Assignment 13

Post Date: 01 Feb 2016    Due Date: 08 Feb 2016, 1 pm
You are permitted and encouraged to work in groups of two.

Problem 1: Delaunay Triangulation of a Convex Polygon

Show that the vertices and edges on the outer face of the Delaunay Graph build a convex polygon.

Problem 2: Linear Time Algorithm

Give an algorithm to determine the Delaunay Graph from the doubly-connected edge list of the Voronoi diagram. Your algorithm should run in linear time.

Using the data structure you chose in the design of the above linear time algorithm; how long does it take to determine whether an edge exists between a pair of nodes? Can you improve it?

Problem 3: Lower Bound

Consider the $d$-th order algebraic decision tree model: An algorithm is allowed to ask if polynomials of degree at most $d$ are positive, negative or 0, and make decisions based on that.

In this model, $\Omega(n \log n)$ is a lower bound for sorting numbers. (You do not have to prove this.)

Show that $\Theta(n \log n)$ is a lower bound for computing Voronoi diagrams in the $d$-th order algebraic decision tree model by reducing the sorting problem to the problem of computing Voronoi diagrams.

You may assume that the Voronoi diagram algorithm should be able to compute for every vertex of the Voronoi diagram its incident edges in cyclic order around the vertex.

Problem 4: Smallest Enclosing Disk

Show that the algorithm MinDisk’s worst case run time is in $\Omega(n^3)$. 