Take-Home Quiz 2

Math 282 Computational Geometry
Spring 2019

This quiz is like a regular homework assignment, except that:

- You must work by yourself. No collaboration or discussion with other students.
- You may only ask questions of Prof. Wright.

You may still use your textbook and computer. Submit your solutions (on Moodle or in the homework box) by 4:00pm on **Friday, April 5**.

1. Is there a set of 100 points that has exactly one triangulation? Either describe how to construct such as set of points, or say it doesn't exist.

2. Define a *simple polygonal chain* as an un-closed polygon: A path of segments connecting points, which does not self-intersect, but does not close to a polygon.

Given a set S of n points, here is a proposed algorithm to find a polygonal chain through those points. Choose some starting vertex v in S. Draw concentric circles centered on v so that each other point of S lies on one of the circles. (Some of the circles may pass through several points, so there could be fewer than $n-1$ circles.) Now form a polygonal chain by connecting v to one of the points of S that lie on the smallest radius circle C_1, and then connect to all the points around C_1 counterclockwise. Next, connect from the last point on C_1 to the closest point on C_2, the next smallest concentric circle. Then connect to all the points around C_2 counterclockwise. And so on, out to the outermost circle.

(a) Does this algorithm always yield a simple polygonal chain, for points in general position? If not, provide a counterexample. If so, argue for why it always works.

(b) Propose a different algorithm for constructing a simple polygonal chain from a given set S of n points in general position. Describe it at a high-level, and argue for why it always works.

3. Exercise 3.40 — Draw three flip graphs, one for each of the polygons in Figure 3.15, with the constraint that the red diagonals are fixed, not flippable. Try to draw the flip graphs in as symmetric a form as you can find.

4. Exercise 3.55

5. Exercise 4.8

6. Exercise 4.14

7. Exercise 4.15