UNIVERSITY OF GOTHENBURG

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

DIT993 Mathematical Modelling and Problem Solving, 7.5 credits

Matematisk modellering och problemlösning, 7,5 högskolepoäng

First Cycle

Confirmation

This course syllabus was confirmed by Department of Computer Science and Engineering on 2021-11-15 to be valid from 2022-08-29, autumn semester of 2022.

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

Position in the educational system

The course is compulsory within the N1COS Computer Science Bachelor's Programme. It is also a single subject course at the University of Gothenburg.

Main field of studies	*Specialization*
Computer Science	G1F, First cycle, has less than 60 credits in first-cycle course/s as entry requirements

Entry requirements

Completed courses to a total of 45 hp are required, including:
- a course in imperative or object oriented programming (DIT012, DIT953 or similar)
- a course in linear algebra (MMG20 or similar)
- a course in mathematical analysis (MMG30 or similar)

Learning outcomes

On successful completion of the course the student will be able to:

Knowledge and understanding

- Describe different model types and their properties, as well as the processes of modelling and problem solving. Describe main aspects of mathemtical thinking.

- Explain the role of mathematics in different areas of application.

Competence and skills

- Mathematical modelling: investigate real problems, suitably translate into a mathemtical model and draw conclusions with the help of the model. This includes to create a precise formulation, simplify, make suitable assumptions and selecting how the problem can be described e.g. with the help of equations or in other mathematical ways.
- Mathematical problem solving: solving complex and unknown problems with an investigative and structured approach. This includes analyzing and understanding, working in smaller steps and trying things out.
- Communicate with and about mathematics.
- Use different computational tools as a natural part of working mathematically.

Judgement and approach

- Show an ability to balance own thinking and using knowledge from others.
- Show a reflective attitude to the contents of the course and to the student's own thinking.
- Show accuracy and quality in all work.

Course content

The course is primarily intended as an introduction to mathematical modelling and problem solving for students with limited experience in the use of mathematics in engineering, but which may come to work in different areas where mathematics is useful.

The main purpose of the course is to provide the student with the ability to apply the theoretical mathematics to solve problems in science and technology. With application oriented exercises, and by teaching modelling and problem solving techniques, the course then bridges the gap between the theoretical courses in mathematics and relevant applications. The course also includes a broader summary of mathematical thinking.

The core of the course is a number of application oriented exercises, which are used as a starting point for the student's own learning. The problems have been carefully selected to develop the student's own skills in modelling and solving problems in a investigative way. The exercises illustrate many areas of application and are organized after the main model types.

In the list below one can find examples indicating the more detailed scope:

- Functions and equations, for example how different mathematical statements can be motivated and how to select and fit functions to empirical data.

- Optimization models, e.g. mathematical programming in economics and decision support.
- Dynamic models, e.g. simulation in biology, physics and engineering.
- Probability models, e.g. stochastic simulation, Markov models for text and Bayesian inference.
- Discrete models, e.g. graphs and networks for modelling projects and activities, modelling with discrete standard problems and boolean logic, planning.
- One to two more modules with topics that can change from instance to instance.

With the exercises as a starting point, we actively teach modelling and problem solving with a supervision style that develops the independence of the student. During lectures, we also discuss different problem solving strategies, reflect on solutions and compare different ways to solve the same problem.

The course also demonstrates the importance of building mathematical computer models for different kinds of applications.

Sub-courses

1. **Assignments** *(Inlämningsuppgifter),* 7.5 credits
   Grading scale: Pass with distinction (5), Pass with credit (4), Pass (3) and Fail (U)

Form of teaching

The course is organized in weekly modules, one for every model type. A module consists of an introductory lecture, exercises for the week, and a compulsory follow-up lecture giving feedback to the solved exercises.

An emphasis is placed on an interactive teaching style with a lot of direct contact between students and teachers. This is done in supervision sessions where students solve the exercises and regularly discuss with the teachers. The students can then receive individual feedback and appropriate guidance in their own problem solving, and develops their independent problem solving ability.

As a follow up to each module, the students are asked to reflect on their own and alternative solutions, and on their own problem solving.

Language of instruction: English
The main teaching language for this course is English, but supervision and support can be given in Swedish.

Assessment

The course is examined through written assignments and a final report, where the students are encouraged to summarize the course in their own way. Additionally, the

course includes compulsory follow-up lectures for each module, and during the examination week there is also compulsory final meeting where the report is discussed. Both the weekly assignments and the final report are normally done in groups of two.

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If a student, who has failed the same examined component twice, wishes to change examiner before the next examination, a written application shall be sent to the department responsible for the course and shall be granted unless there are special reasons to the contrary (Chapter 6, Section 22 of Higher Education Ordinance).

In cases where a course has been discontinued or has undergone major changes, the student shall normally be guaranteed at least three examination occasions (including the ordinary examination) during a period of at least one year from the last time the course was given.

Grades

The grading scale comprises: Pass with distinction (5), Pass with credit (4), Pass (3) and Fail (U).
To receive the grade Pass (3) for the full course, passed assignments and a passed final report is required, together with presence in the compulsory activities of the course.

To receive a grade of 4 or 5, this higher grade is required on both the assignments and the final report. To pass the assignments the reasoning must be correct and of acceptable quality.

For a grade of 4 the student must show a deeper understanding with a good quality of written explanation. For a grade of 5 the student must give very good solutions with clarity and depth in explanations and some creativity and originality. To pass the final report the student must show a fundamental understanding of the contents of the course, and that the presentation and the contents of the report are correct and possible to understand. For a grade of 4 the student must show a deeper understanding with a good quality of written explanation.

For a grade of 5 the student must demonstrate very good understanding of the contents of the course with clarity and depth in explanations and some creativity and originality.

Course evaluation

The course is evaluated through meeting after the course between teachers and student representatives. Further, an anonymous questionnaire is used to ensure written information. The outcome of the evaluations serves to improve the course by indicating which parts could be added, improved, changed or removed.

Additional information

Since the exercises are the core of the course there is no course literature in the traditional sense. For handout material and additional reading, see the course home page.

The course replaces the course DIT992, 7.5 credits. The course cannot be included in a degree which contains DIT992. Neither can the course be included in a degree which is based on another degree in which the course DIT992 is included.

Knowledge of probability/statistics is recommended but is not necessary to follow the course.