Lehrstuhl für Informatik I
Effiziente Algorithmen und
wissensbasierte Systeme
Universität Würzburg

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Homework Assignment #10
Computational Geometry (Winter Term 2016/17)

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]**

This assignment is due at the beginning of the next lecture, that is, on January 18 at 10:15. Solutions will be discussed in the tutorial on Friday, January 20, 14:15–15:45 in room SE I.