

188 762
Computational Geometry
1st Semester 2009

Course Description: This graduate level course is an introductory course to computational geometry. Topics covered include line segment intersection, polygon triangulation, orthogonal range searching, point location, Voronoi diagram, Delaunay triangulation, convex hulls, binary space partitioning, and non-uniform mesh generation.

Prerequisites: None

But you should have the basic knowledge of the following topics:

- Design and analysis of algorithm and data structures
 - big-Oh notation
 - sorting
 - binary search
 - balanced search tree.
- Some basic knowledge of geometry
- Programming language: for example Java or C or C++
- Probability theory (this is only if we have time to study randomize algorithm)

Credit hours: 3.0

Lecture:

- Normal program: Monday and Friday @ 9:30 - 10:30
- Special program: Sunday @ 17:00 – 20:00
Note: if there are less than people enroll on either program both will be taught on Sunday.

Instructor: Dr.Pattarawit Polpinit

Office: 4203 A

E-mail: polpinit@kku.ac.th

Office Hours: Tuesday and Thursday: 2:00 - 3:00 pm or email me for an appointment.

Course Webpage: <http://gear.kku.ac.th/~polpinit/classes/CG/index.html>

Required Text

1. Mark de Berg et al, *Computational Geometry: Algorithms and Applications*. (second or third edition)
2. Preparata and Shamos, *Computational Geometry: An Introduction*.
3. *Lectures note of Dr. Mount, UMD* (<http://www.cs.umd.edu/~mount/427/>)

Objectives:

The objective of this course is to encourage you to learn how to :

- design 'new' geometric algorithms.

- map real-world problems to computational geometric problems.
- read and understand algorithms
- capable of choosing appropriate algorithm
- develop writing skills to present your own geometric algorithms (from home work)
- capable of presentation difficult algorithmic problems
- capable of implementing geometric algorithms.

Course Outline (tentative)

- Convex Hulls:
 - Brute force algorithm
 - Graham's scan
 - Jarvis's march
 - Quick hull
 - Divide and conquer
- Line Segment Intersections:
 - plane-sweep and line segment intersection
 - representation
 - intersection of planar subdivisions.
- Polygon Triangulation:
 - Art gallery problems
 - partitioning polygon.
- Orthogonal Range Searching:
 - kd-trees
 - range trees
 - fractional cascading.
- Point Location:
 - point location
 - trapezoidal maps
- Voronoi Diagrams:
 - divide and conquer algorithm
 - randomized incremental algorithm
 - Fortune's algorithm
- Arrangements and Duality:
 - point/line duality
 - arrangement of lines.
- Delaunay Triangulations:
 - Triangulations of point sets
 - properties of the Delaunay triangulation
 - computing Delaunay triangulation

(And if we have time)

- Motion planning
- Quad tree
- Visibility graphs

Assessment:

- Assignments 30%: usually from the end of chapter exercises. You will be given two weeks to do each assignment. They will be due in class, any late submission will receive 10% penalty per day on your grade on that assignment.
- Midterm 20%
- Final 20%
- Project 30%: either presentation and written report on a research paper related to CG topics or using algorithm in CG to solve some real-world problems.

Course Policies:

1. Lecture slides, homework assignments, other handout will be available in class.
2. Those handouts will be available on the class website about a week after their corresponding lecture.
3. Assignment can be written by hand or type up. You can either hand them in in lecture or email me the typed up home work before the lecture.
4. You will be given two weeks for each home work.
5. Discussion of the assignments is allowed and encouraged between students. However, each student would be expected to do his/her own work. Assignments which are too similar will receive a zero. Any late submission will receive 10% penalty per day on your grade on that assignment.

If You Need Help:

If you have difficulties or problems on the course, you can do one of the following (in the order of preference):

1. Come talk to me after class.
2. Go to the office hour.
3. Send me an email for question that doesn't need a lot of elaboration.
4. Come see me at my office outside office hour: Please make sure you make an appointment by email first.
- 5.

Do not hesitate to contact me if you have problem. Any problem is usually easier to fix if dealt with as soon as possible.