



LUNDS UNIVERSITET
Lunds Tekniska Högskola

Course syllabus

Linjär och kombinatorisk optimering Linear and Combinatorial Optimization

FMAP05, 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

Elective for: BME4, C4, D4-pv, E4, F4, F4-pv, F4-bs, Pi4-bs, Pi4-pv

Language of instruction: The course will be given in English on demand

Aim

In science, technology and economics, linear and combinatorial optimization problems appear more and more often. The most well known example is linear programming, where the so called *simplex method* has been of utmost importance in industry since it was invented in the middle of the 20th century. Other important problems, e.g. for effective data processing, contain discrete variables, for example integers. In connection with these, the importance of combinatorial methods has grown. The aim of the course is to make the students aware of some problems in linear and combinatorial optimization which are important in applications, and to give them knowledge about modern mathematical methods for their solution. The aim is also to make the students develop their ability to solve problems, with and without the use of a computer, and their ability to read mathematical texts.

Learning outcomes

Knowledge and understanding

For a passing grade the student must

- understand and be able to clearly explain the theory behind the simplex method.
- be able to describe and explain the mathematical theory behind some central algorithms in combinatorial optimization.

Competences and skills

For a passing grade the student must

- be able to show a good capability to (i) identify problems in the area, (ii) formulate these in mathematical terms, (iii) choose an appropriate method to solve them, and finally (iv) carry out the solution, possibly with the help of a computer.
- be able to write computer programs to solve linear and combinatorial optimization problems.
- with proper terminology, in a well structured way and with clear logic be able to explain the solution to a problem within linear and combinatorial optimization.

Contents

Linear programming. Integer programming. Transport problems. Assignment problems. Maximal flow. Some modern methods in combinatorial optimization. Algorithm complexity.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)

Assessment: Assignments. A pass on these is sufficient to pass the course. For a higher grade: Oral or written examination, to be decided by the examiner.

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.

Admission

Assumed prior knowledge: FMAB20 Linear Algebra. Programming with Python or Matlab. Some course in mathematics beyond calculus in several variables (for mathematical maturity).

The number of participants is limited to: No

The course overlaps following course/s: FMA240, FMAF35

Reading list

- Kolman, B. & Beck, R.E.: Elementary Linear Programming with Applications. Academic Press, 1995, ISBN: 0-12-417910. Available as E-book from the Maths Library.
- Supplementary material.
- B.Korte & J. Vygen: Combinatorial Optimization, Theory and Algorithms. Springer, 2019, ISBN: 9783662585665. Sixth edition. An earlier edition is available as e-book from the Mathematics Library.

Contact and other information

Course coordinator: Studierektor Anders Holst, Studierektor@math.lth.se

Teacher: Victor Ufnarovski, victor.ufnarovski@math.lth.se

Course homepage: <https://canvas.education.lu.se/courses/20371>