Computational Geometry: Homework 3. Due: 2/23/2004

1. Given n points on a circle, develop an algorithm that would construct an angle-optimal triangulation on these points (i.e. one with the largest possible angle vector). Of course, the faster the algorithm the better and worse than $O(n \log n)$ doesn't count :).

2. Take n points in the plane and lift them to the unit paraboloid $z = x^2 + y^2$. For each of the lifted points, consider the half-space bounded by the tangent plane to the paraboloid at that point and containing the paraboloid. Show that the faces of the polyhedron that is the intersection of all these half-spaces project to Voronoi cells of the (original 2D) points. Try to come up with an elegant solution, with as few calculations as possible (ideally, none at all)

3. Problem 9.7, p.206

4. Problem 6.8, p.143

5. Problem 10.9, p.230

6. Problem 5.12, p.117

7. Consider n points in the plane and a finite set of *allowable slopes*. Design efficient datastructures that can be used for reporting points inside triangles whose all edges have allowable slopes:

(a) having $O(n)$ size and $O(n^{2/3} + k)$ query time

(b) having $O(n \log^2 n)$ size and $O(\log^2 n + k)$ query time

How does the size and query time of your data structures depend on the number of allowable slopes?