Computational Geometry
Winter Term 26/27
`scale.iti.kit.edu`



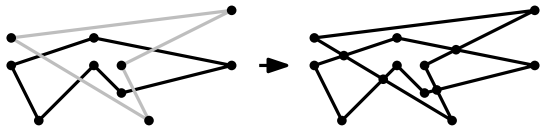
Exercise Sheet 2

Submission due by 2026-11-19

Problem 1: Map Overlay

4 + 4 = 8 points

In this task, the overlay G of two geometric graphs G_1 and G_2 is to be computed. G is again a geometric graph, which partitions the plane into the faces induced by the edges of both G_1 *and* G_2.



Part (a) Describe an efficient algorithm that takes as input two geometric graphs represented as doubly-connected edge lists and outputs their overlay, also as a doubly-connected edge list.

Part (b) Now suppose the input graphs G_1 and G_2 have their faces labeled. Each face in the output graph G is contained in one face of G_1 and one face of G_2. Describe an algorithm that labels each face in G with the labels of the corresponding faces from G_1 and G_2.

Problem 2: Boolean Operations on Polygons

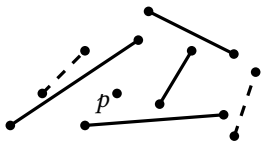
2 points

Given two polygons P_1 and P_2, describe an algorithm that computes the *intersection*, the *union*, and the *symmetric difference* of P_1 and P_2.

Problem 3: Dangerous Walls

4 points

A new streetlamp has been installed at point p on campus. Since then, staff have increasingly complained that their offices are too bright. As a result, n infinitely high (and infinitely thin) straight walls have been erected to shield certain offices from the light. However, unlit walls pose a safety hazard for pedestrians and aircraft, so walls that are completely in the shadow of others must be dismantled. Describe an efficient algorithm that determines which walls are dangerous.



Problem 4: y-Monotone Triangulation **6 points**

Design an algorithm that, given a y-monotone polygon P with n vertices as input, outputs the diagonals that triangulate P in $\mathcal{O}(n)$ time. Show that your algorithm is correct and respects the claimed time complexity.