Midterm Exam – 150 points Computational Geometry March 10, 1998

1. **30 points.** Define each of the following terms (using at most 2 sentences each):

   (a) polygon triangulation,

   (b) convex hull,

   (c) simple polygon.

2. **30 points.** Describe an efficient plane-sweeping method for finding the convex hull of n points in the plane. Be sure to indicate the invariant, events, and data structures needed for this plane sweep, as well as the methods for processing each event.

3. **30 points.** Describe the main components of a segment tree defined on a set $\mathcal{I}$ of n intervals from $\mathbf{R}$, the set of real numbers. Describe how one can use this segment tree to report all the intervals containing a query point x in $O(\log n+k)$ time, where k is the number of intervals in $\mathcal{I}$ that contain x.

   NOTE: For the remainder of this exam you may assume that you have a subroutine for any problem we discussed in class, provided you can correctly characterize its performance bounds.

4. **30 points.** Describe an efficient algorithm for determining the area of a simple polygon P containing n vertices. What is the running time of your method?

5. **30 points.** Suppose you are given a set $\mathcal{S}$ of n axis-aligned rectangles in the plane. Describe an efficient method for finding a point p in the plane that is contained in the most number of rectangles from $\mathcal{S}$. What is the running time of your method?