Introduction to Optimization

Programme course

6 credits

Optimeringslära grundkurs

TAOP07

Valid from: 2017 Spring semester

Determined by
Board of Studies for Electrical
Engineering, Physics and Mathematics

Date determined
2017-01-25

Main field of study
Mathematics, Applied Mathematics

Course level
First cycle

Advancement level
G1X

Course offered for
- Applied Physics and Electrical Engineering - International, M Sc in Engineering
- Applied Physics and Electrical Engineering, M Sc in Engineering
- Mathematics
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- Computer Science, Master's programme
- Computer Science and Software Engineering, M Sc in Engineering

Entry requirements
Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

Prerequisites
Calculus, linear algebra, and Matlab

Intended learning outcomes

Optimization deals with mathematical theory and methods aiming at analyzing and solving decision problems that arise in technology, economy, medicine, etc. The course gives a broad orientation of the field of optimization, with emphasis on basic theory and methods for continuous and discrete optimization problems in finite dimension, and it also gives some insight into its use for analyzing practical optimization problems. After the course, the student shall be able to:

- identify optimization problems and classify them according to their properties, into, for example, linear and nonlinear, or continuous and discrete, problems
- construct mathematical models of simple optimization problems
- define and use basic concepts, such as, for example, local and global optimality, convexity, weak and strong duality, and valid inequalities
- reproduce and apply basic theory for some common types of optimization problems, such as, for example, duality theory for linear optimization problems, and have knowledge about and be able to use optimality conditions, such as, for example, Bellman's equations, to determine the optimality of a given solution
- describe and apply basic principles for solving some common types of optimization problems, such as, for example, branch-and-bound for discrete problems
- use relaxations, and especially Lagrangian duality, to approximate optimization problems, and be able to estimate the optimal objective value through lower and upper bounds
- use commonly available software for solving optimization problems of standard type.

Course content

Fundamental concepts within optimization, such as mathematical modelling, optimality conditions, convexity, sensitivity analysis, duality, and Lagrangean relaxation. Basic theory and methods for linear and nonlinear optimization, and integer and network optimization.

Teaching and working methods

Lectures which include theory, problem solving and applications. Exercises which are intended to give individual training in problem solving. A laboratory course with emphasis on modelling and the use of optimization software.

Examination

LAB1	Laboratory Work	1 credits	U, G
TEN1	Written examination	5 credits	U, 3, 4, 5

Grades
Four-grade scale, LiU, U, 3, 4, 5

Other information
Supplementary courses: Optimization, advanced course Y, Applied optimization - project course, Mathematical optimization.

Department
Matematiska institutionen

Director of Studies or equivalent
Ingegerd Skoglund

Examiner
Torbjörn Larsson

Course website and other links
http://courses.mai.liu.se/GU/TAOP07

Education components
Preliminary scheduled hours: 60 h
Recommended self-study hours: 100 h

Course literature
Jan Lundgren, Mikael Rönnqvist och Peter Värbrand: Optimeringslära (Studentlitteratur). Exempelsamling: Optimeringslära grk för Y.

Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at http://styrdokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.