Eidgenössische Technische Hochschule Zürich
Ecole polytechnique fédérale de Zurich
Politecnico federale di Zurigo
Swiss Federal Institute of Technology Zurich

Institute for Theoretical Computer Science
Dr. B. Gärtner, Dr. M. Hoffmann and Tobias Christ

5.11.2009

Computational Geometry — Homework 3 — HS09

URL: http://www.ti.inf.ethz.ch/ew/courses/CG09/

Exercise 1 (10 points)

A set P of n points in the plane is said to be in *ε-general position* for $\varepsilon > 0$ if no three points of the form

$$p + (x_1, y_1), q + (x_2, y_2), r + (x_3, y_3)$$

are collinear, where $p, q, r \in P$ and $|x_i|, |y_i| < \varepsilon$ for $i = 1, 2, 3$. In words: P remains in general position under changing point coordinates by less than ε each.

Give an algorithm with runtime $O(n^2)$ for checking whether a given point set P is in ε-general position.

Exercise 2 (10 points)

a) You are given a set of n pairwise disjoint line segments. Find an algorithm to answer *vertical ray shooting* queries in $O(\log n)$ time. That is, preprocess the data such that given a query point q you can report in $O(\log n)$ time which segment is the first above q (or if there are none). Analyze the running time and the space consumption of the preprocessing.

b) What happens if we allow intersections of the line segments? Explain in a few words how you have to adapt your solution and how the time and space complexity would change.

Exercise 3 (30 points)

Perform a small research as you did in Homework 1. Choose one of the following problems/topics to investigate.

a) Additively weighted Voronoi diagrams

b) Higher order Delaunay triangulations

c) Halfplane range searching

d) Ham-sandwich cuts

e) Delaunay refinement meshing

Your report should contain

- an informal description of the problem(s) using your own words,
- a precise formal definition of the problem(s),

- a chronological list of the important results,
- the current state of the problem(s), in particular, open questions and possible future directions,
- a complete list of references.

Due date: 19.11.2009, 13h15