

## Exam Geometric algorithms, February 2014

Time 120 minutes.

**1. problem.** Consider randomized incremental algorithm which forms a structure to find the face in a given planar subdivision in which lies given point. Answer the following questions:

- (a) What serves as an input for the algorithm? What is a trapezoidal map? (2 points)
- (b) Describe the searching structure used by the algorithm. Give an example. (2 points)
- (c) Describe the strategy of the algorithm and its main steps. (2 points)
- (d) Give a pseudocode of the procedure which finds trapezoids through which a new added segment goes. (2 points)
- (e) How does the searching structure change after a new segment is added? (2 point)

**2. problem.** Consider linear programming in the plane. Answer the following questions:

- (a) What is the linear programming in the plane? What is 1-dimensional linear programming? (2 points)
- (b) Which possible outputs (results) does the linear programming in the plane have? Complete by a picture. (2 points)
- (c) What is bounded linear programming in the plane? Describe in details how it is solved by randomized incremental algorithm. (4 points)
- (d) What is the running time for the solution of 1-dimensional linear programming. What is the running time for the solution of 2-dimensional linear programming if we do not use the randomized algorithm? What is expected time when we use the randomized algorithm. (2 points)

**3. problem.** Answer the following questions:

- (a) Define notions of incident face, next edge and previous edge used in the framework of double connected edge lists. (2 points)
- (b) What is the input for Delaunay triangulation? Characterize exactly what is output of this algorithm. (2 points)
- (d) Compare time (for searching) and storage difficulties for 2-dimensional kd-trees and range trees. (2 points)
- (e) Give the pseudocode of the algorithm which describes what happens when a sweeping line goes through a merge point in the algorithm which divides a polygon into monotone pieces. (2 points)
- (e) Describe by a formula that the point  $r$  lies on the segment  $qr$ . (2 points)

### Evaluation

0 – 14 F, 15 – 17 E, 18 – 20 D, 21 – 23 C, 24 – 26 B, 27 – 30 A