Homework 8

Math 282 Computational Geometry
Spring 2019

Solve the following problems from the textbook, and submit your solutions either on Moodle or in the homework mailbox (RMS level 3, near the fireplace) by 4:00pm on **Friday, April 12**.

1. Exercise 4.19

2. Exercise 4.31

3. Exercise 5.5 — This exercise refers to the medial axis algorithm described on page 122.

4. Exercise 5.8 — Either give an example or explain why none exists.

5. Exercise 5.11

6. Do one of the following two exercisess:

(a) Let R and B be two sets of 2D points, colored red and blue, respectively. The problem is to find a circle (if it exists) that encloses all the red points, and excludes all the blue points. Use the paraboloid $z = x^2 + y^2$ to "reduce" this to a problem in 3D, an easier problem in the sense that it is *linear* (involving planes) rather than circles. Design an algorithm for solving the 3D problem: It should decide whether the point sets are circularly separable, and if so, provide a separating circle. A brute-force inefficient algorithm suffices, as long as it really would always work. Describe your algorithm at a high level. Give enough detail so that your algorithm is unambiguous, but you don't need to implement it in code.

(b) Write code that computes the convex hull of a set of 3D points, then separates the lower hull from the upper hull and displays each separately. Doing this in Mathematica is recommended, and you may use the built-in function ConvexHullMesh to compute the convex hull. You would then need to extract the triangular faces from the convex hull. To decide whether a triangle is on the lower or upper hull, you could compute an outward-pointing normal vector and examine its z-coordinate.