University of Delaware -- Computer and Information Science

CISC829 – Spring 2008

Computational Geometry

Instructors: Dr. Jingyi Yu
410 Smith Hall
831-0345
yu@cis.udel.edu

Office Hrs: Wednesday: 10:00-12:00

Dr. Errol L. Lloyd
416 Smith Hall
831-1958
elloyd@udel.edu

Office Hrs: Tuesday: 12:30-1:30
Thursday: 11:00-12:00
By appointment

Text: de Berg, van Kreveld, Overmars, Schwarzkopf, *Computational Geometry, Algorithms and Applications*, 2nd edition, Springer, 2000.

References: Cormen, Leiserson, Rivest and Stein, *Introduction to Algorithms* (2nd edition) McGraw-Hill & MIT Press.

Various papers that may be handed out.

Two nice sites with related material are:

David Eppstein's **Geometry in Action** and **Geometry Junkyard**.
http://www.ics.uci.edu/~eppstein/geom.html
http://www.ics.uci.edu/~eppstein/junkyard/

Jeff Erickson's **Computational Geometry Pages**.
http://compgeom.cs.uiuc.edu/~jeffe/compgeom/

Homework: There will be two homework assignments, each consisting of several pencil and paper problems. The problems will be a mix of algorithm design/analysis questions, and graphics/vision applications.

Project: There will be a group project. The default project will be on Delaunay triangulations and subdivision surfaces. Each group must write the implementation and geometric algorithms by their own. Alternative projects, with the permission from the instructors, are possible.

Lecture: Each student will be involved in a group of 2 or 3 students who will be responsible for giving one 75 minute lecture. The groups will be assigned by the instructors in March. The lectures will take place in the last 8 class meetings of the semester. Lecture topics will be provided by the instructors.

Grading:

Homeworks 1 and 2:	20% each
Project:	40% more or less
Lecture:	20%

Class participation - this is the more or less

Course information source

http://www.cis.udel.edu/~elloyd/compgeom.html -- the course webpage. Copies of assignments, announcements, problem solutions, etc may be found here.

Exam: No exam is currently scheduled, however the instructors reserve the right to give a final exam in the final exam period. IF an exam is given, then the grading scale will be revised as follows: Homeworks – 15% each, Project – 30%, Lecture – 20%, Exam – 20%

Objectives of the course:

We will study fundamental data structures and algorithms from computational geometry, with an emphasis on their applications to computer graphics and computer vision. Topics are expected to include:

- Geometry: polygons, polytopes, triangulations, planar and spatial subdivision. Constructions: triangulations of polygons, convex hulls, intersections of halfspaces, Voronoi diagrams, Delaunay triangulations, arrangements of lines and hyperplanes. Geometric duality and polarity, ray space, Plucker coordinates.
- Algorithms and analysis: sweep algorithms, incremental construction, divide-and-conquer, dynamic programming, randomized algorithms.
- Geometric data structures: doubly-connected edge lists, quad-edges, binary space partitions, visibility graphs, k-d trees.
- Applications: stereo vision, triangulation for graphics, interpolation, and surface modeling, visibility, discrepancy and sampling in ray tracing, GPU-based Voronoi diagrams, robot motion planning.