Bilkent University
Department of Computer Engineering

CS 478/564 COMPUTATIONAL GEOMETRY
HOMEWORK 4

Instructor: Uğur Güdükbay
Due date: Friday, May 16th, 2025 (23.55)

In doing the assignments, you are on the honour system, meaning that any submitted assignment is solely the work of the submitter. You are free to discuss the questions with your friends, but you should submit your own work.

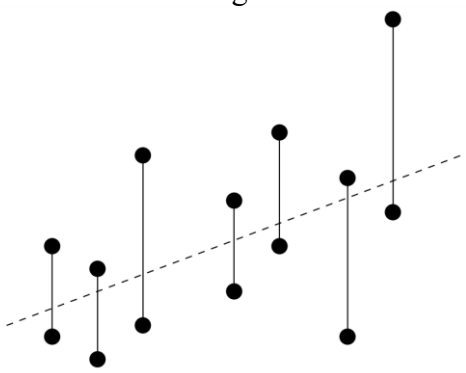
You must use a Word Processor to prepare your answers. Handwritten homework will not be graded.

1) Let P_1 and P_2 be two convex polygons, whose numbers of vertices sum to N. Write a plane-sweep algorithm computing the intersection of P_1 and P_2 in O(N) as follows:

(a) Determine the set J of all intersections of the boundaries of P_1 and P_2.

(b) By using J, construct the boundary of $P_1 \cap P_2$.

2) You are given a set of n vertical line segments in the plane. Present an efficient an algorithm to determine whether there exists a line that intersects all of these segments. An example is shown in the figure below. (Hint: O(n) time is possible.) Justify your algorithm's correctness and derive its running time.



3) Given a collection S of N segments in the plane, and a query segment s*, preprocess S to obtain an efficient algorithm to test if s* intersects any member of S.

4) Devise a plane-sweep algorithm for computing the area of the union of a collection of axes-parallel rectangles. Describe all your data structures in detail with the complexity of the primitive operations. A comprehensive description of the algorithm suffices. State clearly the data structures for the sweep line status and the event-point schedule. Mention about the complexity of your algorithm.