SPRING 2012
ISEN 621 – Heuristic Optimization

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Description of the Course

Focus on heuristic optimization methods that search beyond local optima. Procedures to be covered include neighborhood search methods and advanced meta-heuristic search strategies and approximation algorithms. Heuristic algorithms for various combinatorial engineering problems including traveling salesman, layout and location, vehicle routing and scheduling will be discussed.

There are three parts of this course:

Lectures: The instructor covers fundamentals of heuristic optimization and extensions to meta-heuristic methods. You are expected to come to the class prepared by reading and familiarizing yourself with the topic (see the references below). Two exams are given on this material.

Paper Reviews and Presentations: In the second part, you are first required to find five published research articles on development of heuristic approaches and/or use of heuristic methodologies in applications. By the end of the fourth week of semester, you should provide the instructor with a list of your five papers. Following a template provided by the instructor, you prepare short summaries of these five papers (at most two pages each). Then we pick two papers out of your five papers and you prepare and deliver a presentation of these two papers.

Implementation Project: The third part involves an implementation (very likely by using C++) of a heuristic algorithm from one of the two papers you present. Your implementation should be able to read the input data from an input file, execute the algorithm to solve the associated problem and present the results in an easily understandable output file. You are also required to prepare a documentation of your implementation outlining the problem and the algorithm first, and then presenting the data structures and components (procedure, subroutines, etc) of the whole program.

Grading

Part 1: Two Exams (40% - based on the first part),

Part 2: Paper Reviews and Presentations (30% - topics selection, presentation, and summary reports)

Part 3: Implementation Project (30% - completeness, correctness, efficiency, documentation).

Prerequisites

ISEN 620 and ISEN 622 or instructor's permission.

Office Hours

My official office hours are 10:30-11:30 TTh. However, you can stop by anytime when I am in the office. Alternatively, if you want to make sure that I am in the office, you can make an appointment by phone or e-mail. I encourage each one of you to ask any questions you might have on the material during the lecture or right after the class. It is very much to your benefit to get these points cleared as soon as they occur. You are also strongly encouraged to come and see me in the office whenever you have problems.

Tentative Course Outline

1. Introduction
2. Construction heuristics
3. Approximation Algorithms
4. Neighborhood Functions and Local Search
5. Very Large Scale Neighborhood Search
6. Greedy Randomized Adaptive Search
7. Simulated Annealing
8. Tabu Search
9. Genetic Algorithms
10. Scatter Search and Path-relinking
11. Computational Analysis of Heuristics

References (No Textbook)

1. Talbi, E., Metaheuristics: From Design to Implementation, Wiley, New Jersey, 2009.
2. Sait, S.M. and Youssef, H., Iterative Computer Algorithms with Applications in Engineering: Solving Combinatorial Optimization Problems, Wiley-IEEE Computer Society Press, January 2000.
3. Aarts, E. and Lenstra, J.K. (Eds.), Local Search in Combinatorial Optimization, Princeton University Press, New Jersey, 1997.
4. Michalewicz, Z. and Fogel, D. B., How to Solve It: Modern Heuristics, Springer-Verlag, Berlin, Germany, 2000.
5. Glover, F.W. and Kochenberger, G.A. (Editors), Handbook of Metaheuristics, Kluwer, Boston, MA, 2003.
6. Glover, F.W. and Laguna, M., Tabu Search, Kluwer,Boston, MA, 1997.
7. Hochbaum, Dorit S. (Ed.), Approximation Algorithms for NP-hard Problems, PWS, Boston, MA, 1995.
8. Vazirani, Vijay V., Approximation Algorithms, Springer-Verlag, Berlin, 2001.

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