CSE355/AMS345 Homework 3

Jie Gao*

The following problems are due by October 19th, 9pm.

1. **Intersection of parabolas (20pts)** Let S be a set of n parabolas: the ith one is the graph of a function $y = a_i x^2 + b_i x + c_i$. Our goal is to find all k points where two of them cross. (You may assume no degeneracies: no three curves pass through a common point, and all n parabolas are distinct.) (a). What is the maximum possible value of k (as a function of n)? (Draw an example showing how the upper bound can be attained for n parabolas.) (b). How efficiently can you compute the k crossing points using a variant of the sweeping line algorithm for computing intersections of line segments? (Describe briefly, specifying the events, the sweepling line states, event handling.)
2. **Triangle enclosement (10pts)** Let S be a set of n triangles in the plane. The boundaries of the triangles are disjoint, but it is possible that a triangle lies completely inside another triangle. Let P be a set of n points in the plane. Give an $O(n \log n)$ algorithm that reports each point in P lying outside all triangles.
3. **Intersection of halfplanes (10pts)** Let H be a collection of n halfplanes, each of which contains a portion of the negative y axis (facing downwards). Let Q be the intersection of H. And take S to be the dual of the lines bounding D. Take P as the convex hull of S. Explain the relationship of P and Q. Give an algorithm to compute teh intersection of halfplanes based on your observation.
4. **Stabber.(10pts)** Let S be a set of n segments in the plane. A line ℓ that intersects all segments of S is called a *traversal* or *stabber* of S. Give an $O(n^2)$ algorithm to decide if a stabber for S exists. Hint: Use duality.

*Department of Computer Science, Stony Brook University, Stony Brook, NY 11794. Email: jgao@cs.sunysb.edu