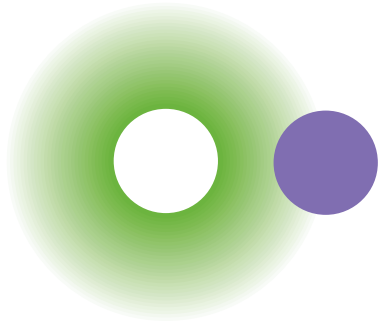

NICTA

NICTA Course Module
Algorithmic Engineering

Professor Vladimir Estivill-Castro

August, 2009

NICTA course modules build toward meeting the course requirement which is part of PhD expectations at certain partner universities, and which forms a part of a NICTA Enhanced PhD program.

- Modules are designed for short intensive delivery, usually over a few days.
- A module may be coordinated by a member of academic staff from a university, by a NICTA researcher, or by a visiting researcher to NICTA or an associated university.
- Modules are designed so that coordinators do not have to commit to regular lecture times spanning an entire session.
- A typical module requires a commitment of 50 hours of work, 15-20 contact hours, reading, assignments and assessment. Such a module meets approximately one-third of the requirements for a postgraduate masters (or higher) level course.
- With the approval of Heads of School modules may accumulate to satisfy coursework requirements. Postgraduate Coordinators can advise on the precise administrative processes by which this is achieved.

Algorithmic Engineering

Background

NP-Complete problems arise in Bio-Informatics, Algorithmic Game Theory, Computational Geometry and other research domains. By combining domain knowledge with the principles of Parameterized Complexity Theory, it is possible to identify input parameters and potentially find tractable approaches that guarantee optimal solutions. The approach of reduction rules also combines with many other approaches to deliver practical alternatives for engineering algorithms to hard problems.

Coordinator

Professor Vladimir Estivill-Castro, Griffith University

Course Description

This course will review what is meant by intractable problems, especially those that fall in the category of NP-Hard problems. The intention is to show several examples without focusing in the mathematical proofs of their intractability. The course will discuss techniques to attempt to solve them despite their established intractability. The course will discuss approximation algorithms, heuristics and then will focus in the algorithmic techniques provided by parameterized complexity theory. In particular, we will emphasize the idea of reduction rules or pre-processing that is common in all the approaches to deal with NP-Hard problems. The course will also emphasize a hands-on approach to their implementation of methods and algorithms to solve these problems and will explore and experiment with fixed-tractable algorithms. We will discuss applications to game theory and computational geometry.

Brief Course Outline

Lecture 1 Motivation and Assumed Knowledge

Lecture 2 Motivation for Approximation Algorithms, the TSP and PTAS

Lecture 3 Approximation Algorithms

Lecture 4 Heuristics: Local Search, Taboo, Search, Simulated Annealing and Evolutionary Algorithms.

Lecture 5 The Foundations of Parameterized Complexity

Lecture 6 Reduction to a Problem Kernel.

Lecture 7 Bounded Search Trees.

Lecture 8 Dynamic Programming

Lecture 9 Crown Structures, Iterative compression and Graphs Minor Theorem.

Lecture 10 Method of Extremal Structure

Lecture 11 Introduction to Algorithmic Game Theory

Lecture 12 Linear Programming, Complexity and Algorithms for 2 players

Lecture 13 Some FPT algorithms in Bio-Informatics

How to enrol Download a Registration Form from the Education web site http://www.nicta.com.au/education/advancedict and return it to:

Chrisanthy.Theodosakis@nicta.com.au

Please discuss your enrolment with your supervisor and postgraduate coordinator.

When

17 November - 20 November, 2009, 9.00 am - 5.00 pm each day

The course will be conducted in Canberra. You will be advised of the location, which will also be displayed on the web site.