Homework Assignment #7
Computational Geometry (Winter Term 2014/15)

Exercise 1

A simple polygon $\mathcal{P}$ is called star-shaped if it contains a point q such that for any point p in $\mathcal{P}$ the line segment $\overline{pq}$ is contained in $\mathcal{P}$. Give an algorithm whose expected running time is linear to decide whether a simple polygon is star-shaped.

[8 points]

Exercise 2

In some applications one is interested only in the number of points that lie in a range rather than in reporting all of them. Such queries are often referred to as range counting queries. In this case one would like to avoid having an additive term of $O(k)$ in the query time.

a) Describe how a 1-dimensional range tree can be adapted such that a range counting query can be performed in $O(\log n)$ time. Prove the query time bound. How does this influence the construction time? **[7 points]**

b) Using the solution to the 1-dimensional problem, describe how 2-dimensional range counting queries can be answered in $O(\log^2 n)$ time. Prove the query time. **[5 points]**

c) Describe how fractional cascading can be used to improve the running time by a factor of $O(\log n)$ for 2-dimensional range counting queries. **[6 extrapoints]**

A cordial invitation to the Christmas celebration of the Faculty of Mathematics and Computer Science on Wednesday, December 17!

Prof. Dr. Klaus Schilling will be holding the Christmas colloquium at Zuse-Hörsaal at 17:00, which is titled "Die Raumsonde ROSETTA: Über einen Kometen zum Ursprung unseres Sonnensystems". Afterwards, there will be mulled wine ("Glühwein") and gingerbread at the foyer of the computer science building.

[0 extrapoints]

This assignment is due at the beginning of the next lecture, that is, on November 26 at 10:15. Solutions will be discussed in the tutorial on Friday, November 28, 14:00–15:30 in room SE I.