

Homework Assignment #10

Computational Geometry (Winter Term 2014/15)

Exercise 1

Prove that the worst case running time of algorithm 3DCONVEXHULL is $O(n^3)$, and that there are sets of points where a bad choice of the random permutation makes the algorithm actually need $\Theta(n^3)$ time. **[5 points]**

Exercise 2

The convex hull of a set P of n points in 3-dimensional space can also be computed by „rotating“ a plane over known edges of the convex hull, thereby discovering new facets. Give a detailed description of an algorithm using this approach. Make sure that your algorithm has running time $O(n^2)$ and prove this bound. **[5 points]**

Exercise 3

Define a simple polytope to be a region in 3-dimensional space that is topologically equivalent to a ball (i.e., it has no holes, but is not necessarily convex) and whose boundary consists of a finite number of planar polygons.

- a) Describe a data structure that can be constructed in $O(n \log n)$ time and allows you to test in $O(\log n)$ expected time whether a query point lies inside a *convex* simple polytope with n vertices. **[5 points]**
- b) Describe how to test in $O(n)$ time whether a query point lies inside a simple polytope with n vertices. **[5 points]**