CENG 111

Fall 2022

Take-Home Exam 2

REGULATIONS

Due date: 23:59, 4 December 2022, Sunday *(Not subject to postpone)*

Submission: Electronically. You should save your program source code as a text file named `the2.py`. Check the announcement on the ODTUCLASS course page for the submission procedure.

Team: There is **no** teaming up. This is an EXAM.

Cheating: Source(s) and Receiver(s) will receive zero and be subject to disciplinary action.

INTRODUCTION

Given a quadrilateral, your task is to write a Python program that calculates the area of the region under the quadrilateral.

PROBLEM & SPECIFICATIONS

You will read, from the standard input, a list of four coordinates each expressed as a tuple of an x-coordinate and a y-coordinate:

`[(`x_0`,`y_0`), (`x_1`,`y_1`), (`x_2`,`y_2`), (`x_3`,`y_3`)]`

These are the vertices of a quadrilateral. The vertices are provided to you such that, as you proceed to the next element in the list, you are traversing clockwise over the vertices of the quadrilateral. However, the starting point (the first element of the list) can be any vertex of the quadrilateral. Moreover, it is guaranteed that no three vertices are co-linear.

Your output, to the standard output, is the area of the region that remains between the quadrilateral and the x-axis, **printed to two fractional digits**.

Example: Consider the quadrilateral drawn in Figure 1. One way this can be provided to your program as input is (we will denote the vertices in the provided order as $\mathbf{v}_0, \mathbf{v}_1, \mathbf{v}_2, \mathbf{v}_3$):

```
[(12.5,11.3), (2.0,12.0), (18.7,16.2), (12.5,7.0)]
```

You are supposed to compute and print the area of the green region in the figure, which is `194.25`.

Note that, in the example, it could have been that $\mathbf{v}_{0x} > \mathbf{v}_{3x}$ whence the green region would extend inwards, touching the edges $\overline{\mathbf{v}_1\mathbf{v}_0}$ and $\overline{\mathbf{v}_3\mathbf{v}_0}$, changing the area of the green region. This is illustrated in Figure 2-left. You should not consider a disconnected region owing to an inward vertex, as illustrated in Figure 2-right.

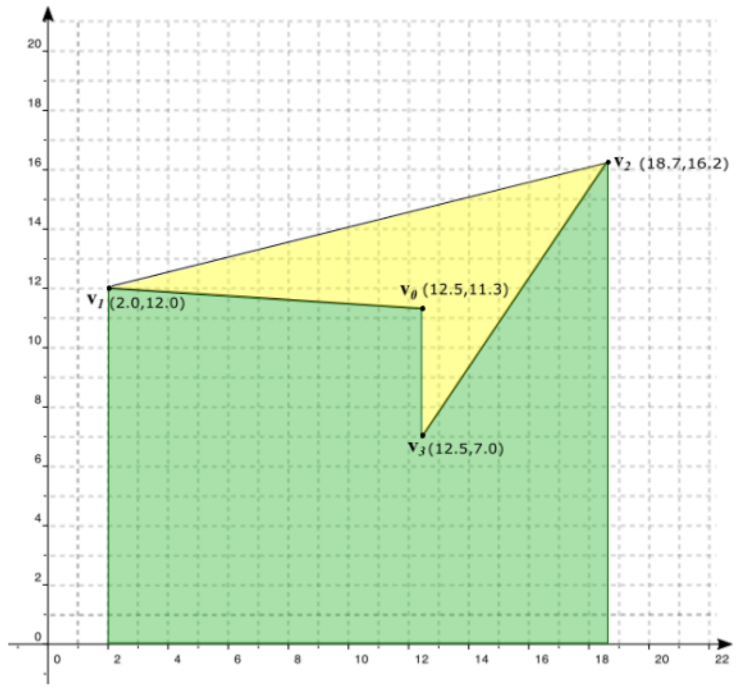

Figure 1: An example quadrilateral. Your task is to find the area of the region under the quadrilateral, drawn in green.

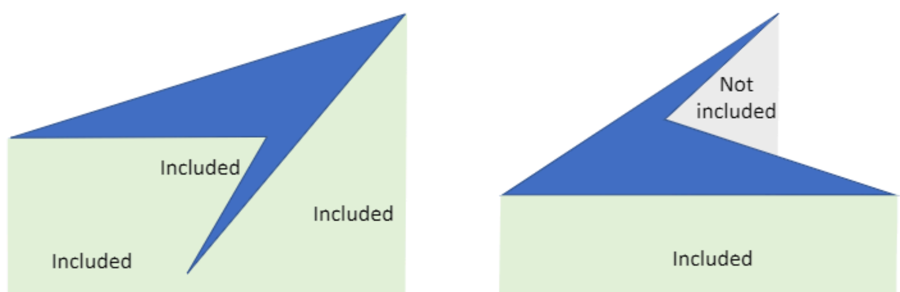

Figure 2: Left: There is a single region under the shape and its area should be calculated. Right: A case where only the green region should be considered.

RESTRICTIONS and GRADING

- You can only use data types and programming concepts that we have learned in the lectures/labs and particularly, **you are not allowed to:**
  - Define functions.
  - Use repetitive constructs (`for`, `while` or list comprehension).
- You can assume that the given quadrilateral does not intersect itself. In other words, no two edges intersect with each other, except for at a vertex.
- No degenerate quadrilaterals will be used for testing your solutions. In particular, you can assume that two vertices will always be different by at least one coordinate (x or y).
- Keep in mind that one can think of a quadrilateral with different number of edges (than the one in Figure 1) touching the green area under it.

- Do not round the calculated area (or any intermediate value). Printing the result with `%.2f` is sufficient.
- Your solution will be evaluated with a tolerance of 0.01 for the calculated area: i.e., a calculated area A is correct with respect to a correct area T if $|A - T| \leq 0.01$.
- Comply with the specifications outlined. Do not print anything other than the calculated area. Do not try to beautify neither the input nor the output. Your program will be graded through an automated process and any violation of the specifications will lead to errors (and reduction of points) in automated evaluation.
- Your program will be tested with multiple data (a distinct run for each data). Any program that performs only 30% and below will enter a glass-box test (eye inspection by the grader TA). The TA will judge an overall THE2 grade in the range of [0,30].
- A program based on randomness will be graded zero.
- The glass-box test grade is not open to discussion nor explanation.