

# Optimization for Learning

## General Information

Course Responsible:

**Pontus Giselsson**

## TAs



Martin Morin



Hamed Sadeghi



Manu Upadhyaya

# Covid-19 Precautions

- Department of Automatic Control general rules<sup>1</sup> say
  - No physical lectures
  - Can have physical exercise sessions, but keep distance
  - No drop-ins at the department for asking questions
- We will have everything online via Zoom:
  - Video lectures
  - Office hours/exercise sessions
  - Discussion seminars

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<sup>1</sup> <http://www.control.lth.se/education/covid-19-teaching-policy-at-automatic-control-fall-2020/>

# Course scope

Course topics:

- Convex analysis
- Supervised learning from an optimization perspective
- Algorithms suitable for large training problems

The course is:

- a math oriented course (but not too much focus on proofs)
- focusing on optimization that is key component in learning

The course is not:

- a machine learning course

# Prerequisites

- Recommended: A (convex) optimization course
- If not: convex analysis part can be tough

# Course Details

Course Week								
1	2	3	4	5	6	7	8	9
Convex Analysis		Learning		Algorithms and Analysis			Exam	
Assignment 1		Assignment 2		Assignment 3				

- Convex analysis
  - 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
- Algorithms
  - Convergence, proximal gradient method, stochastic gradient descent, coordinate gradient descent, (quasi)-Newton methods

Most of the theory in first and third parts

# Exam

- Written exam tests convex analysis and theory part of algorithms
- The result on the exam decides the grade (3-5)

# Handins

- Are done in groups of two and are graded pass or fail
- Test supervised learning and implementation of algorithms
- Involves coding in Julia ([julialang.org](http://julialang.org))
  - Julia is a (new) scientific computing programming language
  - Designed to be as fast as c but as high-level as Matlab/Python
  - We have introduction to Julia that you will do this week
- Are submitted and returned via Canvas
- Need to pass all handins to pass the course
- First handin: two resubmissions, second: one



# Literature

- No official course literature, only slides and videos (on webpage)
- Recommend: *Convex Optimization* by Boyd and Vandenberghe
  - Available for free download (google)
  - Good to read:
    - Section 1: optimization overview
    - Appendix A: general mathematics you need to know
    - Sections 2 and 3: complement slides on convex analysis (especially if you have not taken optimization course before)

## Lecture videos

- Five to ten videos per lectures (3 to 15 minutes each)
- Each video covers a subtopic in lecture
- Videos intended for active listening
- Videos will be uploaded during course
- Only for convex analysis and algorithms (that are tested on exam)
- Available from Canvas course page

## Office hours

- All TAs and course responsible will have online office hours
- Course responsible office hours focus on lectures
- TAs office hours focus on exercises and handins
- Will be on Zoom with Zoom info on Canvas course page

## Discussion seminars

- Discuss concepts and put things into context
- Interactive online session between TA and students
- Held by TA Martin Morin
- Will be on Zoom with Zoom info on Canvas course page

## Discussion forum

- Use the Canvas discussion forum if outside of office hours
- TAs will reply to questions
- Please also help each other by answering questions

# Schedule

- We will use (essentially) the same time slots as in time edit
- Office hours
  - Mondays 13-15 Pontus Giselsson (For questions on lectures)
  - Tuesdays 15-17 Manu Upadhyaya
  - Thursdays 8-10 Hamed Sadeghi
  - Thursdays 15-17 Martin Morin
- Discussion seminars
  - Fridays 10-12 Martin Morin
- Remember: Everything is online with Zoom links on Canvas

## Course representative

- We need a course representative
- If you are interested, send me an email

## Webpage and course program

- Course webpage on Canvas

`https://canvas.education.lu.se/courses/7714/`

contains all course material

- Course program (on Canvas) contains the info in these slides



## Final comments

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