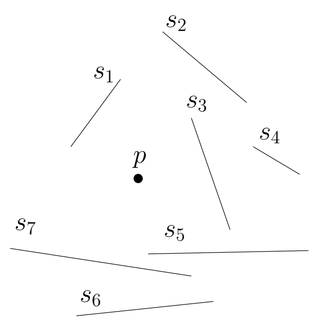
CSCI5010: Midterm Exam

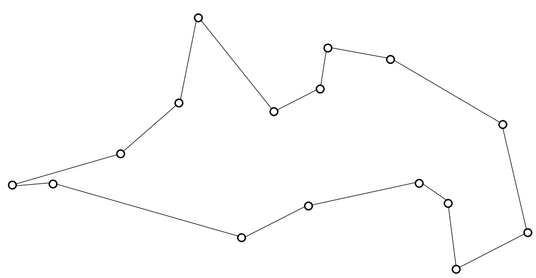
Name: **Student ID:**

Please write all your solutions in the answer book, except Problems 2 and 3 which should be answered in this paper.

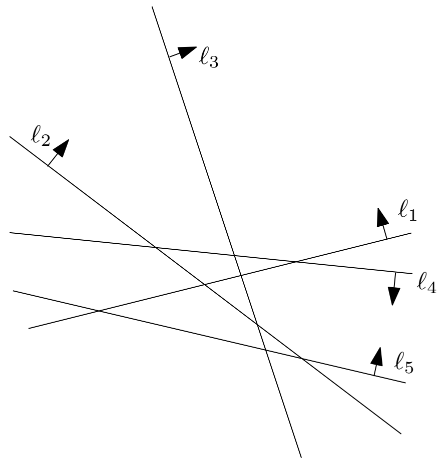
Problem 1 (40%). Let S be a set of n disjoint line segments in the plane, and let p be a point not on any of the line segments in S. We want to determine all line segments of S that p can see, that is, every such line segment of S that contains some point q so the segment pq does not intersect any segment in S (except at q, of course). Give an $O(n \log n)$ time algorithm to solve the problem. For example, in the following figure, you should output all segments but s_4 and s_6.



Problem 2 (10%). Below is an x-monotone polygon. Triangulate this polygon using the algorithm we discussed in class. Add diagonals in the polygon to show the result of the triangulation.



Problem 3 (10%). Run the linear programming algorithm we discussed in class on the following half-planes. Assume that the algorithm processes the boundary lines in the order of $\ell_1, \ell_2, ..., \ell_5$ after permutation. Recall that at any moment the algorithm maintains a point p as the current answer. Explain where p is after processing $\ell_2, \ell_3, ..., \ell_5$, respectively.



Problem 4 (20%). You are given the n vertices of an x-monotone polygon P in $\mathbb{R}^2$ (see the figure in Problem 2 for an example of such a polygon). The vertices are listed for you in counterclockwise order. Describe an algorithm to compute the area of P in $O(n)$ time.

Problem 5 (20%). You are given a convex polygon P in $\mathbb{R}^2$ with n vertices, which have been sorted for you in counterclockwise order. Given a point p in $\mathbb{R}^2$, describe an algorithm that decides whether p falls inside P in $O(\log n)$ time. (You can use the conclusion of Problem 1 in Exercise List 2 if it is helpful).