Universität der Bundeswehr München
Fakultät für Informatik
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Assignment 1

Computational Geometry

May 9, 2018

Exercise 1

The $O(n \log n)$ algorithm to compute the convex hull of a set of n points in the plane that was described in the lecture is based on the paradigm of incremental construction: add the points one by one, and update the convex hull after each addition. In this exercise we shall develop an algorithm based on another paradigm, namely divide-and-conquer.

a) Let P_1 and P_2 be two disjoint convex polygons with n vertices in total. Give an $O(n)$ time algorithm that computes the convex hull of $P_1 \cup P_2$.

b) Use the algorithm from part a) to develop an $O(n \log n)$ time divide-and-conquer algorithm to compute the convex hull of a set of n points in the plane.

Exercise 2

Suppose that we have a subroutine ConvexHull available for computing the convex hull of a set of points in the plane. Its output is a list of convex hull vertices, sorted in clockwise order. Now let $S = \{x_1, x_2, \ldots, x_n\}$ be a set of n numbers. Show that S can be sorted in $O(n)$ time plus the time needed for one call to ConvexHull. Since the sorting problem has an $\Omega(n \log n)$ lower bound, this implies that the convex hull problem has an $\Omega(n \log n)$ lower bound as well. Hence, the algorithm presented in the lecture and your divide-and-conquer algorithm from exercise 1 are asymptotically optimal.