Homework 4

Sam Windham *with Lucio Franco*

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1.

a.

A flip graph with a single node must be formed from a set of points with a unique triangulation. Such a triangulation requires that no two neighboring triangles form a convex quadrilateral.

A set of points that have only one triangulation can formed from the following:

The general form of the set has $n-2$ collinear points (let the last points in either direction be p_1 or p_{n-2}). The set then has two more points that form a triangle with p_1 or p_{n-2}, exterior to the $n-2$ points.

More formally, start with a triangle formed by p_1, p_2, and p_3. Then, add each remaining point exterior to the triangle. These points must fall on the line through p_3, perpendicular to the segment p_1, p_2. At point p_i, the set of i points will contain a unique triangulation. Adding p_i will create two more triangles in its triangulation that together form a convex quadrilateral.

Therefore, this construction will produce a point set with a single-node flip graph for all $n > 3$.

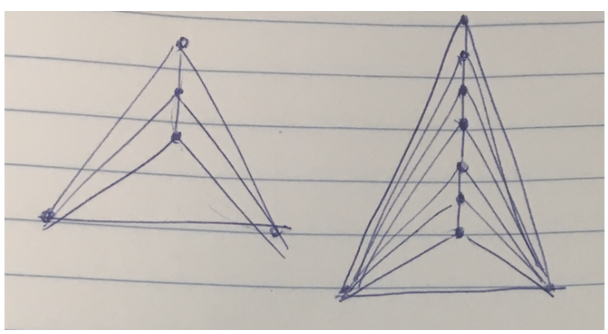

Figure 1: Two examples - unique triangulation for each

b.

c.

2.

3. (or) 4.

5.

a.

```
NN(q: query point, n: node, p: ref point, d: ref distance)
[recursively]
if n = leaf: [base case]
    d' = dist(q, n.point)
    if d' < d:
        d = d'
        p = n.point
if n = node:
    if dist(q, n) < d, then:
        NN(q, n.left, p, d)
        NN(q, n.right, p, d)
return p
```

Initial call: $NN(q, root, null, \infty)$

b.

c.