CAIC Summer of Tech (CSoT)

Week 1 Project — Supply Chain Domain

By Economics and Finance Club × ANCC

Project Title: `Optimizing Shared Logistics Zones`

Introduction

Supply chains are complex systems that coordinate the movement of goods, information, and resources across a network of suppliers, manufacturers, warehouses, and distributors. Problems in supply chains often revolve around optimization — minimizing costs, maximizing efficiency, ensuring timely delivery, and managing limited resources.

This project series introduces participants to the computational thinking needed to analyze and solve such real-world logistics problems. Starting from foundational geometric and graph-based challenges, the series gradually builds toward more complex and computationally intensive tasks.

The first two weeks focus on developing core intuitions — understanding spatial constraints, overlapping service regions, and how networks can represent logistics flows. In later weeks, participants will explore classic combinatorial and packing problems, eventually confronting problems that are computationally hard in nature.

Through this progression, participants will gain insight into not just the structure of supply chain issues, but also the algorithms, heuristics, and trade-offs used to tackle them in practice.

Problem Context

In the rapidly growing smart city of **Geometropolis**, two logistics giants — *HexaHaul Corp.* and *ConvexCarry Ltd.* — have proposed new service areas. Each of their regions is represented by a convex polygon, drawn using coordinate mapping.

However, there's a catch: the zones partially overlap. The central logistics authority has called upon your skills to **compute the exact area of overlap** between their regions to help resolve the dispute.

This simulates real-world use cases in supply chain planning, such as:

- Identifying overlapping distributor zones
- Computing shared delivery regions
- Planning buffer zones and reducing redundancies

Problem Statement

You are given T test cases. In each case:

- Two convex polygons represent the companies' service areas.
- You must compute the **area of their intersection**, rounded to `4 decimal places`.

Assumptions:

- All polygons are convex.
- Vertices are listed in counterclockwise order.
- No vertex of one polygon lies on the edge of the other.
- Both polygons have non-zero area.

Input Format

```
T
N M
x1 y1 x2 y2 ... xN yN
x1' y1' x2' y2' ... xM' yM'
```

- T: Number of test cases ($1 \leq T \leq 10^5$)
- N, M: Number of vertices in the first and second polygon ($3 \leq N, M \leq 5000$)
- The total number of polygon vertex pairs satisfies:

$$\sum_{\text{test cases}} N \times M \leq 2.5 \times 10^7$$

- Coordinates are integers: $-10^7 \leq x_i, y_i \leq 10^7$

Output Format

For each test case, print a single line with the area of the intersection, rounded to **four decimal places**.

Sample Input

```
2
5 3
0 3 1 1 3 1 3 5 1 5
1 3 5 3 3 6
3 3
-1 -1 -2 -1 -1 -2
1 1 2 1 1 2
```

Sample Output

```
2.6667
0.0000
```