COMP163 Homework Assignment 6
Due Friday, December 8, 2023

Reading:
Continue reading in the yellow/blue book and possibly the red book to expand your understanding of computational geometry, as well as more particularly the topics of linear programming, rectilinear computational geometry, and range searching.

Problems:

Give the most efficient algorithms that you can.

1. Rectilinear Contour of Union

   Draw an example involving 4 rectilinear polygons on integer coordinates, build the segment tree, and walk through the performance of whichever of the two algorithms you prefer: Lipski-Preparata, and Wood. The goal is to increase your comprehension of the functionality of the segment tree and the advantages that it offers.

2. Boundary of Intersection

   (a) Briefly describe and then analyse an algorithm for computing the boundary of the intersection region(s) of any two arbitrary simple polygons of n vertices each.

   (b) Briefly describe and then analsye an algorithm for computing the boundary of the intersection region(s) of any two rectilinear polygons of n vertices each.

3. Data structures

   (a) Describe a data structure to maintain a set S of horizontal segments in the plane, described by an interval and a y-position $([lx_i, hx_i], y_i)$, such that all segments that intersect a vertical query line segment $q = (x, [l_y, h_y])$ ($s \in S | q \cap s \neq \emptyset$) can be reported efficiently. Analyse the preprocessing time and space used.

   (b) Describe a method of organizing a set S of n points in R^2 so that all points contained in a query rectangle $R = [l_1, h_1]X[l_2, h_2]$ can be reported in $O(\log n + A)$ time. [HINT: Use treaps as secondary data structures hanging off of the nodes of a primary binary search tree.]