Introduction to Computational Geometry

CS 4800/5800

Fall 2008

Instructor

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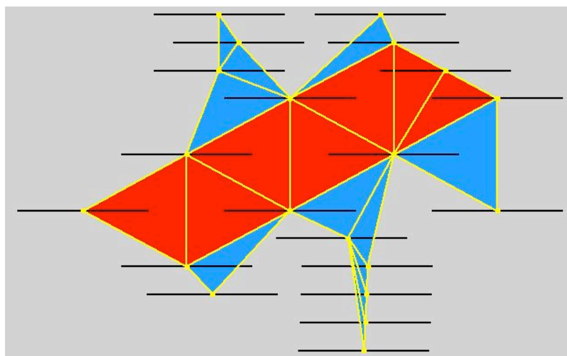

Textbook

Computational Geometry: Algorithms and Applications, Third Edition (March 2008) by Mark de Berg, Otfried Cheong, Marc van Kreveld, Mark Overmars (published by Springer-Verlag)

Classroom and Meeting Times

Tuesdays and Thursdays in NC 1607. We will also meet in the Raytheon Lab (in NC) to do *Mathematica* work. No prior knowledge of *Mathematica* or any other programming language is required.

Prerequisites

None

Computational Geometry Description

Many aesthetic and/or practical problems have their roots in geometry. Applications abound in the areas of Computer Graphics, Robotics, and Computer Aided Design, and Geographic Information Systems. For example,

- *Given n points in the plane, find the two that are closest.* Sounds pretty easy to solve, but what is the best solution? How can you instruct a computer to find the best solution in a reasonable amount of time?

- *Given a dry forested area in danger of wildfire, the Forest Service wishes to deliberately set fires to remove the fire-hazarded area in a controlled way. Where and how many fires should be set?* A current tool used to solve this problem comes from the structure of *Voronoi Diagrams*. From Wikipedia, "In the simplest case, we are given a set of points S in the plane, which are the Voronoi sites. Each site s has a Voronoi cell V(s) consisting of all points closer to s than to any other site. The segments of the Voronoi diagram are all the points in the plane that are equidistant to two sites. The Voronoi nodes are the points equidistant to three (or more) sites."

In brief, Computational Geometry studies problems based in geometry that seek an efficient algorithmic solution. Many of the elegant solutions arise from the aesthetics found in the geometry that is associated with the original problem.

Topics Covered

Classical Geometry, Point Inclusion Problems, Convexity Testing, Art Gallery Theorems, Convex Hull Problem, Visibility Graphs, Vornoi Diagrams and Delaunay Triangulatiions, and Facility Location Problems (a subset of these will be covered as time permits)

Grading and Assignments

- Class Participation 10%
- Two Homework Assignments 20%
- We will work on one "open problem" per week in class. Each student will be responsible for the write-up of one group solution. 15%
- A final project proposal. 20%
- A final project that is either a paper *or* a programming project will be due at the end of the semester. 35%