LUNDS UNIVERSITET
Lunds Tekniska Högskola

Course syllabus

Optimering
Optimization

FMAN61, 7,5 credits, A (Second Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED F/Pi
Date of Decision: 2023-04-18

General Information

Main field: Technology.
Elective Compulsory for: I3
Elective for: BME4, D4-mai, E4, F4, F4-bs, F4-bg, F4-fm, F4-r, F4-mai, M4, Pi4-bs, Pi4-fm, Pi4-bem, Pi4-bam, R4
Language of instruction: The course will be given in English on demand

Aim

The aim of the course is to present basic optimization theory, and to give an overview of the most important methods and their practical use.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- be familiar with and, in his/her own words, be able to describe the optimization algorithms, for problems with and without constraints, encountered in the course, and their properties.
- be familiar with the theory of convex sets and convex functions, and be able to state and derive the most important theorems on convexity.
- be aware of how to make use of convexity in the treatment of an optimization problem.
- be familiar with Karush-Kuhn-Tucker theory and be able to state and derive the most important theorems therein.

Competences and skills
For a passing grade the student must

- be able to demonstrate an ability to solve optimization problems within the framework of the course.
- be able to demonstrate an ability to handle optimization problems using a computer.
- be able to demonstrate an ability to, in the context of problem solving, derive simple results not previously encountered in the course .
- be able to describe the connections between different concepts in the course, with proper terminology and in a well structured and logically consistent manner.
- with proper terminology, suitable notation, in a well structured way and with clear logic be able to describe the solution to a mathematical problem and the theory within the framework of the course.

Judgement and approach
For a passing grade the student must

- be able to explain why convex optimization problems have better properties than others.

Contents

Quadratic forms and matrix factorisation. Convexity. Separating planes and Farkas' Lemma. The theory of optimization with and without constraints: Lagrange functions, Karush-Kuhn-Tucker theory. Duality. Methods for optimization without constraints: line search, steepest descent, Newton methods, conjugate directions, non-linear least squares optimization. The Nelder-Mead search algorithm without derivatives. Methods for optimization with constraints: linear optimization, quadratic programming, penalty and barrier methods.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: Written test comprising theory and problems. Two computer exercises and one project. The final grade is the grade obtained in the written exam.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Parts
Code: 0121. **Name:** Optimization.
Credits: 6. **Grading scale:** TH. **Assessment:** Written test comprising theory and problem solving.
Code: 0221. **Name:** Computer Programming.
Credits: 1,5. **Grading scale:** UG. **Assessment:** The student should write a computer program which solves one of given set of optimization problems, and write a report in which the results are presented and evaluated.
Code: 0321. **Name:** Computer Exercises.
Credits: 0. **Grading scale:** UG.

Admission

Assumed prior knowledge: Basic university studies in calculus and linear algebra, including basic theory of quadratic forms.
The number of participants is limited to: No
The course overlaps following course/s: FMA051, MATC51, FMAN60, MATC61

Reading list

- Lars-Christer Böiers: Mathematical Methods of Optimization. Studentlitteratur, 2010, ISBN: 978-91-44-07075-9. Probably new, alternative material will be used instead. See last item below.
- Computer Laboratory Exercises in Optimization. Provided by the department.
- Diehl, S: Trial print of new course book. Will probably be used. The decision will be taken by August. Distributed by Studentlitteratur.

Contact and other information

Course coordinator: Studierektor Anders Holst, Studierektor@math.lth.se
Course administrator: Studerandeexpeditionen, expedition@math.lth.se
Teacher: Stefan Diehl, Stefan.Diehl@math.lth.se
Course homepage: https://canvas.education.lu.se/courses/20365