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

Study Plan for Master in Applied Computer Science, part-time (120 ECTS) (2024–2028)

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 Master in Applied Computer Science.

Students that are admitted to the specialisation in Internet of Things (IoT) will also have the right to use the protected title **sivilingeniør** after graduation.

The additional title **sivilingeniør** will be stated in the diploma.

Learning outcomes

Knowledge

For all specialisations, the candidate:

- has thorough knowledge of scientific methods used within the field of applied computer science.
- is able to apply computer science knowledge and understanding to new and unfamiliar settings.
- is able to analyse scientific problems within applied computer science and relate this to the history and role of applied computer science in the society.

For the specialisation in artificial intelligence, the candidate:

- possesses advanced knowledge about literature and methods used within the field of applied computer science, especially within the area of artificial intelligence.
- has specialized insight and good understanding of the research and development in applied computer science, especially within the area of artificial intelligence.

For the specialisation in cyber security, the candidate:

- possesses advanced knowledge about literature and methods used within the field of applied computer science, especially within the area of cyber security.
- has specialized insight and good understanding of the research and development in applied computer science, especially within the area of cyber security.

For the specialisation interaction design, the candidate:

- possesses advanced knowledge about literature and methods used within the field of applied computer science, especially within the area of interaction design.

- has specialized insight and good understanding of the research and development in applied computer science, especially within the area of interaction design.

For the specialisation in Internet of Things, the candidate:

- possesses advanced knowledge about literature and methods used within the field of applied computer science, especially within the area of cyber physical systems and internet of things.
- has specialized insight and good understanding of the research and development in applied computer science, especially within the area of cyber physical systems and internet of things.

Skills

The candidate:

- is able to collect and analyse relevant information with emphasis on source criticism and use them to structure and develop academic arguments.
- is able to analyse existing theories, methods and interpretations and independently challenge established knowledge and practice with regards to applied computer science.
- is, in an independent manner, able to use relevant and suitable methods when carrying out research and development activities.
- is able to plan and complete an independent and limited research or development project under supervision and in adherence to research ethics.

General competence

The candidate:

- is able to communicate academic issues, analyses, and conclusions, with specialists in the field and to the public, in writing as well as orally.
- can present research and results from extensive independent work clearly and unambiguous within the field of applied computer science.
- is capable of critical reflection on the ethical challenges within the field of applied computer science.
- is able to utilize gained knowledge and skills to carry out new advanced tasks and projects.

- has retained and further developed his/her academic curiosity, knowledge, openness and precision, and are able to use this to contribute to innovative thinking and innovation processes.

Admission

Requirements for specialisation in Artificial Intelligence

The minimum academic requirements for admission are:
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 computer science, of which at least 20 ECTS credits must be in programming
- at least 3 ECTS credits in algorithms
- at least 3 ECTS credits in statistics
- at least 3 ECTS credits in mathematics

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

Requirements for specialisation in Interaction Design

The minimum academic requirements for admission are:
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 computer science, of which at least 20 ECTS credits must be in programming
- at least 3 ECTS credits in human computer interaction

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

Requirements for specialisation in Cyber Security

The minimum academic requirements for admission are:
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 computer science, of which at least 20 ECTS credits must be in programming
- at least 3 ECTS credits in cyber security

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

Requirements for specialisation in Internet of Things

The minimum academic requirements for admission are:
A bachelor's degree in engineering, or an equivalent education of at least 180 ECTS credits, and in addition, or included:

- at least 80 ECTS credits in computer science, of which at least 20 ECTS credits must be in programming
- at least 25 ECTS credits in mathematics
- at least 7,5 ECTS credits in physics
- at least 5 ECTS credits in statistics

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

For all specialisations:

English language requirement:

1. Passed the subject English at a Norwegian upper secondary school (140 hours) and been awarded an average grade of 3 or better, or

2. International English Language Test Service (IELTS), with a minimum overall band score of 6.0 (academic test), or

3. Test of English as a Foreign Language (TOEFL), HiØ code 6240 with a minimum score of 550 (paper-based), 213 (computer-based), or 80 (internet-based), or

4. Pearson PTE Academic test, with a minimum overall score of 58, or

5. Cambridge ESOL Examinations, First Certificate in English with a grade of B or better, Certificate in Advanced English or Certificate of Proficiency in English, or

6. Completed university degree in the subject English language or literature, or

7. Completed bachelor's degree taught in English from Australia, Canada, Ireland, New Zealand, the UK, or the USA (the degree must have been physically taught in one of these countries), or

8. Other approved documentation of English language tests may be subject to an individual and discretionary assessment.

Structure and content

The structure and content of the programme

In the first and second semester, students take three courses from their chosen specialisations. The four specialisations are:

- 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

In addition to traditional lectures and seminars, students learn through:

- Project work
- Lab exercises
- Workshops
- Reading circles
- Quizzes
- Supervision
- Student presentations
- Student-led seminars
- Plenary discussions
- Colloquium
- Self-study

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.

The department has several lab facilities that are used in the master courses:

- Makerspace
- Digital Fabrication Lab
- VR Lab
- CPS Lab
- Robotics Lab
- Machine Learning Cluster
- Data Security Lab

These labs are used directly in teaching activities, and to carry out compulsory requirements and student projects. The labs are available for all students and employees 24 hours, 7 days a week.

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`s programme is based on research activities at the department, but it 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.

The department also offers possibilites to obtain a double degree with another university in Europe. More specific information can be found on the programme`s webpage.

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 1-2 semesters 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

A master's degree in Applied Computer Science provides opportunities for leading positions within application development, web development, consulting and project management in 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.

A master's degree also qualifies for PhD-studies in Norway and abroad. Different admission requirements may apply at different universities. Østfold University College offers a Phd-programme in digitalisation and society. More information about the programme and admission requirements can be found on our webpage.

The study plan is approved and revised

The study plan is approved

Dean Harald Holone, 1st of March 2023

The study plan is revised

Head of Department, Monica Kristiansen Holone, 27th of November 2023

The study plan applies to

The programme description applies to the period 2024-2028 (master’s programme starting in Autumn 2024)

Programme Coordinator

Faculty of Computer Science, Engineering and Economics.
Head of Department Monica Kristiansen Holone

Study model

Autumn 2024

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 2025

Choose specialisation to view courses

Autumn 2025

Choose specialisation to view courses

Spring 2026

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 2026

Choose specialisation to view courses

Spring 2027

Choose specialisation to view courses

Autumn 2027

Choose specialisation to view courses

Spring 2028

Choose specialisation to view courses

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Emner som ikke er tatt med

Emnesiden finne ikke

- ITI41020 2025h
- ITI42622 2026v
- ITI60020 2026v
- ITI41120 2026v
- ITI54020 2026h

ITI41720 Machine Learning and Deep Learning (Autumn 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 specialisations in artificial intelligence, cyber security and internet of things, full-time and part-time.

Lecture Semester

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

First, third and seventh semster 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
- Introduction to transformers and large language models
- Recurrent neural nets, including state space models
- Convolutional neural nets
- Architecture search

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 tree 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

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 of the faculty of Computer Sciences.

Literature

The current reading list for 2024 Autumn can be found in Leganto

Last updated from FS (Common Student System) July 18, 2024 12:15:28 AM

ITI41222 Evolutionary Computation (Autumn 2024)

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.

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
- 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 one individual oral presentation after submitting the announced exercises. During the oral presentation, the student must explain the implementation details of the submissions and demonstrate a certain level of efficiency for the submitted solutions 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

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.

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ITI41520 Interaction Design (Autumn 2024)

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

Compulsory course in the Master`s programme in Applied Computer Science with specialisation in interaction design, full-time and part-time.

Lecture Semester

1th 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

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

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ITI41322 Interaction Design Experiments (Autumn 2024)

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

Compulsory course in the Master`s programme in Applied Computer Science with specialisation in interaction design, full-time and part-time.

Lecture Semester

1th 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 an empirical 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 2 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

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

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ITI41920 Automation, Adaptation and IoT (Autumn 2024)

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

Compulsory course in the Master`s programme in Applied Computer Science with specialisation in internet of things, full-time and part-time.

Lecture Semester

1th 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 6 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

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

Last updated from FS (Common Student System) July 18, 2024 12:15:29 AM

ITI42122 Cyber Security Governance (Autumn 2024)

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.

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 three assignments.

- a security governance plan 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. All group members must contribute to the plan.

Coursework requirements must be accepted to qualify for the exam.

Examination

The exam is divided into two parts:

- An individual oral presentation of the security governance plan (50%). Duration approx. 5-10 min. Except the presentation, no supporting materials are allowed.
- An individual oral exam (50%) based on the course curriculum. Duration approx. 10-20 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 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 Autumn can be found in Leganto

Last updated from FS (Common Student System) July 18, 2024 12:15:29 AM

ITI41820 Advanced Topics in Machine Learning (Spring 2025)

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

Compulsory course in the Master`s programme in Applied Computer Science with specialisation in artificial intelligence, full-time and part-time.

Recommended requirements

ITI41720 Machine Learning

Lecture Semester

2nd 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

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 in agreement with the course instructor.

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

Last updated from FS (Common Student System) July 18, 2024 12:15:34 AM

ITI41620 Design for Cooperation (Spring 2025)

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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- Literature

The course is connected to the following study programs

Compulsory course in the Master`s programme in Applied Computer Science with specialisation in interaction design, full-time and part-time.

Recommended requirements

ITI41520 Interaction Design

Lecture Semester

2nd 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 co-designing IT solutions in support of such cooperative practices

Skills:

The student is able to

- use methods, tools, and techniques for co-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 Computer-Supported Cooperative Work (CSCW) and Participatory Design (PD)

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.

Additionally, the course introduces the students to Participatory Design (PD), a design approach focused on user involvement in the design of technologies meant for them.

The course gives and overview of the principles of PD and introduces the students to a toolbox of methods, tools and techniques that they can use to enable democratic design practices in the design of IT solutions for 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 and PD

- central theories and concepts in CSCW and PD

- methods, tools and techniques for co-designing support for cooperative practices

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 and submitted 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

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 Spring can be found in Leganto

Last updated from FS (Common Student System) July 18, 2024 12:15:33 AM

ITI42020 Models and Digital Twins for the Internet of Things (Spring 2025)

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. The requirements of these concurrent systems are specified e. g. as sequence diagrams, and it is emphasized that the requirements and design must be consistent. The models are seen as "Digital Twins", and it is shown how they are useful in theory and practice, and how their evolution should be managed.

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

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

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

Last updated from FS (Common Student System) July 18, 2024 12:15:34 AM

ITI42220 Cybersecurity Risk Management and Incident Response (Spring 2025)

Facts about the course

ECTS Credits:
10

Responsible department:
Faculty of Computer Science, Engineering and Economics

Campus:
Halden

Course Leaders:
- **André Alexandersen Hauge**
- **Vikash Katta**

Teaching language:
English

Duration:
½ year

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- Literature

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

Fundamentals of cyber security.

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 differences between security concerns in information technology and operational technology settings
- has a good overview of industry best practices and guidelines for managing cybersecurity risks
- can apply approaches and methods to identify, analyse and evaluate cybersecurity threats
- has a general knowledge of how cyber events are detected and responded to in an realistic operational environment

Skills

The student is able to

- apply industry guidelines for managing cybersecurity risk in industrial settings
- perform security risk analysis on realistic systems
- gain awareness on how various cyber incidents are handled

General competence

The student gets hands-on experience in assessing and managing cybersecurity risks, and gains knowledge on cyber event detection and response in a realistic operational setting.

Content

- Introduction to Information Technology and Operational Technology systems security
- Threat and vulnerability assessment
- Operational cyber event detection and response

Forms of teaching and learning

Teaching will be based on blended learning approaches. There will be lectures and lab exercises on the topics of the course in a weekly or bi-weekly basis. Lab exercises will be performed in collaboration with the Institute for Energy Technology's Cybersecurity Centre.

Workload

Approx. 280 hours.

Coursework requirements - conditions for taking the exam

The student must deliver a report on the case study

Coursework requirements must be accepted to qualify for the exam.

Examination

Individual oral exam and a report on case study.

The exam is divided into two parts:

Individual oral exam (50%) is based on the course curriculum. Duration approximately 30 min. No supporting materials allowed.

Report on a selected case study (50%). The case study is chosen by the course responsible. The case study will be performed and reported in groups of three-four students. 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 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.

Course evaluation

This course is evaluated by a:

- Final couse 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

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