DM872

Mathematical Optimization at Work

Introduction

Marco Chiarandini

Department of Mathematics & Computer Science
University of Southern Denmark

Outline

Who is here?

27 registered in BlackBoard

Prerequisites

- Programming
- Linear Algebra
- Linear and Integer Programming

from DM545 (5 ECTS)
who??

- Math-economy
- Others?

from DM871 (5 ECTS)
who??

- Computer Science (Master)
- Applied Mathematics
- Others?

Outline

1. Course Organization

Aims of the course

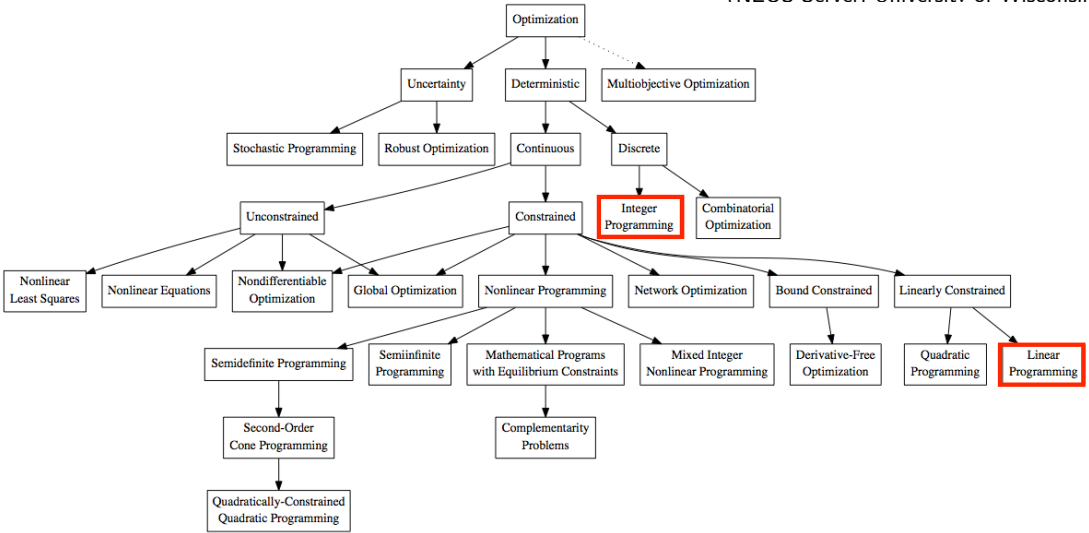
Learn about solving large scale, real-life problems with mixed integer linear programming:

- **advanced techniques** for integer linear programming
- applications
- implementations

$\rightsquigarrow$ You will see the theory and apply the tools learned to solve real life problems using computer software

Optimization Taxonomy

(NEOS Server. University of Wisconsin)



Contents of the Course (aka Syllabus)

Advanced mixed integer linear programming techniques

1 More on Modeling
2 Lazy Constraints
3 Dantzig-Wolfe decomposition
4 (Delayed) Column generation
5 Branch and price
6 Benders decomposition
7 Matheuristics

Applications

7 TSP
8 Vehicle Routing with Time Windows
9 Vehicle Scheduling
10 Crew Scheduling
11 Machine Learning
12 Educational Timetabling

Practical Information

Teacher: Marco Chiarandini (imada.sdu.dk/u/march/)
Instructor: None
Sections (hold): H1

Alternative views of the schedule:

- mitsdu.sdu.dk, SDU Mobile
- Official course description (læserplanen)
- https://dm872.github.io

Schedule:

- Introductory classes: $\sim$ 26 hours ($\sim$ 13 classes)
- Training classes: $\sim$ 20 hours ($\sim$ 10 classes)

Communication Means

- ItsLearning (LMS) $\Leftrightarrow$ Main/Public Web Page (WP)
  (link `https://dm872.github.io`)
- Announcements + Slides in BlackBoard
- Ask peers
- Write to Marco (`marco@imada.sdu.dk`)
- You are welcome to visit me in my office in working hours (9-17)

$\rightsquigarrow$ Make the course interactive and fun!!

Sources — Reading Material

Updated weekly.

Course Material

Public Web Page (WP) is the main reference for list of contents

It contains:

- list of topics and references
- exercises
- links
- resources for programming tasks

Assessment

- Two obligatory medium size projects, evaluation by external censor
- Individual work
- (language: Danish and/or English)

- Final grade: overall evaluation but as starting point the average grade rounded up

Python

- Python 3.10+
- MILP specific:
  - gurobipy, Gurobi 11+ (commercial 100 000 DKK, alternative Cplex, Express)
  - SCIP Optimization Suite + PyScipOpt (Commercial alternative Gurobi or Cplex $\approx$ 100 000 Dkk)
  - Python-MIP + CBC or Gurobi 11+
  - Pyomo + Ipopt, CBC, HiGHS, Gurobi 11+, Cplex
- ipython, jupyter, jupyterLab (= interactive python) or Google CoLab
- VS Code, Spyder3.