PROJECTS COURSE
COMP 7717: Algorithms in Practice

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Class Time: TR 5:30PM-6:55PM (MAY BE RESCHEDULED)

Course Overview

This class will study how algorithms are and can be used in practice. The goal is to prove that efficient algorithms are useful and implementable in practice and do have a place outside a theoretical course in algorithms. Look at last year's course information (URL: `http://www.msci.memphis.edu/~giri/projects.html` to see exciting projects that some of the students finished.

Typical Problems of Interest

- Combinatorial Optimization (how can a telecommunications company satisfy demands for bandwidths at specified periods of time; how can FedEx devise the best route for a courier)
- Traveling Salesperson (how to visit the most cities with limited fuel expenses)
- VLSI Design (How does Cadence Design Systems do their Layouts; Stacking Layouts; Compaction)
- Geometric Algorithms in Geographical Information Systems (how are boundaries stored; how are labels placed on a map)
- Other Geometric Algorithms (how to compute shortest paths in terrains; collision detection problems)
- Network Design (how to design a network with various kinds of constraints; how to make a network fault-tolerant; what is a network editor)
- Pattern Matching (how is geometric hashing used to do pattern matching in 3-d molecular structures)
- Algorithms in Data Mining (what can be gained and where is it used)
- Computational Biology (How are motifs detected in protein sequences; how are protein structures determined; why is it important in drug design; how can multiple alignments be done in DNA sequences; how can predictions in structure using programs help in design of biology experiments)
- Computational Finance (Wall Street applications – can programs make money; currency trading applications)
- Algorithm Animation (how to animate algorithms, what tools exist)
- Graphics Applications (Rendering problems – Why do strips of triangles render faster than simply rendering triangles; Wavelet algorithms; 3-d Graphics)
- Computational Morphology (what is the shape of a set of points)
- Data Compression (how are gifs encoded)
- Solving Differential Equations (what kind of computations does the Earthquake Center do)
- Simulation and Modeling (how to generate random data with different probability distributions so that software simulations can be exhaustively tested for correctness and performance; how to generate random points in space to simulate requests for wireless phone calls)
- $\cdots$

Evaluation

The class will be project based. This is what is expected in the class:

1. Pick a team (consisting of 1 or 2 students)
2. Pick a topic of interest
3. Research the topic – what are problems of interest, what kind of software exists out there, what are theoretical algorithms for the problem, what can be implemented
4. Make a presentation in class on the topic
5. FINAL PROGRAMMING PROJECT: Implementation with the goal of making some part more efficient or for comparing 2 different methods
6. Create a Web Page on your project. This page will contain useful information and links on the topic and links to your implementation and results.
7. Make a presentation/demo in class on the results of the implementation.

During the course of the semester, you will learn about `LEDA` and `CGAL`, which provides a library of efficient data structures and algorithms in C++, and could help in implementing some of your algorithms. You will also gain experience with creating a web page using **Java/HTML**.

Prerequisite: **COMP 4/6030: Introduction to Algorithms**, or Permission of Instructor.

Prescribed Text: "The Algorithm Design Manual" by Steven Skiena, publisher – Telos/Springer Verlag. The book comes with a CD-ROM and has useful information for implementing algorithms. A number of other useful books will be held on reserve in the Math library.

The meeting time for this class will be rescheduled on the first class day to a time that it is acceptable to the class. Be present on the first day, if you want to influence this decision.

This course is listed as **COMP 7/8901: Topics in Algorithms** in the Schedule of Classes. Undergraduates who wish to participate may do so by registering for independent study with me for **COMP 4/6901: Ind. Study**.

Home Page: `http://www.msci.memphis.edu/~ giri`