University of Konstanz
Department of Computer & Information Science
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Design and Analysis of Algorithms
Winter 2018/2019

Assignment 13

Post Date: 28 Jan 2019 **Due Date:** 04 Feb 2019, 11:30 am
You are permitted and encouraged to work in groups of two.

Problem 1: Interior of a Simple Polygon — 4 Points

Show how to determine efficiently whether a given point $q \in \mathbb{R}^2$ is in the interior of a simple polygon P. For simplicity you may assume that q does not have the same x-coordinate as any vertex of P.

Problem 2: Disks between obstacles — 4 Points

Given a set P of points within an axis-parallel rectangle R, show how to construct a largest disk D with the following properties: (i) the center of D is within R or on its boundary and (ii) no point of P is contained in the interior of D.

What is the runtime of your algorithm?

Problem 3: Binary Search Tree — 4 Points

You have stored a linear order of a set of n items in a binary search tree T. For each item you have direct access to the respective node in T. For each node of T you have the pointers PARENT$[v]$, LEFT$[v]$, RIGHT$[v]$. You do not have any other information about the linear order. Develop an algorithm that outputs the successor of a given item if one exists in time proportional to the height of T.

Problem 4: Shamos & Hoey — 8 Points

(a) Consider the following extension of the algorithm of Shamos & Hoey:
Whenever the algorithm finds an intersection it does not stop but saves the intersection to a list and continues.

Disprove the following statements:

i. The list contains all intersections.
ii. The intersections in the list are ordered by their x-values.

(b) Extend the algorithm of Shamos & Hoey such that it outputs all intersections according to their appearance on the x-axis. Assume that no two endpoints are equal and that at most two line segments intersect in one point.

Provide your algorithm in pseudo-code and analyze its run time.