UNIVERSITY OF GOTHENBURG

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

DIT206 Discrete optimization, 7.5 credits

Diskret optimering, 7,5 högskolepoäng

Second Cycle

Confirmation

This course syllabus was confirmed by Department of Computer Science and Engineering on 2020-11-04 to be valid from 2022-01-17, spring semester of 2022.

Field of education: Science 100%
Department: Department of Computer Science and Engineering

Position in the educational system

The course is a part of the Computer Science Master´s programme and an elective course at the University of Gothenburg.
The level for the course in relation to degree requirements is Master´s degree, code A1F.
The course has course/courses at second cycle level as entry requirements.

The course can be part of the following programmes: 1) Mathematical Sciences, Master's Programme (N2MAT), 2) Computer Science, Master's Programme (N2COS), 3) Applied Data Science Master's Programme (N2ADS), 4) Computer Science, Bachelor's Programme (N1COS) and 5) Software Engineering and Management Master's Programme (N2SOF)

Main field of studies	*Specialization*
Computer Science	A1F, Second cycle, has second-cycle course/s as entry requirements
Data Science	A1F, Second cycle, has second-cycle course/s as entry requirements

Entry requirements

- 7,5 credits programming in high level language like Java, Python etc
- 7,5 credits basic course in calculus/analysis

- 7,5 credits basic course in linear algebra

Applicants must prove knowledge of English: English 6/English B or the equivalent level of an internationally recognized test, for example TOEFL, IELTS.

Learning outcomes

After completion of the course the student should be able to:

Knowledge and understanding

- Describe what is a linear program (LP) and an integer linear program (ILP).
- Describe the geometry of a LP by visualizing it graphically.
- Describe the relationship between an ILP and its LP relaxation.

Competence and skills

- Formulate a continuous optimization problem as an LP.
- Formulate a discrete optimization problem as an ILP and relax it to an LP, and recover approximate discrete solution to the original problem from the optimal LP.
- Solve an LP using the Simplex algorithm.
- Formulate the dual of an LP and relate it to the original LP.
- Use LP duality to design optimization algorithms.
- Formulate discrete optimization problems as a vector program, relax it to an SDP and recover a discrete solution to the original problem

Judgement and approach

- Recognize which optimization formulation is appropriate to a given problem.
- Judge which algorithm works efficiently for a given optimization problem.

Course content

The course gives an introduction to modelling various optimization problems using linear programming (LP) and integer linear programming (ILP). The Simplex algorithm to solve LPs is described and analysed. The LP relaxations of ILPs are studied and analysed to design approximation algorithms. The duality theory of linear programs is studied and used to design approximation algorithms. Vector programs to model discrete optimization problems are described and relaxed to semi-definite programs (SDPs)

Sub-courses

1. **Written hall examination** *(Skriftlig salstentamen),* 7.5 credits
   Grading scale: Pass with distinction (5), Pass with credit (4), Pass (3) and Fail (U)

Form of teaching
Lectures twice weekly and exercise sessions.

Language of instruction: English
The course is held in English.

Assessment
The course is examined by a written exam (assignments could be used for bonus points).

If a student, who has failed the same examined element on two occasions, wishes to change examiner before the next examination session, such a request is to be submitted to the department in writing and granted unless there are special reasons to the contrary (Chapter 6, Section 22 of Higher Education Ordinance).

In the event that a course has ceased or undergone major changes, students are to be guaranteed at least three examination sessions (including the ordinary examination session) over a period of at least one year, though at most two years after the course has ceased/been changed. The same applies to work experience and VFU, although this is restricted to just one additional examination session.

Grades
The grading scale comprises: Pass with distinction (5), Pass with credit (4), Pass (3) and Fail (U).
To pass the course, all mandatory components must be passed. To earn a higher grade than Pass, a higher weighted average from the grades of the components is required.

Course evaluation
The course is evaluated through meetings both during and after the course between teachers and student representatives. Further, an anonymous questionnaire isused to ensure written information. The outcome of the evaluations serves to improve the course by indication which parts could be added, improved, changed or removed.

Additional information
The course is a joint course together with Chalmers.

Course literature to be announced the latest 8 weeks prior to the start of the course.

The course replaces the course DIT370, 7.5 credits. The course cannot be included in a degree which contains DIT370. Neither can the course be included in a degree which is

based on another degree in which the course DIT370 is included.