

# COMP 567 – Discrete Optimization 2

## Course Content

### General

This course covers the formulation and solution of integer programs and looks at their application to a wide range of problems in operations research and combinatorial optimization. Integer programs are used to model situations where some of the variables are indivisible, for example 0/1 variables, which model yes/no decisions. Typical applications include scheduling problems, vehicle routing, telecommunication networks, electricity generation, cutting stock problems, and mine production planning.

### Content

#### Week 1

- Introduction
- Introduction to discrete optimization (Components of a mathematical model, linear programming models, integer programming models, MIPs, other)
- Classical problems in discrete optimization (knapsack, assignment problem, TSP, other)

#### Week 2

- The simplex method (the algorithm, outcomes, cycling and degeneracy)
- Duality (Dual formulation, Duality theorems, some uses of duality)

#### Week 3

- Initial presentations
- Dual simplex method

#### Week 4

- Relaxations (motivation, definition, linear relaxation)
- Gomory's cutting plane methods

#### Week 5

- Branch and Bound (the algorithm, branching strategies, node selection)

#### Week 6

- Restriction approach
- Dantzig-Wolfe decomposition method and column generation

#### Week 7

- Relaxation approach
- Benders decomposition

#### Week 8

- Initial project presentations

#### Week 9

- Stochastic integer programming

#### Week 10

- Advanced aspects of stochastic integer programming

**Week 11**

- Metaheuristics: Local search methods (descent, Tabu search, simulated annealing, variable neighborhood search)
- Adaptive large neighborhood search

**Week 12**

- Metaheuristics: Population based methods (Genetic algorithm, Scatter Search, particle swarm)

**Week 13**

- Final project presentations

**Other:**

- Final examination and a substantial project (teams of 2 persons)

**Textbooks:**

- Linear programming, V. Chvatal, 1983
- Integer programming, L.A. Wolsey, 1998
- Integer and Combinatorial Optimization, G. Nemhauser and L.A. Wolsey, 1988
- Introduction to Stochastic Programming, Birge and Louveaux, 2011
- Handbook of metaheuristics - Second Edition, International Series in Operations Research & Management Science, M. Gendreau and J.Y. Potvin (Eds.), 2010