Computational Geometry: Homework 2

Problem 1 *(Edge-List → DCEL).*

Frequently, a planar graph *G=(V,E)* is represented in the edge-list form, which for each vertex $v_i \in V$ contains the list of its incident edges, arranged in the order in which they appear as one proceeds counterclockwise around v_i. Show that the edge-list representation of *G* can be transformed to the DCEL (Doubly-Connected-Edge-List) representation in time O(|V|).

Problem 2 *(Simple Polygon).*

Problem 1 in the textbook Preparata & Shamos (p.148).

Given *N* points in the plane, construct a simple polygon having them as its vertices.

1. Show that $\Omega(N \log N)$ is a lower bound to running time.
2. Design an algorithm to solve this problem. (*Hint*: Modify Graham's scan.)

Problem 3. *(Classify Vertices)*

Problem 3 in the textbook Preparata & Shamos (p.148).

Given a point *p* and a vertex *v* of a convex polygon *P* in the plane, give an algorithm to classify in constant time vertex *v* with respect to $\overline{pv}$ (as *concave* or *supporting* or *reflex)*.

Problem 4. *(Keil-Kirkpatrick)*

Problem 6 in the textbook Preparata & Shamos (p.148).

Let *S* be a set of *N* points in the plane with integer coordinates between 1 and N^d, where *d* is a constant. Show that the convex hull of *S* can be found in linear time.