CMPS 3130/6130 Computational Geometry – Spring 17

2/2/17

3. Homework

Due **2/9/17** at 5pm.

Please submit this homework on canvas.

1. **DCEL (6 points)**

   Which of the following equalities are always true? Justify your answers.

   (a) $Twin(Twin(\vec{e})) = \vec{e}$

   (b) $Next(Prev(\vec{e})) = \vec{e}$

   (c) $Twin(Prev(Twin(\vec{e}))) = Next(\vec{e})$

2. **Walking the DCEL (9 points)**

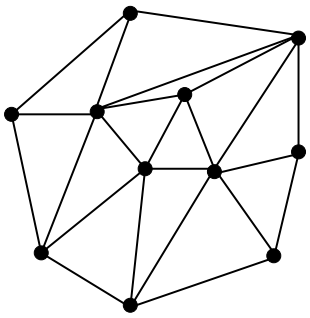
   Assume you are given a planar subdivision in a DCEL. (You may assume that the planar subdivision does not contain any holes, i.e., there are no nested faces.) In addition, you are given two points p and q in the plane as well as two references to faces F_p and F_q of the DCEL such that $p \in F_p$ and $q \in F_q$. Assume each face of the DCEL has some printable label.

   Describe an algorithm that prints out all the labels of faces of the DCEL that are intersected by the line segment pq.

   You may, but do not have to, write pseudo-code, but please make clear what DCEL operations you are using. Analyze the runtime of your algorithm.

3. **Triangulating a Point Set (10 points)**

   A triangulation of a set of points P in the plane is a simple, planar embedded, connected graph $T = (P, E)$ such that (i) every edge in E is a line segment, (ii) the outer face is bounded by edges of $CH(P)$, and (iii) all inner faces are triangles.
   Give an algorithm for computing such a triangulation of n points in the plane and analyze its runtime.



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4. **Kirkpatrick's Hierarchy (5 points)**
Consider slide 12 of the point location slides as well as the figure below. The path in the DAG for locating point p is $K - I - C - u - i$. But there are other paths in the hierarchy that also end in triangle i.

Now consider the path $K-J-F-v-i$. Describe where in the original triangulation a point p' has to lie such that the point location for it would follow this path.