Midterm Exam – 150 points Computational Geometry March 15, 1995

1. **30 points.** Define each of the following terms (using at most 2 sentences each):
   (a) convex hull of a set of points,
   (b) Voronoi diagram,
   (c) point location data structure.

2. **30 points.**
   (a) Draw, as best you can, the Voronoi diagram for the set of points
   $$\{(2,1),(0,0),(2,5),(3,2),(4,3),(5,3),(5,1)\}.$$
   (b) Sketch an efficient algorithm to construct a Voronoi diagram for a set S 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.** Suppose you are a set S of n points in the plane. Define the *diameter* of S to be the largest distance between two points in the set. Briefly describe an $O(n \log n)$ time method for determining the diameter of S.

4. **30 points.** Suppose you are given two sets, A and B, of points in the plane, where A and B both contain n points each. Describe an efficient method for finding, for each point in A, its nearest neighbor in B. What is the running time of your method?

5. **30 points.** Suppose you are given a set S of n points in $\Re^3$. Describe an efficient data structure that can determine, for any query point $p \in \Re^3$, in $O(\log n)$ time whether p is inside the convex hull of S or not. What is the preprocessing time and space for your data structure?