

Master in Applied Computer Science, part-time (120 ECTS)

Study Plan for Master in Applied Computer Science, part-time (120 ECTS) (2023–2027)

Facts about the program

ECTS Credits:
120

Study duration:
4 years

Teaching language:
English

Campus:
Halden

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What do you learn?

Degree/title obtained

Students that complete and pass the programme are awarded the degree of Master in Applied Computer Science.

Some students will also have the right to use the protected title sivilingeniør after graduation if they fulfil the following requirements:

- Completed a bachelor's degree in computer engineering based on the national curriculum regulations or an equivalent education that meets the minimum requirements of 25 ECTS mathematics, 7,5 ECTS physics and 5 ECTS statistics.

The additional title sivilingeniør will be stated in the diploma.

Learning outcomes

Knowledge

The candidate has

- deep knowledge about research and development within the field of applied computer science;
- advanced knowledge about literature and methods used within the field of applied computer science.

Skills

The candidate is able to

- work independently with a problem statement over an extended period of time;
- analyse a situation, formulate a problem statement, and develop a plan for solving the problem;
- create models and implement them in a digital environment;
- make realistic and feasible plans by considering account possibilities, limitations and use of time;
- collect and analyse relevant information with emphasis on source criticism
- present research and results clearly and unambiguous within the field of applied computer science;
- formulate his/her own and other people's reflections and solutions within the field of applied computer science.

General competence

The candidate

- has retained and further developed his/her academic curiosity, knowledge, openness and precision as well as the ability to distinguish between knowledge and opinions;
- is capable of critical reflection on ethical, scientific and philosophical issues within the field of applied computer science;
- has gained knowledge of scientific literature, methods and theories within the field of applied computer science;
- can communicate knowledge clearly in writing as well as orally.

Admission

A bachelor's degree or an equivalent education of at least 180 ECTS credits, and in addition or included at least 80 ECTS credits in informatics, and in addition or included at least 20 ECTS credits in programming

To be admitted, the applicant must have an average grade value from the qualifying education of at least 25 (according to ECTS standards).

Proof of English proficiency is also required.

In addition, all applicants must pass both a written essay and an online entrance test.

Applicants from countries outside the EU/EEA must submit proof of funding when submitting their application.

Structure and content

The structure and content of the programme

The master programme in applied computer science is a natural extension of the department's bachelor studies and builds on the research activities of the department's staff.

In the first and second semester, students select three courses from one of the following four specialisations:

- Interaction Design
- Artificial Intelligence
- Internet of Things
- Cyber Security

In the third and fourth semester, the students have a common course in scientific methods, ethics and writing and work with an interdisciplinary project together with students from other specialisations. This project is either a project defined by the research groups at the department or a business project defined by one of our business partners. In addition, students have an elective course.

In the next two to four semesters, the students are doing their master's thesis (60 ECTS). In order to qualify for the master's thesis, students must have passed at least 50 ECTS.

Teaching, learning methods and forms of assessment

Learning partly takes place through seminars and traditional lectures. Additionally, it will take other forms:

- student-led seminars
- projects

Each student's benefit from this type of organisation will depend on the student's own efforts and interest. The student must show interest in his/her professional development, and must be able to work independently with theory, implementation and knowledge acquisition. The students are offered supervision in all courses in the master programme. Master students are expected to take initiatives and approach tutors, and be responsible for their own learning.

A modern library is available for all students at Østfold University College. The library helps the students in developing their information competence, i.e. the ability to search, find, evaluate and use relevant information. In addition to personal service, the students are offered library courses on international databases and evaluation of information quality. They are also offered courses in scientific referencing.

Compulsory assignments

Some of the courses have requirements for attendance and/or compulsory assignments, exercises and projects. These assignments have to be completed and approved before taking the final examination. More details regarding compulsory assignments are found in the course descriptions.

Academic writing

The students will be trained in academic writing throughout the study programme. This is done by emphasising content, structure, reliability, and referencing.

Continuous feedback

The taught courses include exercises, assignments and projects, completed either individually or in groups. The students are given feedback on all exercises, assignments and projects.

Assessment

Final assessment takes several forms: written individual examination, portfolio assessment, project assessment, oral examination, or a combination of these. The grading scale used is the A - F scale.

Upon agreement with the instructor you may in some cases use Norwegian for your hand ins and/or exams.

More details regarding assessment are found in the course descriptions.

Plagiarism control/ cheating

Master's theses are subject to electronic plagiarism control, as may also be the case with other courses and required coursework. Exam papers that are partly or entirely identical will not be approved and will be regarded as cheating. For further information please see Exam regulations for Østfold University College.

Research and development work

The master programme is based on research activities at the department, but is also contributes to our research. All courses in the first year are directly related to the research performed at the department. This implies that our courses are continually developed and always up to date.

The master theses are always based on research and development performed at the department or at one of our partners. Students may get the opportunity to participate in the department's research projects, as well as to carry out a business project with a relevant IT company. Papers written by students have on several occasions led to scientific publications.

Internationalisation

The international aspect is taken care of by the use of international literature. In addition, several members of the academic staff have close contacts with foreign institutions and research environments. The language of instruction is entirely in English, and therefore accommodates the needs of foreign students.

Programme evaluation

To be able to offer relevant education of good quality, HiØ is dependent on feedback from the students and their participation in course and program evaluations. This study programme is regularly evaluated in order to assure and develop its quality:

- An annual national student survey is conducted among second year students on all bachelor's and master's degree programmes by the Norwegian Agency for Quality Assurance in Education (NOKUT). The results of the survey are published on the website studiebarometeret.no.
- Østfold University College conducts periodic evaluations of the study program as a whole.
- Evaluations are carried out in all individual courses; see the individual course descriptions for more details.

Reading list

See separate course descriptions.

Course literature is subject to change until 15th of May for autumn courses, and 15th of November for spring courses.

Studies abroad

Students may take their third semester of their studies at a university abroad. Both the International Coordinator at the department as well as HiØ's International Office help accommodate studies abroad, and the department have exchange agreements with several universities in Europe, USA, Canada and Australia.

Detailed information on exchange opportunities at universities abroad can be found on HiØ's international pages.

Work and future studies

The master's programme qualifies for PhD-studies in Norway and abroad. Different admission requirements may apply at different universities.

A master degree from us provides opportunities for leading positions within application development, web development, consulting and project management in leading IT companies in Norway and abroad. It also qualifies for work in the public sector, for instance in the fields of research, health and education

The study plan is approved and revised

The study plan is approved

Dean Harald Holone, 27.October 2020

The study plan is revised

Head of Department, Monica Kristiansen Holone, November 1, 2022

The study plan applies to

The programme description applies to the period 2023-2027 (master's programme starting in Autumn 2023)

Programme Coordinator

Study model

Autumn 2023

Select specialisation

Specialisation in Artificial Intelligence

Specialisation in Interaction Design

Specialisation in Internet of Things

Specialisation in Cyber Security

Choose specialisation to view courses

Spring 2024

Choose specialisation to view courses

Autumn 2024

Core courses

ITI41020

Scientific Methods, Ethics and Writing

10 stp

Spring 2025

Core courses

ITI41120

Interdisciplinary Project

10 stp

Elective courses

Choose one elective

ITI42622 / Valgbart emne Complex Systems Modelling and Optimization	10 stp
ITI60020 / Valgbart emne Digital Fabrication and Making	10 stp

Autumn 2025

Core courses

ITI54020 / Part 1 of 4 Master's Thesis

Spring 2026

Core courses

ITI54020 / Part 2 of 4 Master's Thesis

Autumn 2026

Core courses

ITI54020 / Part 3 of 4 Master's Thesis

Spring 2027

Core courses

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Emner som ikke er tatt med

Emnesiden finne ikke

– ITI54020 2025h

ITI41720 Machine Learning and Deep Learning (Autumn 2023)

Facts about the course

ECTS Credits:
10

Responsible department:
**Faculty of Computer Science,
Engineering and Economics**

Campus:
Halden

Course Leader:
Roland Olsson

Teaching language:
English

Duration:
½ year

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The course is connected to the following study programs

Mandatory course in the master programme in applied computer science with specialisations in artificial intelligence, cyber security and internet of things, full-time and part-time.

Recommended requirements

Knowledge in:

- Statistics and statistical programming
- Mathematics
- Programming
- Algorithms and data structures

Lecture Semester

First semester (autumn) in the full-time and part-time programme (For those who started in 2023)

First, third and seventh semester in the part-time programme (For those who started in 2021 and 2022)

The student's learning outcomes after completing the course

Knowledge

The student

- is familiar with both the possibilities and advantages of employing the machine learning methods in the course, as well as possible problems that may be encountered and how to overcome them.

- knows how the algorithms presented in the course work and their characteristics, for example which problems they work best for, overfitting, expected accuracy and computational requirements, for example how much benefit that accelerators may provide.

Skills

Given a machine learning application, the student is able to

- determine which theory and which methods that are presented in the course that are relevant and also how to apply them.
- perform hyperparameter tuning or in some cases even perform modifications of the source codes.
- use at least one implementation for each of the major machine learning techniques that are taught in the course.

General competence

The student

- is able to independently read machine learning papers and other literature and evaluate what works well and what does not for new problems.
- knows the terminology of machine learning and is familiar with the mathematics that is common in the field.
- knows the general behaviour of machine learning methods for example regarding how much data that is required, how to preprocess the data and ensure that its quality is sufficient.

Content

This course gives an advanced insight into the main methods used in machine learning. The topics covered in this course are:

- Concepts related to basic types of learning (supervised, unsupervised, reinforcement): preprocessing, feature extraction, overfitting, error functions
- Decision and regression trees, random forest and XGBoost

- Artificial neural networks, deep learning
- Optimization (evolutionary algorithms and other search methods)
- Bayesian inference / classification

Ethics and privacy in machine learning is also mentioned.

Additionally, the course contains up to date topics that are not known when this text is being written.

Forms of teaching and learning

The students will learn by attending lectures, read the books, papers and online material in the course reading list and above all by working on two projects. The project work is supervised each week and results in a 10 pages report for each project. These reports are part of the examination in the course.

Workload

Approx. 280 hours.

Examination

Portfolio and individual written exam

The exam consists of both a portfolio and an individual written exam.

The portfolio (determines 65% of the final grade) consists of two projects. The projects can be carried out individually or in groups of maximum three students. The students will get an individual grade.

The individual written exam determines 35% of the final grade and focuses on theory. Duration 3 hours. No supporting materials allowed.

Both parts of the exam must be passed to pass the exam as a whole. The student will get an individual joint grade for the entire course. Grades: A - F.

Examiners

External and internal examiner, or two internal examiners.

Conditions for resit/rescheduled exams

Upon re-examination, each part of the examination can be retaken.

Course evaluation

This course is evaluated by a

- Mid-term evaluation (compulsory)

The responsible for the course compiles a report based on the feedback from the students and his/her own experience with the course. The report is discussed by the study quality committee of the faculty of Computer Sciences.

Literature

The [current reading list for 2023 Autumn](#) can be found in Leganto

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ITI41222 Evolutionary Computation (Autumn 2023)

Facts about the course

ECTS Credits:
10

Responsible department:
**Faculty of Computer Science,
Engineering and Economics**

Campus:
Halden

Course Leader:
Hasan Ogul

Teaching language:
English

Duration:
½ year

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The course is connected to the following study programs

Mandatory course in the master programme in applied computer science with specialisation in artificial intelligence, full-time and part-time.

Recommended requirements

Knowledge in:

- Algorithms and data structures
- Programming
- Programming libraries related to machine learning
- Statistics
- Mathematics

Lecture Semester

First semester (autumn) in the full-time and part-time programme.

The student's learning outcomes after completing the course

Knowledge

The student

- understand the basic principles of evolutionary computation.
- gets an overview of different types of evolutionary computation methods
- becomes familiar with the benefits and drawbacks of these methods
- can implement these methods to solve problems in practical, industrial and other complex domains

Skills

The student can

- formulate a real-world problem as an evolutionary search/optimization/classification problem by deciding on necessary representations and evolutionary operators
- decide the suitable evolutionary algorithms/techniques based on the nature of the applications
- implement different evolutionary algorithms/techniques for such problems by using a package and/or coding his/her own algorithms

General competence

The student gains insight into evolutionary, biologically and nature inspired algorithms/techniques for search, optimization, and classification; and becomes capable of working with such algorithms and techniques.

Content

This course gives an insight into different evolutionary computation methods and their applications.

The topics covered in this course are:

- A general overview of the field of evolutionary computation
- The underlying principles and theory of evolutionary computation
- A detailed overview of the leading evolutionary, bio-inspired, social and other nature-inspired algorithms
- Multi-objective evolutionary algorithms
- Hybridization and memetic algorithms
- Neuro-evolution
- Issues with evolutionary computation techniques: parameter control, convergence, diversity, elitism, etc.
- Applications of evolutionary computation methods in solving science, industry and real-world search/optimization/classification tasks
- Advanced and recent trend in evolutionary computation

Forms of teaching and learning

Lectures, colloquium, self-study and project work.

Workload

Approx. 280 hours.

Coursework requirements - conditions for taking the exam

The student must deliver:

- Up to 3 mandatory exercises
- Attend individual oral presentations for each of the announced exercises. During the oral presentations, the student must explain the implementation details of the submission and demonstrate a certain level of efficiency for the submitted solution to the exercise.

Coursework requirements must be accepted to qualify for the exam.

Examination

Individual portfolio and written exam

The exam is divided into two parts:

- The individual portfolio consists of up to three exercises and determines 50% of the final grade.
- The individual written exam is based on the course curriculum and determines 50% of the final grade. Duration 3 hours. No supporting materials allowed.

Both parts of the exam must be passed to pass the exam as a whole. The student will get an individual joint grade for the entire course. Grades: A - F.

Examiners

External and internal examiner, or two internal examiners.

Conditions for resit/rescheduled exams

Upon re-examination, each part of the examination can be retaken.

Course evaluation

This course is evaluated by a:

- Mid-term evaluation (compulsory)

The responsible for the course compiles a report based on the feedback from the students and his/her own experience with the course. The report is discussed by the study quality committee at the Department of Computer Science and Communication.

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ITI41520 Interaction Design (Autumn 2023)

Facts about the course

ECTS Credits:
10

Responsible department:
**Faculty of Computer Science,
Engineering and Economics**

Campus:
Halden

Course Leader:
Juan Carlos Torrado

Teaching language:
English

Duration:
½ year

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The course is connected to the following study programs

Mandatory course in the master programme in applied computer science with specialisation in interaction design, full-time and part-time.

Recommended requirements

The student should have some experience on investigating or creating interactive systems evidenced through the completion of relevant courses in software and hardware prototyping, data science, cyber-physical systems, interaction design, design methods, or human computer interaction.

Lecture Semester

First semester (autumn) in the full-time and part-time programme.

The student's learning outcomes after completing the course

Knowledge

By participating in the theoretical modules the student learns to:

- identify and describe contemporary trends in interaction design and classify IxD projects accordingly
- formulate research questions and hypotheses for interaction design projects
- understand and reflect on choosing a design methodology for a specific project and appropriate documentation techniques
- explain and reflect on the results of interaction design projects

Skills

The student is able to

- perform a scientific literature review
- apply appropriate methods for designing new and existing technology for interaction between humans and machines
- prototype interaction design ideas at an appropriate level of fidelity using contemporary tools and techniques
- carry out evaluation plans with appropriate data collection and analysis strategies for interaction design projects
- design, conduct, and analyse surveys, interviews, or experiments as appropriate
- document the findings in a way appropriate for scientific publication and present appropriately

General competence

The student gains

- competence in critical reading and reflection
- group-work skills

Content

The theoretical modules investigate contemporary trends in interaction design and design methods. Presentations demonstrate multimodal interfaces, virtual and augmented reality, mobile and wearable, as well as tangible, embodied, and sonic interaction design. Design methods from user-centred and participatory design, as well as designing for specific user groups like users with disabilities, underrepresented populations or older adults, and research through design are discussed.

In project work, the student applies appropriate methods to investigate interaction between humans and machines. Projects may survey specific use contexts, create an interactive artifact or system, perform an empirical study, or a meta-analysis of a literature review. Projects are structured based on deadlines which offer the student several opportunities to get formative feedback during supervision. The results of the project should be documented in a way that is appropriate for scientific publication and may be submitted to an international academic conference.

Forms of teaching and learning

The Interaction design course is an advanced course in Interaction Design which consists of theoretical and project work modules. The following methods are used:

- Presentations
- Supervision
- Workshops
- Reading Circle
- Quizzes
- Project Work

Workload

Approx. 280 hours.

Coursework requirements - conditions for taking the exam

The student must during the semester:

- present at least one paper from the reading list (individual or in a group) and lead a plenary discussion based on this.
- complete and present at least one approved group project.

Coursework requirements must be accepted to qualify for the exam.

Examination

Individual written exam and scientific documentation in groups

The exam is divided into two parts:

- Individual written exam (50%) based on the course curriculum. Duration 4 hours. No supporting materials allowed.
- Scientific documentation in groups (50%) based on the group project.

Grading scale A - F in both parts. Both parts of the exam must be passed to pass the course. The student will get an individual joint grade for the entire course.

Examiners

External and internal examiner, or two internal examiners.

Conditions for resit/rescheduled exams

Upon re-examination, each part of the examination can be retaken.

Course evaluation

This course is evaluated by a:

- Mid-term evaluation (compulsory)

The responsible for the course compiles a report based on the feedback from the students and his/her own experience with the course. The report is discussed by the study quality committee at the Department of Computer Science and Communication.

Literature

The [current reading list for 2023 Autumn](#) can be found in Leganto

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ITI41322 Interaction Design Experiments (Autumn 2023)

Facts about the course

ECTS Credits:
10

Responsible department:
**Faculty of Computer Science,
Engineering and Economics**

Campus:
Halden

Course Leader:
Georgios Marentakis

Teaching language:
English

Duration:
½ year

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The course is connected to the following study programs

Mandatory course in the master programme in applied computer science with specialisation in interaction design, full-time and part-time.

Lecture Semester

First semester (autumn) in the full-time and part-time programme.

The student's learning outcomes after completing the course

Knowledge

The candidate understands:

- use of quantitative methods in designing different interaction design settings
- experiment design and analysis
- quantitative descriptors of usability, users experience, affective and embodied aspects of interaction
- quantitative evaluation of user performance and experience

Skills

The candidate can:

- review literature and develop relevant hypotheses
- select quantitative measures for evaluating hypotheses
- design, plan, and execute experiments to gather data as appropriate for the different stages of the design process with a focus on evaluation
- apply statistical methods for analysing data from experiments
- reflect and discuss on the outcome of the experiments
- understand strengths and limitations of quantitative methods

General competence

The candidate:

- develops critical skills required for developing and testing hypotheses
- develops group work skills

Content

The theoretical aspect of the course provides an in-depth discussion on the application of quantitative methods in interaction design and human computer interaction. The students are presented ways to quantify usability, user behaviour, and user experience as it emerges in common and emerging interactive settings involving different technologies. Relevant theory in experiment design and analysis is presented. Appropriate methods for statistical analysis are presented and discussed.

In the project work, students design, run, and analyse and experiment that addresses an aspect of an interaction design problem after reviewing relevant literature within a domain that is suggested or approved by the lecturer. Subsequently, they write a short scientific paper presenting their study.

Forms of teaching and learning

The following methods are used:

- Presentations
- Supervision
- Workshops
- Reading and discussing literature
- Project Work

Workload

Approx. 280 hours.

Coursework requirements - conditions for taking the exam

The student must during the semester:

- complete and present at least one approved project (individually or in groups of 2-4 students) in which a quantitative user study is designed, executed, analysed and discussed
- provide and present a research paper (individually or in groups of 2-4 students) in which the project is described in accordance with the details provided by the instructor

Coursework requirements must be accepted to qualify for the exam.

Examination

Individual written exam and project paper (individually or in groups of 2-4 students)

The exam is divided into two parts, each part counting 50%:

- Individual written exam based on the course curriculum. Duration 4 hours. No supporting materials allowed.
- Project paper (individually or in groups of 2-4 students) based on the project.

Grading scale A - F in both parts. Both parts of the exam must be passed to pass the course. The student will get an individual joint grade for the entire course.

Examiners

External and internal examiner, or two internal examiners.

Conditions for resit/rescheduled exams

Upon re-examination, each part of the examination can be retaken.

Course evaluation

This course is evaluated by a:

- Mid-term evaluation (compulsory)

The responsible for the course compiles a report based on the feedback from the students and his/her own experience with the course. The report is discussed by the study quality committee at the Department of Computer Science and Communication.

Literature

The [current reading list for 2023 Autumn](#) can be found in Leganto

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ITI41920 Automation, Adaptation and IoT (Autumn 2023)

Facts about the course

ECTS Credits:
10

Responsible department:
**Faculty of Computer Science,
Engineering and Economics**

Campus:
Halden

Course Leader:
Maben Rabi

Teaching language:
English

Duration:
½ year

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The course is connected to the following study programs

Mandatory course in the master programme in applied computer science with specialisation in internet of things, full-time and part-time.

Lecture Semester

First semester (autumn) in the full-time and part-time programme.

The student's learning outcomes after completing the course

Knowledge

The student has knowledge of

- The reasons for, and benefits of the spread of embedded, networked computers
- examples of real-time systems, delivering automation, adaptation and remote monitoring, both in industry and society
- basic sensing, communication, control, and computing elements in a typical cyber-physical system
- techniques for modelling cyber-physical systems from descriptions of their components
- basic architectural templates for internet of things (IoT)
- examples of adaptation and learning in IoT systems

Skills

The student is able to

- decompose any given IoT system into its sensing, communication, control, and computing elements
- apply basic modelling methods to capture the dynamic behaviour
- predict dynamic behaviour using simulation tools

- predict performance from approximate modelling and analysis
- perform simulation, implementation and testing of simple Arduino or Raspberry-Pi based networked, mechatronic, IoT systems

General competence

The student

- knows the way of abstracting device and embedded software details, and extracting the overall functional behaviour, in concrete examples of IoTs
- is familiar with the terminology of the area of cyber-physical systems

Content

- Introduction to embedded computing devices
- Introduction to basic sensing, actuating and other physical devices
- Common communication protocols for real-time applications
- Modelling of continuous and discrete dynamics
- Challenges in specification, verification, and systems engineering

Forms of teaching and learning

Lectures, seminar/workshops, and project work with software tools and mechatronic hardware.

Workload

Approx. 280 hours.

Coursework requirements - conditions for taking the exam

The student must:

- deliver up to 5 mandatory assignments
- finish their final project work

These assignments require working with software packages, hardware implementation and programming, as well as reading and summarizing papers from the research literature. The final project also involves similar activities.

Coursework requirements must be accepted to qualify for the exam.

Examination

Oral exam and project report in groups of 2-3 students

The exam is divided into two parts:

- Oral exam in groups (50%): Based on the course curriculum. Duration 30 min. No supporting materials allowed. The students will get an individual grade.
- Project report in groups (50%): Based on the project work. The students will get an individual grade.

Grading scale A - F in both parts. Both parts of the exam must be passed to pass the exam as a whole. The students will get an individual joint grade for the entire course.

Examiners

External and internal examiner, or two internal examiners.

Conditions for resit/rescheduled exams

Upon re-examination, each part of the examination can be retaken.

Course evaluation

This course is evaluated by a:

- Mid-term evaluation (compulsory)

The responsible for the course compiles a report based on the feedback from the students and his/her own experience with the course. The report is discussed by the study quality committee at the Department of Computer Science and Communication.

Literature

The [current reading list for 2023 Autumn](#) can be found in Leganto

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ITI42122 Cyber Security Governance (Autumn 2023)

Facts about the course

ECTS Credits:
10

Responsible department:
**Faculty of Computer Science,
Engineering and Economics**

Campus:
Halden

Course Leader:
Mary Luz Sanchez Gordon

Teaching language:
English

Duration:
½ year

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The course is connected to the following study programs

Mandatory course in the master programme in applied computer science with specialisation in cyber security, full-time and part-time.

Recommended requirements

Knowledge about:

- Governance and management of IT
- Cyber security

Lecture Semester

First semester (autumn) in the full-time and part-time programme.

The student's learning outcomes after completing the course

Knowledge

The student

- knows main ISO IT Security standards
- is familiar with the Information Technology Infrastructure Library (ITIL)
- is able to understand main risk scenarios and challenges
- knows how to apply Control Objectives for Information and Related Technology (COBIT) to specific information security topics/practices within an enterprise.
- is able to identify and understand security and controls across the strategic, tactical, and operational levels within an organization
- is able to understand main adversary tactics and techniques
- is able to distinguish governance and management by their types of activities and responsibilities

Skills

The student is able to

- use well-known frameworks and standards (COBIT, ITIL, ISO 27K) in real settings
- justify the need of IT Security and continuity planning issues for effective IT and guide them in practical business settings
- select the appropriate controls
- know whether business operations and information are secure and reliable
- know whether an enterprise is maintaining an effective system of internal control
- assess and articulate security risks from the board level to the code level.

General competence

The student gains experience with project work, including planning, performing and reporting in an existing research area.

Content

- Control Objectives for Information and Related Technology (COBIT)
- Information Technology Infrastructure Library (ITIL) for security management
- ISO/IEC 27001 Information Security Management Systems

Forms of teaching and learning

Teaching will be based on blended learning approaches. There will be recorded lectures of the topics of the course and in a weekly or bi-weekly basis, physical meetings will take place to mentor the development of the paper and guide students in the course.

Workload

Approx. 280 hours.

Coursework requirements - conditions for taking the exam

The student must deliver up to four assignments.

Coursework requirements must be accepted to qualify for the exam.

Examination

Individual oral exam and a security governance plan

The exam is divided into two parts:

- The plan (50%) is graded on a selected case study. The case study is chosen by the students and agreed with the course responsible. The plan can be developed individually or in groups of two students. The students will get an individual grade.
- The individual oral exam (50%) is based on the course curriculum, aspects of the plan developed. Duration approx. 20-30 min. No supporting materials are allowed.

Grading scale A - F in both parts. Both parts of the exam must be passed to pass the course. The student will get an individual joint grade for the entire course.

Examiners

External and internal examiner, or two internal examiners.

Conditions for resit/rescheduled exams

Upon re-examination, each part of the examination must be retaken.

Course evaluation

This course is evaluated by a:

- Mid-term evaluation (compulsory)

The responsible for the course compiles a report based on the feedback from the students and his/her own experience with the course. The report is discussed by the study quality committee at the Department of Computer Science and Communication.

Literature

The [current reading list for 2023 Autumn](#) can be found in Leganto

Last updated from FS (Common Student System) July 17, 2024 12:15:25 AM

ITI41820 Advanced Topics in Machine Learning (Spring 2024)

Facts about the course

ECTS Credits:
10

Responsible department:
**Faculty of Computer Science,
Engineering and Economics**

Campus:
Halden

Course Leader:
Roland Olsson

Teaching language:
English

Duration:
½ year

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The course is connected to the following study programs

Mandatory course in the master programme in applied computer science with specialisation in artificial intelligence, full-time and part-time.

Recommended requirements

ITI41720 Machine Learning

Lecture Semester

Second semester (spring) in the full-time and part-time programme.

The student's learning outcomes after completing the course

Knowledge

The student

- knows the possibilities and advantages of employing the machine learning methods in the course as well as possible problems that may be encountered and how to overcome them
- knows how the algorithms presented in the course work and their characteristics, for example which problems they work best for, overfitting, expected accuracy and computational requirements, for example how much benefit that accelerators may provide

Skills

Given a machine learning application, the student is able to

- determine which theory and which methods that are presented in the course that are relevant and also how to apply them

- perform hyperparameter tuning or in some cases even perform modifications of the source codes
- use at least one implementation for each of the major machine learning techniques that are taught in the course

General competence

The student

- is able to independently read machine learning papers and other literature and evaluate what works well and what does not for new problems
- knows the terminology of machine learning and be familiar with the mathematics that is common in the field
- knows the general behaviour of machine learning methods for example regarding how much data that is required, how to preprocess the data and ensure that its quality is sufficient

Content

The course goes in depth on selected topics and methods within machine learning and their applications. Examples include:

- advanced neural net and deep learning models, such as: ResNET, Zero shot, GAN, LSTM.
- Evolutionary and bio-inspired algorithms algorithms (like GA, EA, ES, PSO, ACO, AIS) in search, optimization and classification.
- Program induction. Symbolic regression. Automatic programming.
- Markov models, Kernel methods. SVM
- Implementing machine learning in Industries and business

- Machine learning challenges and future
- Philosophical fundamental problems and ethical questions related to machine learning

The course syllabus will continuously be updated with methods from state-of-the-art research. Other topics may be chosen by machine learning group members each year and may vary depending on who is involved.

Forms of teaching and learning

The students will learn by attending seminars, reading papers and online material in the course reading list and above all by working on a project with a selected topic throughout the course and giving presentations at the seminars.

Workload

Approx. 280 hours.

Coursework requirements - conditions for taking the exam

The student must:

- give presentations at two seminars
- contribute with questions in at least two other seminars
- deliver a mid-term report

Coursework requirements must be accepted to qualify for the exam.

Examination

Individual project report and individual oral exam

The exam is divided into two parts:

- An individual project report which determines 50% of the final grade.
- An individual oral exam which determines 50% of the final grade. The individual oral exam based on the course curriculum and project work. Approximately 30 minutes duration. No supporting materials allowed.

Both parts of the exam must be passed to pass the exam as a whole. The student will get an individual joint grade for the entire course. Grades: A - F.

Examiners

External and internal examiner, or to internal examiners.

Conditions for resit/rescheduled exams

Upon re-examination, each part of the examination can be retaken. Upon re-examination, a new project must be carried out in agreement with the course instructor.

Course evaluation

This course is evaluated by a

- Mid-term evaluation (compulsory)

The responsible for the course compiles a report based on the feedback from the students and his/her own experience with the course. The report is discussed by the study quality committee at the Department of Computer Science and Communication.

Literature

The [current reading list for 2024 Spring](#) can be found in Leganto

ITI41620 Design for Cooperation (Spring 2024)

Facts about the course

ECTS Credits:
10

Responsible department:
**Faculty of Computer Science,
Engineering and Economics**

Campus:
Halden

Course Leaders:
• **Klaudia Carcani**
• **Joakim Karlsen**

Teaching language:
English

Duration:
½ year

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The course is connected to the following study programs

Mandatory course in the master programme in applied computer science with specialisation in interaction design, full-time and part-time.

Recommended requirements

ITI41520 Interaction Design

Lecture Semester

Second semester (spring) in the full-time and part-time programme.

The student's learning outcomes after completing the course

Knowledge:

The student is familiar with

- central theories and concepts for understanding how people cooperate, both in workplaces and in everyday life
- methods, tools and techniques for designing IT solutions in support of such cooperative practices

Skills:

The student is able to

- use methods, tools, and techniques for designing IT solutions in support of cooperative practices

General competence

The student can

- conduct methodologically and ethically sound research according to the scientific standards in CSCW

Content

The course introduces the students to Computer-Supported Cooperative Work (CSCW), an interdisciplinary research field concerned with understanding how to support cooperative practices by technology design.

The course gives an overview of central theories and concepts for understanding how people cooperate, both in workplaces and in everyday life and introduces a toolbox of methods, tools and techniques that will help them design IT solutions in support of such cooperative practices.

Forms of teaching and learning

There will be lectures, plenary discussions and project work.

The lectures and plenary discussions will focus on:

- classical case studies in CSCW
- central theories and concepts in CSCW
- methods, tools and techniques for designing support for cooperative practices as developed in CSCW

The project work will lead to the writing of one scientific paper and will be conducted according to the requirements and deadlines set by the professors responsible for the course.

Workload

Approx. 280 hours.

Coursework requirements - conditions for taking the exam

The student must have finished their project work.

Coursework requirements must be accepted to qualify for the exam.

Examination

Individual oral exam and scientific paper

The exam is divided into two parts:

- Individual oral exam (50%): Based on the course curriculum. Duration 30 min. Some supporting material, specified by the professors, will be allowed.
- Individual scientific paper (50%): Based on the project work.

Grading scale A - F in both parts. Both parts of the exam must be passed to pass the exam as a whole.

Examiners

External and internal examiner, or two internal examiners.

Conditions for resit/rescheduled exams

Upon re-examination, each part of the examination can be retaken.

Course evaluation

This course is evaluated by a:

- Mid-term evaluation (compulsory)

The responsible for the course compiles a report based on the feedback from the students and his/her own experience with the course. The report is discussed by the study quality committee at the Department of Computer Science and Communication.

Literature

The [current reading list for 2024 Spring](#) can be found in Leganto

Last updated from FS (Common Student System) July 17, 2024 12:15:36 AM

ITI42020 Models and Digital Twins for the Internet of Things (Spring 2024)

Facts about the course

ECTS Credits:
10

Responsible department:
**Faculty of Computer Science,
Engineering and Economics**

Campus:
Halden

Course Leader:
Øystein Haugen

Teaching language:
English

Duration:
½ year

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The course is connected to the following study programs

Mandatory course in the master programme in applied computer science with specialisation in internet of things, full-time and part-time.

Recommended requirements

ITI41920 Automation, Adaptation and the Internet of Things.

General programming skills is an advantage.

Lecture Semester

Second semester (spring) in the full-time and part-time programme.

The student's learning outcomes after completing the course

Knowledge

The student understands

- the challenges associated with cyber-physical systems
- the relevance of good software design principles
- how evolution and maintenance should be organized
- the value of abstraction

Skills

The student has the capability to

- model and implement reactive systems with concurrency
- perform analysis of consistency of models of systems with concurrency
- give and take constructive criticism of the system design and functioning
- receive the experience of building a cyber-physical system and making it execute

General competence

The student

- can build systems on «Internet of Things»
- can assess realistically what errors may occur in cyber-physical systems and how to minimize their vulnerability
- has some insight into precise descriptions and their semantics

Content

The course focuses on how reactive systems can be built with emphasis on modeling. The models are executable and based on state machines. The requirements of these concurrent systems are specified as sequence diagrams, and it is emphasized that the requirements and design should be consistent. We show how the concept of "Digital Twins" is useful in theory and practice.

We emphasize reactive systems on the Internet of Things, and we use a running example where the functionality is enhanced during the course following an agile approach.

Towards the end of the course, we show how systems can be made more resilient to unexpected incidents and errors. To perform risk-analysis of such systems will also be covered.

Forms of teaching and learning

The course has three intensive teaching sessions, each session is two full working days consisting of lectures and guided lab and exercises.

In between the teaching session there is supervised project work. For each instance of the course, we create new project tasks. We teach the project teams how to give and take constructive feedback.

Workload

Approx. 280 hours.

Coursework requirements - conditions for taking the exam

- Mandatory project: There will be one project, with deliverable at each teaching session (2 deliverables). Project group size should be 2-4 people, but with few students, single person project will be possible. The students should expect to spend 100 hours on the project.
- Plenary presentation and evaluation of the project. The project should normally result in an executable model that should be demonstrated at the plenary presentation.

Coursework requirements must be accepted to qualify for the exam.

Examination

Individual oral exam

Individual oral exam based on the course curriculum and mandatory exercises. Approximately 30 minutes duration. No supporting materials allowed.

Assessment on the A - F grading scale.

Examiners

External and internal examiner, or two internal examiners.

Course evaluation

This course is evaluated by a:

- Mid-term evaluation (compulsory)

The responsible for the course compiles a report based on the feedback from the students and his/her own experience with the course. The report is discussed by the study quality committee at the Department of Computer Science and Communication.

Literature

The [current reading list for 2024 Spring](#) can be found in Leganto

Last updated from FS (Common Student System) July 17, 2024 12:15:37 AM

ITI41020 Scientific Methods, Ethics and Writing (Autumn 2024)

Facts about the course

ECTS Credits:
10

Responsible department:
**Faculty of Computer Science,
Engineering and Economics**

Campus:
Halden

Course Leader:
Cathrine Linnes

Teaching language:
English

Duration:
½ year

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The course is connected to the following study programs

Compulsory course in the Master`s programme in Applied Computer Science for all specialisations, full-time and part-time.

Lecture Semester

1th semester (autumn) in the full-time programme and 3rd semester (autumn) in the part-time programme.

The student's learning outcomes after completing the course

Knowledge

The student

- has advanced knowledge of research design
- has insight into the ethical challenges in the field of computer science
- has knowledge of qualitative, quantitative and mixed methods
- has knowledge of relevant data collection techniques
- has knowledge of relevant data analysis techniques
- is familiar with publishing channels relevant to applied computer science, different types of publications, their roles and functions

Skills

The student is able to

- search for and assess scientific literature within the field of applied computer science
- use scientific references and reference managers
- construct a problem statement or research question and evaluate their soundness
- select relevant methods to address a research problem

- discuss issues related to ethics in research design
- use relevant techniques for data collection
- use relevant techniques for data analysis

General competence

The student

- is able to write a scientific paper
- is able to orally present a scientific project for specialists within the field, as well as for the general public
- has competence in critical reading and reflection

Content

- Research design and ethics
- Qualitative, quantitative and mixed methods
- Scientific writing and peer-review
- Publishing channels relevant to applied computer science, different types of publications, their roles and functions

Forms of teaching and learning

Lectures, presentations, and lab exercises.

Workload

Approx. 280 hours.

Examination

Individual portfolio and individual written exam.

The exam consists of both an individual portfolio and an individual written exam. The portfolio counts 60% and consists of:

- Two research projects
- One idea paper

The individual written exam counts 40% and is based on the course curriculum. Duration 2 hours. No supporting materials permitted.

Both parts of the exam must be passed to pass the exam as a whole.

The student will get an individual joint grade for the entire course. Grades: Assessment on the A - F grading scale.

Examiners

One external and one internal examiner, or two internal examiners will be involved in the assessment.

Conditions for resit/rescheduled exams

Upon re-examination, each part of the examination can be retaken.

Course evaluation

This course is evaluated by a

- Final course evaluation (compulsory)

The responsible for the course compiles a report based on the feedback from the students and his/her own experience with the course. The report is discussed by the study quality committee at the Department of Computer Science and Communication.

Literature

The [current reading list for 2024 Autumn](#) can be found in Leganto

ITI41120 Interdisciplinary Project (Spring 2025)

Facts about the course

ECTS Credits:
10

Responsible department:
**Faculty of Computer Science,
Engineering and Economics**

Campus:
Halden

Course Leader:
Thi Thuy Nga Dinh

Teaching language:
English

Duration:
½ year

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The course is connected to the following study programs

Compulsory course in the Master`s programme in Applied Computer Science for all specialisations, full-time and part-time.

Lecture Semester

2nd semester (spring) in the full-time programme

4th semester (spring) in the part-time programme

The student's learning outcomes after completing the course

Knowledge

The student

- has an in-depth knowledge of the process leading to the completion of an interdisciplinary or industrial project carried out in teams of diverse individuals
- is familiar with relevant publishing channels

Skills

The student is able to

- contribute to the writing of a scientific paper aimed at publishing
- critically reflect on the role of diversity and interdisciplinarity, as well as the role of personal experience, professional background, gender, culture, and other social identities when working in interdisciplinary and diverse teams

- apply their academic expertise in cooperation with people from other subject areas, and jointly define problems and find solutions to them

General competence

The student gains experience with interdisciplinary or industrial project work and the process leading to the completion of the project done by a team of diverse individuals, including planning, carrying out part of the work, reporting, presenting, and reflecting on possible issues.

Content

In this course, the students will complete an interdisciplinary project carried out together with a team composed by students from all the specialisations, or in collaboration with one of our partners in the private or public sector.

The project's topic is chosen in collaboration with a supervisor and shall, as a general rule, tackle a complex real-world problem faced by today's digital society. Teams will be required to leverage their collective skills and contribute with their specific expertise in their specialisation areas to effectively collaborate and contribute towards the solution to the project challenges.

In case of a project in collaboration with a private or public partner, the student(s) and the company have to prepare a draft project description that must be endorsed by the faculty before the work starts. This is done to ensure necessary volume and depth in the project. In addition, an agreement between the student and the company must be made.

Forms of teaching and learning

Practical project team-work with regular supervision. Students will be working in groups of 4-8 students. In case of industrial projects, the groups can be smaller. In such case, an external mentor from the collaborating partner has to be identified, in addition to the internal supervisor.

Workload

Approx. 280 hours.

Coursework requirements - conditions for taking the exam

The student must deliver:

- a project description within two weeks after starting the project
- a mid-term report

Examination

Paper and oral presentation in groups

The paper (approx. 10 pages) is graded on the A - F grading scale. It is given a tentative grade of the paper. This grade can be adjusted at the oral presentation. The papers are submitted for the whole group. The students will get an individual grade. The paper must be passed before the oral presentation can be carried out.

The group presentation consists of a presentation and discussion of the paper. Duration approx. 20-30 min with questions from the examiners. Except the presentation, no supporting materials are allowed. The students will get an individual grade.

If the student decides to challenge the assessment, the paper must be re-assessed. If the new assessment affects the tentative grading of the paper, a new oral exam will be arranged.

Examiners

External and internal examiner, or to internal examiners.

Conditions for resit/rescheduled exams

Upon re-examination, both parts of the examination must be retaken. Upon re-examination, a new project must be carried out.

Course evaluation

This course is evaluated by a

- Mid-term evaluation (compulsory)

The responsible for the course compiles a report based on the feedback from the students and his/her own experience with the course. The report is discussed by the study quality committee at the Department of Computer Science and Communication.

Literature

The [current reading list for 2024 Spring](#) can be found in Leganto

Last updated from FS (Common Student System) July 17, 2024 12:15:39 AM

ITI42622 Complex Systems Modelling and Optimization (Spring 2025)

Facts about the course

ECTS Credits:
10

Responsible department:
**Faculty of Computer Science,
Engineering and Economics**

Campus:
Halden

Course Leader:
Stefano Nichele

Teaching language:
English

Duration:
½ year

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The course is connected to the following study programs

Elective course in Master in Applied Computer Science. Full-time and part-time.

Recommended requirements

- Background in computer science or engineering
- Programming skills

Lecture Semester

Second semester (spring) in the full-time programme.

Fourth semester (spring) in the part-time programme.

The student's learning outcomes after completing the course

Knowledge

The student

- has a solid understanding of complex systems theory and modelling, including cellular automata, network, and agent-based models
- has knowledge on how to use optimization methods to program complex systems to produce a wanted behavior, in particular using biologically inspired methods
- has a clear understanding of key concepts in complex systems such as emergence, self-organization, adaptation, evolution.
- can relate underlying concepts and general principles from different complex systems

Skills

The student is able to

- model and analyse complex systems using cellular automata, networks and agent-based models
- program complex systems and optimize them using biologically inspired tools
- design and implement evolutionary methods

General competence

The student:

- has theoretical and practical understanding of complex systems modelling
- can understand and discuss relevance, strength and limitations of complex systems models and biologically inspired optimization methods
- is able to work in relevant research projects

Content

One of the challenges in our digitalized society is to model and predict the behavior of the complex systems that surround us. Complex systems are systems made of a large set of components interacting locally and giving rise to an emergent behavior without centralized control. Complex systems are all around us, for example social networks, the neurons in the brain, an artificial neural network, the stock market, the weather, a smart city, a biological ecosystem, virus spread, and many more.

This course will introduce different complex systems models, such as cellular automata, networks, and agent-based models, and how to program and use them to model real world system. Methods for programming complex systems models will include an introduction to biologically inspired optimization methods (such as artificial evolution).

Forms of teaching and learning

The course consists of lectures and seminars on techniques and methods, as well as a project to be carried out individually or in groups of 2-3 students. The project will be chosen from a portfolio of available problems. The students must submit both code and a project report.

Workload

Approx. 280 hours.

Examination

Project (individual or in groups of 2-3 students) and individual oral exam

The exam is divided into two parts:

- 50% of the grade based on the project. All students in the group will share the same grade.
- The individual oral exam (50%) is based on the course curriculum. Duration approx. 20-30 min. No supporting materials are allowed.

Grading scale A - F in both parts. Both parts of the exam must be passed to pass the course. The student will get an individual joint grade for the entire course.

Examiners

One external and one internal examiner, or two internal examiners will be involved in the assessment.

Conditions for resit/rescheduled exams

Upon re-examination, each part of the examination can be retaken. Upon re-examination, a new project must be carried out.

Course evaluation

This course is evaluated by a:

- Final course evaluation (compulsory)

The responsible for the course compiles a report based on the feedback from the students and his/her own experience with the course. The report is discussed by the study quality committee at the Department of Computer Science and Communication.

Literature

Pensum for vil komme i Leganto

Last updated from FS (Common Student System) July 17, 2024 12:15:40 AM

ITI60020 Digital Fabrication and Making (Spring 2025)

Facts about the course

ECTS Credits:
10

Responsible department:
**Faculty of Computer Science,
Engineering and Economics**

Campus:
Halden

Course Leader:
Fahad Faisal Said

Teaching language:
English

Duration:
½ year

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The course is connected to the following study programs

Elective course in the master programme in applied computer science full-time and part-time.

There must be at least 7 students to run the course.

Lecture Semester

Second semester (spring) in the full-time programme.

Fourth semester (spring) in the part-time programme.

The student's learning outcomes after completing the course

Knowledge

By participating in the theoretical modules, the student learns to:

- identify and describe the central principals of digital fabrication.
- understand and reflect on the maker movement and its impact on society.
- analyse and assess methods and techniques for digital fabrication in relation to prototyping and product development.

Skills

The student is able to:

- independently translate an idea into a prototype using digital fabrication techniques.
- critical assess what types of digital fabrication technologies are appropriate in new domains.

- analyse technical and organizational limitations of digital fabrication.
- document digital fabrication processes in a way appropriate for sharing and collaborating.

General competence

The student gains:

- competence in critical reading and reflection.
- group-work skills.

Content

In this course, key phenomena and concepts in the field of digital fabrication are introduced and analysed. The course presents digital fabrication from two perspectives: digital fabrication technologies and the maker movement. The technological perspective is based on hands-on activities and project work to familiarize students with technologies and processes for developing physical prototypes including additive and subtractive production technologies and electronics. The perspective on maker movement discusses digital fabrication in terms of enabling sustainable and democratizing practices for the digital society. The course will include invited speakers working and researching in the field of digital fabrication and making.

Presented technologies include, but not limited to:

- Modelling for digital fabrication
- 3D printing
- Laser cutting and engraving
- CNC machining
- Electronics programming and production

Forms of teaching and learning

The course consists of project work and theoretical modules. The following methods are used:

- Project Work
- Laboratories and workshops
- Reading Circle
- Lectures
- Supervision

The course is hands-on and practical, and it is expected that students work on their own and in groups.

Workload

Approx. 280 hours.

Coursework requirements - conditions for taking the exam

The student must during the semester:

- present at least one item from the reading list (individually or in groups of 2-3 students).
- complete up to 4 mandatory projects (individually or in groups of 2-3 students) handed in at predefined dates by the course responsible

Coursework requirements must be accepted to qualify for the exam.

Examination

Prototype and poster session with oral presentation (individually or in groups of 2-3 students)

The students need to develop a prototype from project work. The students are given an individual tentative grade on the prototype using the A - F grading scale. This grade can be adjusted at the poster session / oral presentation.

The poster session with oral presentation is carried out at the course exhibition. Duration of oral presentation is approx.15-20 min. Except the presentation, no supporting materials are allowed. An individual grade will be given.

The prototype must be passed before the poster session with oral presentation can be carried out.

All group members must contribute to the prototype and poster session with oral presentation.

If the student decides to challenge the assessment, the prototype must be re-assessed. If the new assessment affects the tentative grading of the prototype, a new poster session with oral presentation will be arranged.

Examiners

One external and one internal examiner, or two internal examiners will be involved in the assessment.

Conditions for resit/rescheduled exams

Upon re-examination, both parts of the examination must be retaken.

Course evaluation

This course is evaluated by a

- Final course evaluation (compulsory)

The responsible for the course compiles a report based on the feedback from the students and his/her own experience with the course. The report is discussed by the study quality committee

at the Department of Computer Science and Communication.

Literature

The [current reading list for 2024 Spring](#) can be found in Leganto

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