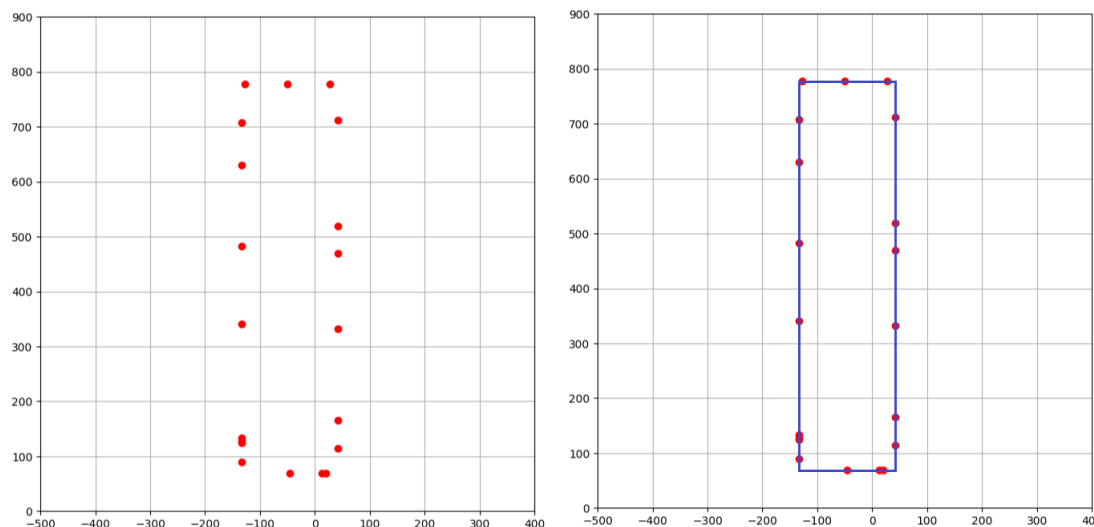
$$-3 \leq Y_i \leq 10^3 \text{ for all } i$$

Main Sample Explanations

For test case #1, the sampled points are plotted in the diagram on the left. The only rectangle that these points could have been sampled from is the rectangle drawn in the diagram on the right, which has a width of 25 and a height of 50, giving it an area of $25 \times 50 = 1250$. Note that the sample output for this test case is `1250.0000000000000000000001`. This demonstrates that your code does not need to output a perfectly exact value. As long as it's close enough as per the output format, your answer will be considered correct.



For test case #2, the sampled points are plotted in the diagram on the left. The only rectangle that these points could have been sampled from is the rectangle drawn in the diagram on the right, which has a width of 176.12 and a height of 707.31, giving it an area of $176.12 \times 707.31 = 124571.4372$. Note that the rectangle may not necessarily be centered at $(0, 0)$.



Bonus Sample Input

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```
1
15
595.1461537619098 -19.11714267834472
744.004157367241 -1.550984377444749
988.1365165815125 156.99042344152545
733.4063884989355 138.227429067347
596.8428377017889 -21.729806832031457
573.3245789710361 14.485135797381233
966.7642218446249 245.89299156277835
962.570875615006 252.3501785029125
670.7284672650158 -49.13677392661745
870.4130831217591 80.5399318554797
959.4597210937328 257.14093634723446
997.778487690789 198.1352102078391
813.6753242498179 190.35468544185318
951.1889265354808 269.87684311039493
649.6124725858225 83.81102380961775
```

Bonus Sample Output

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```
56088
```

Bonus Sample Explanations

For test case #1, the diagrams are shown below. The rectangle has a width of 123 and a height of 456, giving it an area of $123 \times 456 = 56088$. The rectangle is also rotated exactly 33° . Additionally, note that even though all the given points are within 10^3 , the corner of the rectangle exceeds 10^3 .

