Midterm Exam – 150 points Computational Geometry March 12, 1997

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

   (a) convex hull,

   (b) planar subdivision,

   (c) trapezoidal decomposition.

2. **30 points.** Describe an efficient method for finding the convex hull of n points in the plane.

   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.

3. **30 points.** Describe an efficient algorithm for determining the *width* of a set S of n points in the plane. Recall that the width of a point set is the smallest distance between two parallel lines that contain the points of S between them.

4. **30 points.** Suppose you are given a set S of n line segments in the plane, such that each makes a positive angle with the x-axis of either $30°$ or $60°$ (so there are only two possible slopes for the lines in S). Sketch an efficient algorithm for finding all the pairs of intersecting segments in S. What is the running time of your method?

5. **30 points.** Describe a dynamic data structure that can store a set of n intervals in $\mathbf{R}$ that all have integer endpoints in the range $[1, N]$. Mention how your structure efficiently supports each of the following operations (hint: think of left and right endpoints separately):

   (a) $Insert([a, b])$: insert a new interval $[a, b]$ to the set.

   (b) $Delete([a, b])$: remove a interval $[a, b]$ from the set.

   (c) $Outside([a, b])$: report all the intervals in the set that do **not** intersect $[a, b]$.

   What is the running time for each method?