

Optimization for Learning

Course Responsible – Pontus Giselsson

Short Bio

- PhD, LTH, Dept. of Automatic Control (2012)
- Postdoc, Stanford, S. Boyd (2013 – 2014)
- Faculty member LTH, Dept. of Automatic Control (2015 –)
- Current research group: 3 PhDs, 1 postdoc

Research interests

- Large-scale optimization and its application

TAs



Manu Upadhyaya



Max Nilsson

This course

- First given in 2019 with some updates every year
- Why this course was developed
 - optimization useful tool in many fields (machine learning)
 - wanted to teach course that reflects my research interests

Course Scope

Course topics:

- Convex analysis
- Supervised learning from an optimization perspective
- Algorithms for large-scale problems (as parts of above two blocks)

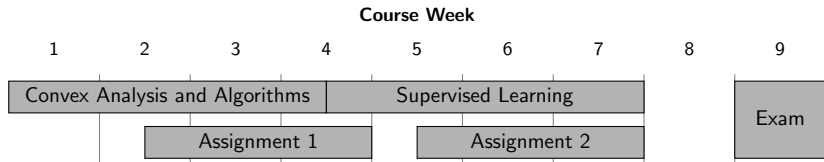
The course is:

- a math oriented course
- focusing on optimization that is key component in learning

The course is not:

- a machine learning course

Course Details



Convex analysis and algorithms

- Convex sets, convex functions, subdifferentials, proximal operators, conjugate functions, duality, proximal gradient method

Supervised learning

- Least squares, logistic regression, support vector machines (SVM), deep learning regression and classification, stochastic gradient descent and implicit regularization

Prerequisites

- Recommended: A (convex) optimization course
- If not: convex analysis part can be tough
- We have math prerequisites document, read this week!

Literature

- No official course literature, only slides and videos (on webpage)
- Recommend: *Convex Optimization* by Boyd and Vandenberghe (free download, google)
 - Sec. 1: optimization overview
 - App. A: general mathematics (complements our math prereq.)
 - Sec. 2 and 3: complement slides on convex analysis (especially if you have not taken optimization course before)

Lectures

- Two lectures per week
 - Mondays 13-15 (except today)
 - Wednesdays 13-15
- Convex analysis part
 - 5-10 short pre-recorded short videos¹ for each sub-topic in lecture
 - active listening: skip back (forward), change playback speed, etc
 - watch all videos before lecture
 - lecture will (likely) not cover everything
- Supervised learning part
 - no pre-recorded short videos (yet) but maybe lecture recordings
 - read through slides before lecture

¹<https://www.control.lth.se/fileadmin/control/Education/EngineeringProgram/FRTN50/VideoPlatform/>

Exercise Sessions

- Two exercise sessions per lecture
 - Tuesdays 8-10 and 15-17
 - Thursdays 8-10 and 15-17
- Manu (afternoon sessions) and Max (morning sessions) are TAs
- For asking questions
- TA will solve problems in beginning of some exercises

Discussion Forum

- We use the Canvas discussion forum
- Teachers will reply to questions
- Help each other by answering questions - a great way to learn!

Examination Format

- Two mandatory hand-ins
- A written exam that decides grade (3-5)

Handins

- Are done in groups of two and are graded pass or fail
- Involves coding in Python in Jupiter notebook
 - Get started via `Introduction to Python` this week
 - Report generated from notebook
- Are submitted and returned via Canvas
- Need to pass both handins to pass the course
- At most two resubmissions

Schedule

- Check time edit!
- Lectures
 - Mondays 13-15 Pontus Giselsson
 - Wednesdays 13-15 Pontus Giselsson
- Exercises
 - Tuesdays 8-10 Max Nilsson
 - Tuesdays 15-17 Manu Upadhyaya
 - Thursdays 8-10 Max Nilsson
 - Thursdays 15-17 Manu Upadhyaya

Course representative

- We need a course representative
- If you are interested, send me an email or let me know now!

Canvas

- Course webpage

<https://canvas.education.lu.se/courses/19973/>

will be updated throughout course

- Course material
- Course program
- Hand-in and correction of submissions
- Discussion forum
- Contact information
- Announcements
- ...

Weekly announcements

- Containing upcoming week's exercises, hand-ins, and lectures
- Other updates

Final comments

- We start in a quite high pace, recommend early start
- Don't hesitate to ask questions and provide feedback
- We hope you will enjoy the course!