

DM872  
Mathematical Optimization at Work

## Introduction

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## 1. Course Organization

# Who is here?

17 in total registered in BlackBoard

Prerequisites

- Programming
  - Linear Algebra
  - Linear and Integer Programming
- from DM545 (5 ECTS)**  
who??

- Math-economy  
(2nd year ? )
- Others?

**from DM871 (5 ECTS)**  
who??

- Computer Science  
(Master)
- Applied Mathematics  
(2nd year ? )
- Others?

## 1. Course Organization

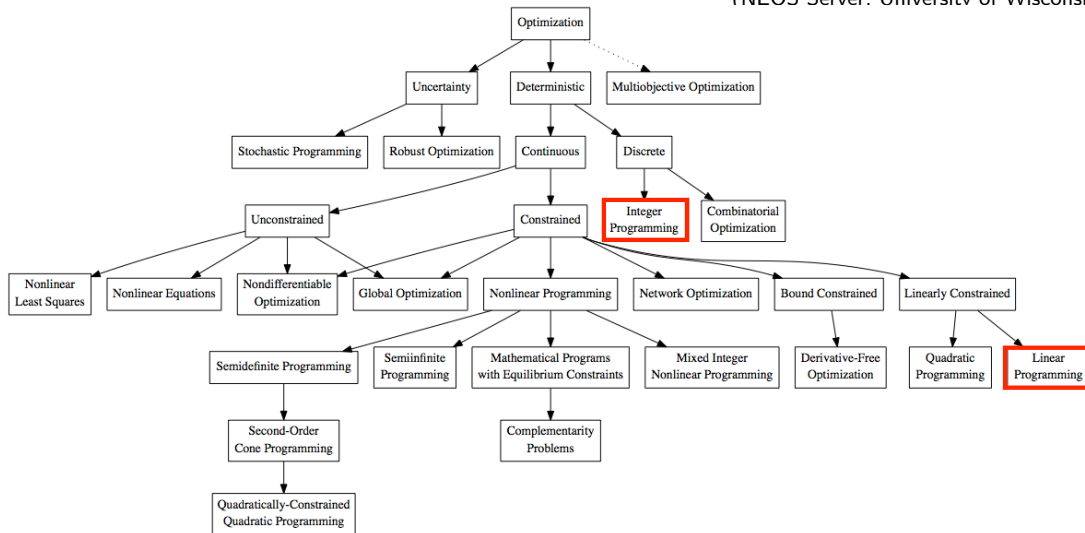
Learn about solving large scale, real-life problems with mixed integer linear programming:

- **advanced techniques** for integer linear programming
- Applications
- Implementations

→ 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 Educational Timetabling
- 9 Vehicle Scheduling
- 10 Crew Scheduling
- 11 Vehicle Routing with Time Windows
- 12 Machine Learning

Teacher: Marco Chiarandini ([www.imada.sdu.dk/u/march/](http://www.imada.sdu.dk/u/march/))

Instructor: None

Sections (hold): H1

Alternative views of the schedule:

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

Schedule:

- Introductory classes:  $\sim$  30 hours ( $\sim$  15 classes)
- Training classes:  $\sim$  18 hours ( $\sim$  9 classes)



- ItsLearning (LMS)  $\Leftrightarrow$  Main Web Page (WP)  
(link <https://dm872.github.io>)
- **Announcements + Slides** in BlackBoard
- Write to Marco ([marco@imada.sdu.dk](mailto:marco@imada.sdu.dk))
- Ask peers
- You are welcome to visit me in my office in working hours (8-16)

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

# Sources — Reading Material

Course Organization

Updated weekly.  
Student's notes.

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

- 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 3.10+
- Previous years:
  - Gurobi 9.1+ (commercial 100 000 DKK, alternative Cplex, Express)
  - SCIP Optimization Suite + PyScipOpt (Commercial alternative Gurobi or Cplex  $\approx$  100 000 Dkk)
  - GLPK or SCIP + Pyomo
- This year:
  - gurobipy, Gurobi 10+ (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 10+
- ipython, jupyter, jupyterLab (= interactive python) or Google CoLab
- VS Code, Spyder3.