CS6204: Combinatorial and Graph Algorithms

Semester 1, 1999/00 (Jul-Oct 99)
Leong Hon Wai, S15 04-16

Pre-requisites: CS1102 is required. CS3230 preferred

Assessment: (40%) Homework (40%);
(20%) Programming Project -- using C++ and LEDA
(40%) Final Exam [Open Book]

Objectives:
This course presents advanced material on the design and analysis of combinatorial algorithms with emphasis on efficient algorithms and data structures. It also provides practical experience of re-using a C++ library of advanced data structures and algorithms in software development. This course is meant for students/ candidates who intend to (i) do research in computer science in general, and algorithm design in particular, or (ii) do advanced application/software development in other areas of computer science.

Course Outline (Semester 1, 1999/00)

A. ADVANCED DATA STRUCTURES
   Priority Queues, Heaps and Graph Algorithms
   Leftist Heaps and Fast MST Algorithm
   Amortized Analysis
   Fibonacci Heaps and Fast Shortest Path Algorithm
   LEDA - A Library of Efficient Data Structures and Algorithms

B. COMBINATORIAL ALGORITHMS
   Shortest Path -- Problems, Algorithms, Applications
   Maximum Matching -- Problems, Algorithms, Applications
   Network Flow -- Problem, Algorithms, Applications
   Graph Partitioning -- Problem, Algorithms, Applications
   Network Design Problem -- Algorithms, Applications

C. NP-COMPLETENESS
   Cook's Theorem
   Proving NP-Completeness
   Approximation Algorithms
   Local Search Methods

Project Work:
For project work, each student is expected to do a C++ programming project using LEDA to solve a combinatorial optimization problem -- to be announced later. LEDA is a powerful C++ library of data structures and algorithms that can be reused to implement advanced algorithms covered in the course. To help learn LEDA and realize the power of LEDA, one or two simpler implementation exercises will also be included.