Methods and Model for Combinatorial Optimization
General info and Programme

Luigi De Giovanni Marco Di Summa

Teachers

Luigi De Giovanni

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office hours: Thursday, h 11:30 - 13:00
(please, book via email)

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Goals

Introduction to advanced modelling and solution techniques for combinatorial optimization problems in decision supporting.
The course aims at providing mathematical and algorithmic tools to solve optimization problems of practical interest, also with the use of the most popular software packages or libraries.

Preliminary Programme

Review, advanced topics and application of Linear Programming and Duality

- Linear Programming models, simplex method, basic notions of duality theory
- Column generation technique for large size linear programming models
- Applications: production planning optimization, network flows

Advanced methods for Mixed Integer Linear Programming (MILP)

- Branch & Bound and relaxation techniques
- Alternative formulations of MILPs
- Cutting plane methods and Branch & Cut techniques
- Applications: Travelling Salesman Problem, Facility Location, Set Covering etc.

Meta-heuristics for Combinatorial Optimization

- Neighbourhood search and variants
- Genetic Algorithms

Network Optimization

- Modelling optimization problems on graphs as network flows
- Algorithms for network flows problems (e.g. spanning trees, minimum cost flows, maximum flow)

Labs

- On-line optimization servers (e.g., NEOS)
- Optimization software and Algebraic modelling languages (e.g. AMPL, **IBM-OPL**)
- Optimization libraries (e.g. **Cplex**, Coin-OR, Scip)

Practical info

Schedule

- Thursday 8:30 - 10:30
- Friday 8:30 - 10:30

Classes will be in Room 1BC50 **or** in LabTA : **please, always check** the official on-line schedule, or the section *Notice* of the course web page.

Planned learning activities and teaching methods: Classes, Labs, Discussion about case studies. During labs, some basic optimization algorithms will be implemented, both exact (using integer programming libraries) and heuristic.

Textbooks

- Lecture notes provided by the teacher + articles from scientific journals.
- Optimization software packages available on line and in labs.

Examination methods

- Each student should deliver **two exercises** (with a short report of about 10 pages) concerning the implementation of 1. a MILP model and 2. a metaheuristic for a combinatorial optimization problem proposed by the teacher (e.g. Travelling Salesman Problem, Telecommunication network configuration, Production planning etc.) [**1-10 /30, minimum 5**].
- **Oral examination** on course contents [**1-20 /30, minimum 10**].
- Each student ***may choose*** to present a **short project** concerning the implementation of exact and/or heuristic solution methods for a realistic application of combinatorial optimization [+2 to +6 /30].

Web page

http://www.math.unipd.it/∼luigi/courses/metmodoc/metmodoc.html