

## 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.