

CSE 5392-016 (Computational Geometry) SYLLABUS

Spring 2005: TR 5:30-6:50, Preston Hall 100

Instructor: Bob Weems, Associate Professor (weems@uta.edu, <http://reptar.uta.edu>)
Office: 344 Nedderman, 817/272-2337
Hours: TR 4:00-5:00 PM and by appointment (please email by 8:30 AM)

Prerequisite: Advanced Algorithms (CSE 5311)

Objective: Introduction to geometric algorithms and related research issues.

Goals:

1. Exposure to algorithms and data structures for geometric problems.
2. Exposure to techniques for addressing degenerate cases.
3. Exposure to randomization as a tool for developing geometric algorithms.

Textbook: J. O'Rourke, *Computational Geometry in C, 2nd ed.*, Cambridge Univ. Press, 1998.

References: Adobe Systems Inc., *PostScript Language Tutorial and Cookbook*, Addison-Wesley, 1985. (www-cdf.fnal.gov/offline/PostScript/BLUEBOOK.PDF)

M. de Berg et.al., *Computational Geometry: Algorithms and Applications, 2nd ed.*, Springer-Verlag, 2000.

B. Casselman, *Mathematical Illustrations: A Manual of Geometry and PostScript*, Springer-Verlag, 2005. (<http://www.math.ubc.ca/~cass/graphics/manual>)

T. Cormen, et.al., *Introduction to Algorithms, 2nd ed.*, MIT Press, 2001.

J. O'Rourke, *Art Gallery Theorems and Algorithms*, Oxford Univ. Press, 1987.

R. Motwani and P. Raghavan, *Randomized Algorithms*, Cambridge Univ. Press, 1995.

K. Mulmuley, *Computational Geometry: An Introduction Through Randomized Algorithms*, Prentice Hall, 1994.

F.P. Preparata and M.I. Shamos, *Computational Geometry: An Introduction*, Springer-Verlag, 1985.

Grade: Based on the following weights:

40% Homework Presentations (slides and 5-15 minute talk)

40% Participation in Software Development Exercises

≤ 20% "Discretionary" Quizzes (2-5% each) and Exams (10-20% each)

Policies:

1. Attendance is not required, but is highly encouraged. Consult me in advance if you must miss class for a good reason.
2. CHEATING - YOU ARE EXPECTED TO KNOW UNIVERSITY POLICIES. All cases of plagiarism will be processed through University channels outside the CSE department.

- a. **Academic Integrity Policy:** It is the policy of the University of Texas at Arlington to uphold and support standards of personal honesty and integrity for all students consistent with the goals of a community of scholars and students seeking knowledge and truth. Furthermore, it is the policy of the University to enforce these standards through fair and objective procedures governing instances of alleged dishonesty, cheating, and other academic/non-academic misconduct.

You can assume responsibility in two ways. **First**, if you choose to take the risk associated with scholastic dishonesty and any other violation of the Code of Student Conduct and Discipline, you must assume responsibility for your behaviors and accept the consequences. In an academic community, the standards for integrity are high. **Second**, if you are aware of scholastic dishonesty and any other conduct violations on the part of others, you have the responsibility to report it to the professor or assistant dean of students/director of student judicial affairs. The decision to do so is another moral dilemma to be faced as you define who you are. Students who violate University rules on scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and dismissal from the University. Since dishonesty harms the individual, all students, and the integrity of the University, policies on scholastic dishonesty will be strictly enforced.

- b. **Statement on Ethics, Professionalism, and Conduct of Engineering Students:** The statement is attached.
3. Any request for special consideration must be appropriately documented **in advance**. (Special consideration does not include giving a higher grade than has been earned.)
4. Please email the following information to weems@uta.edu by Thursday, January 27:
 - a. Name (as listed by the university).
 - b. Additional email addresses. *I may send moderately-large attachments to these addresses.*
 - c. Brief description of system(s) you will tentatively develop code under.
 - d. Special circumstances affecting your performance.

Course Outline

Readings from O'Rourke and other sources are in ().

0. Getting started with PostScript
1. Signed area/volume calculations and related predicates (1.3-1.5, 7.1-7.3; CLRS 33.1)
 - Triangle area from determinant
 - General polygon area
 - Tetrahedral area from determinant
 - Direction of turn from area
 - Segment intersection
 - Segment-triangle intersection
2. Polygon triangulation (1.1-1.2, 1.6, 2.1-2.4, 7.11.4)
 - Fisk's proof of $\lfloor \frac{n}{3} \rfloor$ upper bound on number of guards
 - Two ears theorem for triangulating polygons
 - Monotone partitions
 - Randomized triangulation
3. 2-d convex hulls (3)
 - Gift wrapping
 - Quickhull
 - Graham scan
 - Incremental algorithm
 - Preparata-Hong algorithm

4. 3-d convex hulls (4.1-4.5)
 - Polyhedra and data structures
 - Gift wrapping
 - Preparata-Hong algorithm
 - Incremental algorithm
 - Randomized incremental algorithm
5. Voronoi diagrams
 - Concepts
 - Delaunay triangulations
 - Incremental (randomized) algorithm
 - Fortune's sweep
 - Applications
 - Medial axis
 - DTs and convex hulls
6. Arrangements (5.8, 6)
 - Relationship to paraboloid transformation
 - Combinatorics
 - Incremental algorithm
 - Duality mapping and properties
 - Higher-order Voronoi diagrams
 - Applications
7. More significant predicates (7.4-7.9, 7.11, CLRS 33.2)
 - Point in polygon
 - Point in polyhedron
 - Intersection of convex polygons
 - Intersection of segments
 - Intersection of general polygons
 - Extreme point of convex polygon
 - Planar point location by monotone subdivisions
8. Motion planning (8.1-8.5)
 - Visibility graphs
 - Moving a disk
 - Moving a convex polygon
 - Moving a line segment

Calendar/Topics

January				February			
18	Syllabus	20	0.	1	2.		3
25	1.	27		8	3.		10
				15	4.		17
				22			24
March				April			
1	5.	3		5	7.		7
8		10		12			14
15	SPRING	17	BREAK	19	8.		21
22	6.	24		26			28
29		31					
May							
3		5					

April 15 is the last day to withdraw.

Statement of Ethics - Student Confirmation

(CSE 5392-016, Spring 2005)

The following is an excerpt from the College of Engineering's statement on Ethics, Professionalism, and Conduct of Engineering Students. The notes are modifications appropriate for Computer Science and Engineering courses. Read the statement carefully, sign it, and return it to your instructor. Additional copies of this statement can be obtained from your course web page.

Statement on Ethics, Professionalism, and Conduct of Engineering Students College of Engineering The University of Texas at Arlington

The College cannot and will not tolerate any form of academic dishonesty by its students. This includes, but is not limited to 1) cheating on examination, 2) plagiarism, or 3) collusion.

Definitions:

A. **Cheating on an examination** includes:

1. Copying from another's paper, any means of communication with another during an examination, giving aid to or receiving aid from another during an examination;
2. Using any material during an examination that is unauthorized by the proctor;
3. Taking or attempting to take an examination for another student or allowing another student to take or attempt to take an examination for oneself.
4. Using, obtaining, or attempting to obtain by any means the whole or any part of an unadministered examination.

B. **Plagiarism** is the unacknowledged incorporation of another's work into work which the student offers for credit.

C. **Collusion** is the unauthorized collaboration of another in preparing work that a student offers for credit.

D. Other types of **academic dishonesty** include using other student's printouts from the ACS labs or students' disk, etc.

1. The use of the source code of another person's program, even temporarily, is considered **plagiarism**.
2. Allowing another person to use your source code, even temporarily, is considered **collusion**.
3. Use of another person's source code with your modification is considered **plagiarism**.
4. Taking material verbatim (without quoting the source) for reports and/or presentations is considered **plagiarism**.

The penalty assessed for cheating on a given assignment will be the entire weight of the assignment and will include notification of the proper authorities as stipulated in the **UTA Handbook of Operating Procedures** and on the web at <http://www2.uta.edu/discipline>

You may be entitled to know what information UT Arlington (UTA) collects concerning you. You may review and have UTA correct this information according to procedures set forth in UT System BPM #32. The law is found in sections 552.021, 552.023 and 559.004 of the Texas Government Code.

I have read and I understand the above statement.

Student's signature: _____

Student's name (printed): _____

Student's ID number: _____