ComS 418/518: Computational Geometry
Spring 2008
www.cs.iastate.edu/∼cs518

General Information

Lectures

Tuesdays and Thursdays, 9:30am-10:50am, in Sweeney 1160.

Course Staff

Instructor	**Teaching Assistant**
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Catalog Description

Prerequisites: Com S 311 or permission of instructor, Engl 250, Sp Cm 212.

Introduction to data structures, algorithms, and analysis techniques for computational problems that involve geometry. Line segment intersection, polygon triangulation, 2D linear programming, range queries, point location, arrangements and duality, Voronoi diagrams and Delaunay triangulation, convex hulls, robot motion planning, visibility graphs. Other selected topics. Programming assignments. A scholarly report must be submitted for graduate credit. ComS 418 is open for nonmajor graduate credit.

Textbook

The required textboook (which should be available in the bookstore) is

> Mark de Berg, Marc van Kreveld, Mark Overmars, Otfried Schwarzkopf, *Computational Geometry: Algorithms and Applications* (2nd rev. ed.), Springer-Verlag, 2000; ISBN: 3-540-65620-0

For general background on algorithms, you can consult the following.

J. Kleinberg and E. Tardos, *Algorithm Design*, Addison-Wesley, 2005; ISBN 0-321-29535-8.

T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein, *Introduction to Algorithms*, Second Edition MIT Press, 2001; ISBN 0-262-03293-7.

Topics

Our aim is to cover substantial portions of chapters 1–10 of the textbook. The topics (numbered according to the corresponding chapters) are:

1. *Introduction.* Convex Hulls in two dimensions. Degeneracies and Robustness. Application Domains.
2. *Line Segment Intersection.* The Doubly-Connected Edge List. Computing the Overlay of Two Subdivisions. Boolean Operations
3. *Guarding and Triangulations.* Partitioning a Polygon into Monotone Pieces. Triangulating a Monotone Polygon.
4. *Linear Programming.* Half-Plane Intersection. Incremental Linear Programming. Randomized Linear Programming. Linear Programming in Higher Dimensions. Smallest Enclosing Discs.
5. *Orthogonal Range Searching.* Kd-Trees. Range Trees. Fractional Cascading.
6. *Point Location and Trapezoidal Maps.* A Randomized Incremental Algorithm. Dealing with Degenerate Cases.
7. *Voronoi Diagrams.* Definition and Basic Properties. Algorithms.
8. *Arrangements and Duality.* Computing the Discrepancy. Duality. Arrangements of Lines. Levels and Discrepancy.
9. Delaunay Triangulations. A Randomized Algorithm.
10. Additional Geometric Data Structures. Interval Trees. Priority Search Trees. Segment Trees.

If time permits, we will cover Chapter 11 (Convex Hulls in 3-Space) and Chapter 12 (Binary Space Partitions).

Grading

Grading will be based on two midterm exams, a final exam, homework assignments, a programming project, and, for graduate credit, a scholarly report or essay. The weights are as follows:

	Homeworks	Project	Midterm 1	Midterm 2	Final	Essay
undergrad	20%	10%	20%	20%	30%	
grad	19%	9%	19%	19%	29%	5%

Your final course grade will be curved to account for any homework/exam/instruction errors. Separate curves will be used for 418 and 518. The standard 90-80-70 grading scale can be used to obtain a lower bound for your grade.

Homework

There will be 8 to 10 homework assignments. Assignments must be submitted at the beginning of the lecture on the due date. Any homework turned in after this time will be considered late. Late homework will be accepted until 5pm on the due date for a penalty of 30%. Homework will not be accepted after 5pm.

We highly encourage you to use a typesetting program (such as Microsoft Word, OpenOffice, or LaTeX) to type your solutions. Although typed solutions are not required, being able to professionally present answers to difficult questions is. At the very least, we expect complete English sentences.

Exams

There will be two midterm exams and a final exam. The dates and times are as follows.

Exam 1	**Exam 2**	**Final**
Thursday Feb 21	Thursday April 3	Tuesday May 6
9:30-10:50 am	9:30-10:50 am	9:45-11:45 am

Note that the date and time for the final is tentative — the Spring 2008 final exam schedule will be available approximately mid term. All exams will be held in our classroom, 1160 Sweeney.

Programming Project

There will be one programming project, which will be assigned toward the beginning of the second half of the semester. The goal of this assignment is to put into practice some of the ideas presented in class. The project will involve algorithm design and must be accompanied by a written description and analysis of the algorithms used.

The Scholarly Report

For graduate credit, students enrolled in Com S 518 must submit an essay on some additional topic assigned by the instructor or self-chosen with the instructor's consent. This essay will require approximately 10 to 15 hours of self-study and writing.

Academic Dishonesty Policy

In this course, you may discuss assignments with other students. (Do not assume this is true in all your courses!) However, we expect you to think through and fully understand assignment solutions you submit. That is, the solutions you turn in must be written based on your own understanding. Plagiarism will be dealt with harshly. You should consult the University Policy for details regarding academic misconduct and its consequences.

Students with Disabilities

Iowa State University complies with the American with Disabilities Act and Section 504 of the Rehabilitation Act. Any student who may require an accommodation under such provisions should contact the instructor as soon as possible and no later than the end of the first week of class or as soon as you become aware. No retroactive accommodations will be provided in this class.

The instructor reserves the right to enforce ISU policy concerning examination scheduling.