CS 6463 Computational Geometry, Fall 10

10/6/10

3. Homework

Due **10/20/10** before class

1. Parabolic Arcs (5 points)
   Give an example where the parabola defined by some site p_i contributes more than one arc to the beach line. Can you give an example where it contributes a linear number of arcs?

2. Sum of Edge Lengths (5 points)
   Give an example which shows that the Delaunay Triangulation of a point set is not always the triangulation with the minimum sum of edge lengths.

3. Weighted Voronoi Diagrams (10 points)
   Let $P = \{p_1, \ldots, p_n\} \subseteq \mathbb{R}^2$, and let $w_i > 0$ be the *weight* of point site p_i, for each $i = 1, \ldots, n$. In the *additively weighted* Voronoi diagram the Voronoi cell for p_i is defined as

   $$V_{add}(p_i) = \{q \in \mathbb{R}^2 \mid w_i + ||p_i - q|| < w_j + ||p_j - q|| \text{ for all } p_j \in P \setminus \{p_i\}\}$$

   In the *multiplicatively weighted* Voronoi diagram the Voronoi cell for p_i is defined as

   $$V_{mult}(p_i) = \{q \in \mathbb{R}^2 \mid w_i * ||p_i - q|| < w_j * ||p_j - q|| \text{ for all } p_j \in P \setminus \{p_i\}\}$$

   Show how the bisectors look like for both kinds of weighted Voronoi diagrams, and give some examples of Voronoi diagrams for each case. You are welcome to research on the web as long as you give references.

4. Edge Flips (10 points)
   (a) Show that any two triangulations of a convex polygon can be transformed into each other by edge flips.
   (b) Show that any two triangulations of a planar point set can be transformed into each other by edge flips.

5. Worst-Case DT Runtime (5 points)
   Show that the worst-case runtime of the randomized algorithm to compute the Delaunay triangulation of a set of n points in the plane is $\Omega(n^2)$. *Hint: Find a worst-case example using one of the Delaunay triangulation programs.*