

# Optimization Theory and Algorithms

## Evaluation:

Presentation	30%
Course Project	70%

## Textbooks and useful reference books:

- Wayne L. Winston, **Operations Research: Applications and Algorithms**, Thomson.
- Talbi, El-Ghazali, **Metaheuristics : from design to implementation**, Hoboken, N.J. : John Wiley & Sons, c2009.
- Paul A. Jensen and Jonathan F. Bard. Hoboken, **Operations research: models and methods**, N.J.: [Great Britain] : Wiley, c2003.
- Michel Gendreau and Jean-Yves Potvin, **Handbook of Metaheuristics**, Springer

## Syllabus:

### Part 1: Nonlinear Programming (Week 1&2)

- Review of Differential Calculus
- Introductory Concepts
- Convex and Concave Functions
- Solving NLPs with One Variable
- Golden Section Search
- Unconstrained Maximization and Minimization with Several Variables
- The Method of Steepest Ascent
- Lagrange Multipliers
- The Kuhn–Tucker Conditions
- Quadratic Programming

### Part II: Single-Solution Based Metaheuristics(Week 3)

- Common Concepts for Single-Solution Based Metaheuristics
- Fitness Landscape Analysis
- Local Search
- Simulated Annealing
- Tabu Search
- Iterated Local Search
- Variable Neighborhood Search
- Guided Local Search
- Other Single-Solution Based Metaheuristics

### Part III: Population-Based Metaheuristics(Week 4)

- Evolutionary Algorithms
- Common Concepts for Evolutionary Algorithms

- Scatter Search
- Swarm Intelligence
- Other Population-Based Methods

#### Part IV: Presentation

- Papers presented by instructor
  1. Carrabs, F., Cordeau, J.-F., Laporte, G., 2007b. Variable neighborhood search for the pickup and delivery traveling salesman problem with LIFO loading. *INFORMS Journal on Computing* 19 (4), 618–632.
  2. Li, Y., Lim, A., Oon, W.-C., Qin, H., Tu, D., 2011. The tree representation for the pickup and delivery traveling salesman problem with LIFO loading. *European Journal of Operational Research* 212 (3), 482–496.
  3. "Multiple Pickup and Delivery Traveling Salesman Problem with Last-in-first-out Loading and Distance Constraints", Brenda Cheung, Xiang Gao, Andrew Lim, Hu Qin and Wenbin Zhu, *European Journal of Operational Research*, Volume 223, Issue 1, 16 November 2012, Pages 60-75.
- Papers presented by Students
  1. "A Two-Stage Hybrid Local Search for the Vehicle Routing Problem with Time Windows", Russell Bent, Pascal Van Hentenryck, *Transportation Science*, Vol. 38, No. 4, November 2004, pp. 515–530.
  2. "A new crossover approach for solving the multiple travelling salesmen problem using genetic algorithms", Shuai Yuan, Bradley Skinner, Shoudong Huang, Dikai Liu, *European Journal of Operational Research*, Volume 228, Issue 1, 1 July 2013, Pages 72–82.
  3. "Vehicle routing with multiple deliverymen: Modeling and heuristic approaches for the VRPTW", Vitória Pureza, Reinaldo Morabito, Marc Reimann, *European Journal of Operational Research*, Volume 218, Issue 3, 1 May 2012, Pages 636–647.
  4. "Heuristics for the variable sized bin-packing problem", Mohamed Haouari, Mehdi Serairi, *Computers & Operations Research*, Volume 36, Issue 10, October 2009, Pages 2877–2884.
  5. "The double traveling salesman problem with multiple stacks: A variable neighborhood search approach", *Computers & Operations Research*, Ángel Felipe, M.Teresa Ortuño, Gregorio Tirado, Volume 36, Issue 11, November 2009, Pages 2983–2993.
  6. "A Memetic Algorithm with a large neighborhood crossover operator for the Generalized Traveling Salesman Problem", *Computers & Operations Research*, Volume 37, Issue 11, November 2010, Pages 1844–1852.
  7. "A heuristic procedure for the Capacitated m-Ring-Star problem", *European Journal of Operational Research*, Volume 207, Issue 3, 16 December 2010, Pages 1227–1234.
  8. "The Granular Tabu Search and Its Application to the Vehicle-Routing Problem", *European Journal of Operational Research*, Volume 207, Issue 3, 16 December 2010, Pages 1227–1234.