



# Programme syllabus

Master's Programme, Computer Science, 120 credits

Masterprogram, datalogi

*120.0 credits*

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*Valid for students admitted to the education from autumn 19 (HT - Autumn term; VT - Spring term).*

This is a translation of the Swedish, legally binding, programme syllabus.

## Programme objectives

The aim of the Master's programme is to provide a broad education in Computer Science with the possibility of deepening and specializing within the area of computer science, the method science for construction of computer programmes including theoretical foundations as well as the practical ability to develop products and systems which include computers and software.

The programme will provide the students with the requisites and abilities to participate and lead work within evaluation, development and implementation of new technology within the field of computer science.

In addition to this comes the Higher Education Ordinance goal for Master's degree.

## Knowledge and understanding

The objective of the program is to provide the student with deepened knowledge within computer science and engineering,

The programme will also provide students with advanced knowledge, including understanding of the methodology and the scientific perspective, within an area of computer science.

## Skills and abilities

The objective of the programme is to provide the student with:

- a good analytical problem solving ability,
- the ability to independently define and solve construction problems within computer science,
- the requisites and abilities to participate in and develop practices implemented in industry, maintenance and academic research,

- the requisites for successful work in international and interdisciplinary project groups which include engineers and non-engineers. This goal includes abilities in oral and written presentation and argumentation in Swedish and English.

## **Ability to make judgements and adopt a standpoint**

The objective of the programme is that the student should:

- be able to evaluate the quality of scientific studies and show a reflective and critical approach to scientific and non-scientific texts,
- through self-development, retain his/her own professional ability during a professional career,
- follow the discussion about technology in society and contribute to it.

Beyond this, there are similar goals for the Master of Science in Engineering programme which are defined by the higher education ordinance.

## **Extent and content of the programme**

The programme is in the second cycle and comprises 120 ECTS credits, which, at normal study rate, corresponds to two years. The programme is given in English, but some elective courses are given in Swedish.

One of the following tracks must be chosen:

- Data Science
- Interaction Design
- Cognitive Systems
- Software Technology
- Theoretical Computer Science
- Scientific Computing
- Visualization and Interactive Graphics
- Security and Privacy

Under special circumstances and individual track can be approved by the programme director.

## **Eligibility and selection**

General admission requirements, and the special admission requirements must be fulfilled in order to be admitted:

- **Mathematics:** three different subjects of a total of 22,5 credits. Among those subjects there must be a course in one-variabel calculus, a course in linear algebra and a course in discrete structures.
- **Computer Science/Information technology:** three different subjects of a total of 22.5 credits. Among those subjects there must be a course in object oriented programming, a course in algorithms and data structures and a course in computational complexity.
- A course in Calculus in Several Variable is required to some of the tracks.

Selection process:

If the number of applicants exceeds the number of places available a programme committee will make a selection from the following criterias:

1. Evaluation of university
2. Grades from previous study
3. Motivation to study

The evaluation scale is 1-75.

## **Implementation of the education**

### **Structure of the education**

Each academic year consists of two semesters which are 20 weeks each, and each semester is further divided into two study periods.

During the first study year, compulsory courses are taken, a total of 30 ECTS credits.

Beside the compulsory courses the students must follow a track in the computer science master. The track consist of 30 ECTS credits of compulsory or conditionally elective courses which will deepen the knowledge in a field of computer science.

A Programme Integrating Course, 2 hp, spread over two years is also compulsory for the programme.

The programme is concluded by a degree project comprising 30 ECTS credits.

Other courses are elective.

### **Courses**

The programme is course-based. Lists of courses are included in [appendix 1](#).

After each course a student evaluation is performed and then analyzed by the course leader in the course analysis document, which is normally published on the web.

### **Grading system**

Courses in the first and the second cycle are graded on a scale from A to F. A-E are passing grades, A is the highest grade. The grades pass (P) and fail (F) are used for courses under certain circumstances.

The grading scale is found in the course syllabus.

### **Conditions for participation in the programme**

Participation requires admission to courses within the programme, and course registration.

For further studies, special admission requirements for the course are to be fulfilled. Special admission requirements are listed in the respective course syllabus.

## **Degree project**

The degree project is the final part of the education. The project work may begin when special admission requirements for the course are fulfilled.

## **Degree**

Master of Science

### **Requirements for the Degree of Master of Science (Two Years)**

After completing the programme, the student may apply for the degree. The programme is designed so that students, when they graduate, have fulfilled the national requirements for a degree. This means that the students have completed courses comprising 120 ECTS credits, of which at least 90 ECTS credits are second cycle, and at least 60 ECTS credits (including a 30 ECTS credits degree project) constitute indepth studies in the main field of study.

[Appendix 1 - Course list](#)

[Appendix 2 - Programme syllabus descriptions](#)



# Appendix 1: Course list

Programme syllabus for studies starting in autumn 2019, Master's Programme, Computer Science, 120 credits (TCSCM)

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## General courses

### Year 1

#### Mandatory courses (32.0 Credits)

Code	Name	Credits	Edu. level
<a href="#">DA2210</a>	<a href="#">Introduction to the Philosophy of Science and Research Methodology for Computer Scientists</a>	6.0 hp	Second cycle
<a href="#">DD2300</a>	<a href="#">Program Integrating Course in Computer Science</a> <i>One credit each academic year</i>	2.0 hp	Second cycle
<a href="#">DD2380</a>	<a href="#">Artificial Intelligence</a>	6.0 hp	Second cycle
<a href="#">DD2395</a>	<a href="#">Computer Security</a>	6.0 hp	Second cycle
<a href="#">DD2440</a>	<a href="#">Advanced Algorithms</a>	6.0 hp	Second cycle
<a href="#">IK2218</a>	<a href="#">Protocols and Principles of the Internet</a>	6.0 hp	Second cycle

#### Supplementary information

Students from CTFYS or CINTE, KTH, who miss the equivalent courses in previous degree are also required to take:

- DD2350 Algorithms, Data Structures and Complexity 9,5 credits *or* DD2352 Algorithms and Complexity 7.5 cr.
- SF1662 Discrete Mathematics 7,5 cr, SF1610 Discrete Mathematics, 7,5 cr. *or* SF1679 Discrete Mathematics 7.5 cr.

The course ID2200 Operating system 6 hp is compulsory for students from CDATE, who started 2011 or earlier.

The course DM2573 Sustainability and Media Technology 7.5 credits is compulsory for studenter from CMETE.

The course IK2218 Protocols and Principles of the Internet. should be replaced by an elective course, of at least 6 cr. for students from CINTE.

## Year 2

### Mandatory courses (32.0 Credits)

Code	Name	Credits	Edu. level
<a href="#">DA231X</a>	<a href="#">Degree Project in Computer Science and Engineering, Second Cycle</a>	30.0 hp	Second cycle
<a href="#">DD2300</a>	<a href="#">Program Integrating Course in Computer Science</a> <i>One credit each academic year</i>	2.0 hp	Second cycle

### Supplementary information

Students from CTFYS or CINTE, KTH, who miss the equivalent courses in previous degree are also required to take:

- DD2350 Algorithms, Data Structures and Complexity 9,5 credits *or* DD2352 Algorithms and Complexity 7.5 cr.
- SF1662 Discrete Mathematics 7,5 cr, SF1610 Discrete Mathematics, 7,5 cr. *or* SF1679 Discrete Mathematics 7.5 cr.

The course ID2200 Operating system 6 hp is compulsory for students from CDATE, who started 2011 or earlier.

The course DM2573 Sustainability and Media Technology 7.5 credits is compulsory for studenter from CMETE.

The course IK2218 Protocols and Principles of the Internet. should be replaced by an elective course, of at least 6 cr. for students from CINTE.

## Track, Cognitive Systems (CSCS)

### Year 1

#### Mandatory courses (7.5 Credits)

Code	Name	Credits	Edu. level
<a href="#">DD2421</a>	<a href="#">Machine Learning</a>	7.5 hp	Second cycle

#### Conditionally elective courses

Code	Name	Credits	Edu. level
<a href="#">DD2418</a>	<a href="#">Language Engineering</a> <i>Conditionally elective for the subtrack Conversational systems</i>	6.0 hp	Second cycle
	<a href="#">Deep Learning in Data Science</a>		Second

<a href="#">DD2424</a>	<i>Compulsory for the subtrack Vision and robotics, Conditionally elective for the subtrack Conversational systems</i>	7.5 hp	cycle
<a href="#">DT2112</a>	<a href="#">Speech Technology</a> <i>Conditionally elective for the subtrack Conversational systems</i>	7.5 hp	Second cycle
<a href="#">DT2119</a>	<a href="#">Speech and Speaker Recognition</a> <i>Conditionally elective for the subtrack Conversational systems</i>	7.5 hp	Second cycle

### Recommended courses

Code	Name	Credits	Edu. level
<a href="#">DD2429</a>	<a href="#">Computational Photography</a>	6.0 hp	Second cycle
<a href="#">DD2434</a>	<a href="#">Machine Learning, Advanced Course</a>	7.5 hp	Second cycle
<a href="#">DD2438</a>	<a href="#">Artificial Intelligence and Multi Agent Systems</a>	15.0 hp	Second cycle
<a href="#">DD2447</a>	<a href="#">Statistical Methods in Applied Computer Science</a>	6.0 hp	Second cycle
<a href="#">DD2476</a>	<a href="#">Search Engines and Information Retrieval Systems</a>	9.0 hp	Second cycle
<a href="#">DT1130</a>	<a href="#">Spectral Transforms</a>	7.5 hp	First cycle
<a href="#">DT2410</a>	<a href="#">Audio Technology</a>	7.5 hp	Second cycle
<a href="#">EL2320</a>	<a href="#">Applied Estimation</a>	7.5 hp	Second cycle
<a href="#">SF2940</a>	<a href="#">Probability Theory</a>	7.5 hp	Second cycle

### Supplementary information

**Prerequisites:** SF1626 Multivariate Calculus, 7,5 credits (or equivalent).

The student should choose one of the subtrack with following mandatory courses:

- Vision and Robotics:**  
DD2410, DD2423, DD2424.
- Conversational system:**  
Conditionally elective courses: DT2112 och DT2119 (one must be chosen), and choose at least 7,5 credits from: DD2424, DD2437, DT2140, DD2418, in addition, read: DT2150 (*to be replaced Autumn20 by DT2151*).

*Subject to changes.*

## Year 2

### Mandatory courses (32.0 Credits)

Code	Name	Credits	Edu. level
<a href="#">DA231X</a>	<a href="#">Degree Project in Computer Science and Engineering, Second Cycle</a>	30.0 hp	Second cycle
<a href="#">DD2300</a>	<a href="#">Program Integrating Course in Computer Science</a>	2.0 hp	Second cycle

### Conditionally elective courses

Code	Name	Credits	Edu. level
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<a href="#">DD2410</a>	<a href="#">Introduction to Robotics</a> <i>Compulsory for the subtrack Vision and robotics</i>	7.5 hp	Second cycle
<a href="#">DD2423</a>	<a href="#">Image Analysis and Computer Vision</a> <i>Compulsory for the subtrack Vision and robotics</i>	7.5 hp	Second cycle
<a href="#">DD2437</a>	<a href="#">Artificial Neural Networks and Deep Architectures</a> <i>Conditionally elective for the subtrack Conversational systems</i>	7.5 hp	Second cycle
<a href="#">DT2140</a>	<a href="#">Multimodal Interaction and Interfaces</a> <i>Conditionally elective for the subtrack Conversational systems</i>	7.5 hp	Second cycle
<a href="#">DT2151</a>	<a href="#">Project in Conversational Systems</a> <i>Compulsory for the subtrack Conversational systems</i>	7.5 hp	Second cycle

## Recommended courses

Code	Name	Credits	Edu. level
<a href="#">DD2418</a>	<a href="#">Language Engineering</a>	6.0 hp	Second cycle
<a href="#">DD2434</a>	<a href="#">Machine Learning, Advanced Course</a>	7.5 hp	Second cycle
<a href="#">DD2438</a>	<a href="#">Artificial Intelligence and Multi Agent Systems</a>	15.0 hp	Second cycle
<a href="#">DD2447</a>	<a href="#">Statistical Methods in Applied Computer Science</a>	6.0 hp	Second cycle
<a href="#">DD2476</a>	<a href="#">Search Engines and Information Retrieval Systems</a>	9.0 hp	Second cycle
<a href="#">DT2410</a>	<a href="#">Audio Technology</a>	7.5 hp	Second cycle
<a href="#">EL2320</a>	<a href="#">Applied Estimation</a>	7.5 hp	Second cycle
<a href="#">SF1861</a>	<a href="#">Optimization</a>	6.0 hp	First cycle
<a href="#">SF2940</a>	<a href="#">Probability Theory</a>	7.5 hp	Second cycle

## Supplementary information

**Prerequisites:** SF1626 Multivariate Calculus, 7,5 credits (or equivalent).

The student should choose one of the subtrack with following mandatory courses:

- Vision and Robotics:**  
DD2410, DD2423, DD2424.
- Conversational system:**  
Conditionally elective courses: DT2112 och DT2119 (one must be chosen), and choose at least 7,5 credits from: DD2424, DD2437, DT2140, DD2418, in addition, read: DT2151 (*replaces DT2150 from Autumn20*).

*Subject to changes.*

## Track, Data Science (CSDA)

### Year 1

#### Mandatory courses (7.5 Credits)



Code	Name	Credits	Edu. level
<a href="#">DD2421</a>	<a href="#">Machine Learning</a>	7.5 hp	Second cycle

### Conditionally elective courses

Code	Name	Credits	Edu. level
<a href="#">DD2418</a>	<a href="#">Language Engineering</a> <i>Compulsory for the subtrack Natural Language Processing</i>	6.0 hp	Second cycle
<a href="#">DD2420</a>	<a href="#">Probabilistic Graphical Models</a> <i>Conditionally elective for the subtrack Machine learning</i>	7.5 hp	Second cycle
<a href="#">DD2424</a>	<a href="#">Deep Learning in Data Science</a> <i>Compulsory for the subtrack Machine Learning</i>	7.5 hp	Second cycle
<a href="#">DD2476</a>	<a href="#">Search Engines and Information Retrieval Systems</a> <i>Compulsory for the subtrack Natural Language Processing</i>	9.0 hp	Second cycle

### Recommended courses

Code	Name	Credits	Edu. level
<a href="#">DD2438</a>	<a href="#">Artificial Intelligence and Multi Agent Systems</a>	15.0 hp	Second cycle
<a href="#">DH2320</a>	<a href="#">Introduction to Visualization and Computer Graphics</a>	6.0 hp	Second cycle
<a href="#">DH2321</a>	<a href="#">Information Visualization</a>	6.0 hp	Second cycle
<a href="#">DT2112</a>	<a href="#">Speech Technology</a>	7.5 hp	Second cycle
<a href="#">DT2119</a>	<a href="#">Speech and Speaker Recognition</a>	7.5 hp	Second cycle

### Supplementary information

**Prerequisites:** SF1626 Multivariate Calculus, 7,5 credits (or equivalent).

One of the subtracks must be chosen:

#### 1. Machine Learning:

- Mandatory course: DD2424.
- Conditionally elective courses (one of the courses must be chosen): DD2434, DD2437, DD2420.

#### 2. Natural Language Processing:

Mandatory courses: DD2476 and DD2418.

#### 3. Bioinformatics:

Mandatory course: SF2940.

*Subject to changes.*

## Year 2

### Mandatory courses (39.5 Credits)

Code	Name	Credits	Edu. level
<a href="#">DA231X</a>	<a href="#">Degree Project in Computer Science and Engineering, Second Cycle</a>	30.0 hp	Second cycle
<a href="#">DD2300</a>	<a href="#">Program Integrating Course in Computer Science</a>	2.0 hp	Second cycle
<a href="#">DD2430</a>	<a href="#">Project Course in Data Science</a>	7.5 hp	Second cycle

### Conditionally elective courses

Code	Name	Credits	Edu. level
<a href="#">DD2434</a>	<a href="#">Machine Learning, Advanced Course</a> <i>Conditionally elective for the subtrack Machine learning</i>	7.5 hp	Second cycle
<a href="#">DD2437</a>	<a href="#">Artificial Neural Networks and Deep Architectures</a> <i>Conditionally elective for the subtrack Machine learning</i>	7.5 hp	Second cycle
<a href="#">SF2940</a>	<a href="#">Probability Theory</a> <i>Compulsory for the subtrack Bioinformatics</i>	7.5 hp	Second cycle

### Recommended courses

Code	Name	Credits	Edu. level
<a href="#">DD2257</a>	<a href="#">Visualization</a>	7.5 hp	Second cycle
<a href="#">DD2419</a>	<a href="#">Project Course in Robotics and Autonomous Systems</a>	9.0 hp	Second cycle
<a href="#">DD2423</a>	<a href="#">Image Analysis and Computer Vision</a>	7.5 hp	Second cycle
<a href="#">DD2447</a>	<a href="#">Statistical Methods in Applied Computer Science</a>	6.0 hp	Second cycle
<a href="#">EL2320</a>	<a href="#">Applied Estimation</a>	7.5 hp	Second cycle
<a href="#">SF1811</a>	<a href="#">Optimization</a>	6.0 hp	First cycle

### Supplementary information

**Prerequisites:** SF1626 Multivariate Calculus, 7,5 credits (or equivalent).

One of the subtracks must be chosen:

#### 1. Machine Learning:

- Mandatory course: DD2424.
- Conditionally elective courses (one of the courses must be chosen): DD2434, DD2437, DD2420.

#### 2. Natural Language Processing:

Mandatory courses: DD2476 and DD2418.

#### 3. Bioinformatics:

Mandatory course: SF2940.

*Subject to changes.*

## Track, Interaction Design (CSID)

## Year 1

### Mandatory courses (15.0 Credits)

Code	Name	Credits	Edu. level
<a href="#">DH2628</a>	<a href="#">Interaction Design Methods</a>	7.5 hp	Second cycle
<a href="#">DH2629</a>	<a href="#">Interaction Design as a Reflective Practice</a>	7.5 hp	Second cycle

### Conditionally elective courses

Code	Name	Credits	Edu. level
<a href="#">DH2321</a>	<a href="#">Information Visualization</a>	6.0 hp	Second cycle
<a href="#">DH2400</a>	<a href="#">Physical Interaction Design and Realization</a>	7.5 hp	Second cycle
<a href="#">DH2632</a>	<a href="#">Human-Computer Interaction, Research Seminars</a>	3.0 hp	Second cycle
<a href="#">DH2642</a>	<a href="#">Interaction Programming and the Dynamic Web</a>	7.5 hp	Second cycle

### Recommended courses

Code	Name	Credits	Edu. level
<a href="#">DM2518</a>	<a href="#">Mobile Development with Web Technologies</a>	7.5 hp	Second cycle

### Supplementary information

In total, at least 15 credits from the conditionally elective courses must be taken during study year 1-2.

*Subject to changes.*

## Year 2

### Mandatory courses (32.0 Credits)

Code	Name	Credits	Edu. level
<a href="#">DA231X</a>	<a href="#">Degree Project in Computer Science and Engineering, Second Cycle</a>	30.0 hp	Second cycle
<a href="#">DD2300</a>	<a href="#">Program Integrating Course in Computer Science</a>	2.0 hp	Second cycle

### Conditionally elective courses

Code	Name	Credits	Edu. level
<a href="#">DH2408</a>	<a href="#">Evaluation Methods in Human-Computer Interaction</a>	6.0 hp	Second cycle
<a href="#">DH2413</a>	<a href="#">Advanced Graphics and Interaction</a>	9.0 hp	Second cycle
<a href="#">DM2630</a>	<a href="#">User Experience Design and Evaluation</a>	9.0 hp	Second cycle
<a href="#">DT2140</a>	<a href="#">Multimodal Interaction and Interfaces</a>	7.5 hp	Second cycle

### Recommended courses

Code	Name	Credits	Edu. level
<a href="#">DM2518</a>	<a href="#">Mobile Development with Web Technologies</a>	7.5 hp	Second cycle

### Supplementary information

At least 15 credits from the conditionally elective courses must be taken during study year 1-2.

*Subject to changes.*

## Track, Scientific Computing (CSSC)

### Year 1

#### Mandatory courses (15.0 Credits)

Code	Name	Credits	Edu. level
<a href="#">DD2356</a>	<a href="#">Methods in High Performance Computing</a>	7.5 hp	Second cycle
<a href="#">DD2363</a>	<a href="#">Methods in Scientific Computing</a>	7.5 hp	Second cycle

#### Conditionally elective courses

Code	Name	Credits	Edu. level
<a href="#">DD2365</a>	<a href="#">Advanced Computation in Fluid Mechanics</a>	7.5 hp	Second cycle

#### Recommended courses

Code	Name	Credits	Edu. level
<a href="#">DD2401</a>	<a href="#">Neuroscience</a>	7.5 hp	Second cycle
<a href="#">DD2421</a>	<a href="#">Machine Learning</a>	7.5 hp	Second cycle
<a href="#">DD2443</a>	<a href="#">Parallel and Distributed Computing</a>	7.5 hp	Second cycle
<a href="#">DH2320</a>	<a href="#">Introduction to Visualization and Computer Graphics</a>	6.0 hp	Second cycle
<a href="#">DT2212</a>	<a href="#">Music Acoustics</a>	7.5 hp	Second cycle
<a href="#">EL2820</a>	<a href="#">Modelling of Dynamical Systems</a>	7.5 hp	Second cycle
<a href="#">HL2008</a>	<a href="#">Simulation Methods in Medical Engineering</a>	7.5 hp	Second cycle

### Supplementary information

**Prerequisites:** SF1626 Multivariate Calculus, 7,5 credits.

Conditionally elective courses (*one* must be taken): DD2437, DD2257, DD2365.

*Subject to changes.*

### Year 2

## Mandatory courses (39.5 Credits)

Code	Name	Credits	Edu. level
<a href="#">DA231X</a>	<a href="#">Degree Project in Computer Science and Engineering, Second Cycle</a>	30.0 hp	Second cycle
<a href="#">DD2300</a>	<a href="#">Program Integrating Course in Computer Science</a>	2.0 hp	Second cycle
<a href="#">DD2444</a>	<a href="#">Project Course in Scientific Computing</a>	7.5 hp	Second cycle

## Conditionally elective courses

Code	Name	Credits	Edu. level
<a href="#">DD2257</a>	<a href="#">Visualization</a>	7.5 hp	Second cycle
<a href="#">DD2437</a>	<a href="#">Artificial Neural Networks and Deep Architectures</a>	7.5 hp	Second cycle

## Recommended courses

Code	Name	Credits	Edu. level
<a href="#">BB2280</a>	<a href="#">Molecular Modeling</a>	7.5 hp	Second cycle
<a href="#">DD2360</a>	<a href="#">Applied GPU Programming</a>	7.5 hp	Second cycle
<a href="#">DD2402</a>	<a href="#">Advanced Individual Course in Computational Biology</a>	6.0 hp	Second cycle
<a href="#">DD2421</a>	<a href="#">Machine Learning</a>	7.5 hp	Second cycle
<a href="#">DD2435</a>	<a href="#">Mathematical Modelling of Biological Systems</a>	9.0 hp	Second cycle
<a href="#">EL2820</a>	<a href="#">Modelling of Dynamical Systems</a>	7.5 hp	Second cycle
<a href="#">SF2561</a>	<a href="#">The Finite Element Method</a>	7.5 hp	Second cycle
<a href="#">SF2565</a>	<a href="#">Program Construction in C++ for Scientific Computing</a>	7.5 hp	Second cycle

## Supplementary information

**Prerequisites:** SF1626 Multivariate Calculus, 7,5 credits.

Conditionally elective courses (*one* must be taken): DD2437, DD2257, DD2365.

*Subject to changes.*

## Track, Security and Privacy (CSSP)

### Year 1

#### Mandatory courses (7.5 Credits)

Code	Name	Credits	Edu. level
<a href="#">DD2520</a>	<a href="#">Applied Cryptography</a>	7.5 hp	Second cycle

#### Conditionally elective courses

Code	Name	Credits	Edu. level
<a href="#">DD2448</a>	<a href="#">Foundations of Cryptography</a>	7.5 hp	Second cycle
<a href="#">DD2525</a>	<a href="#">Language-Based Security</a>	7.5 hp	Second cycle

### Recommended courses

Code	Name	Credits	Edu. level
<a href="#">DD2460</a>	<a href="#">Software Safety and Security</a>	7.5 hp	Second cycle
<a href="#">EN2720</a>	<a href="#">Ethical Hacking</a>	7.5 hp	Second cycle
<a href="#">EP2520</a>	<a href="#">Building Networked Systems Security</a>	7.5 hp	Second cycle
<a href="#">EP2790</a>	<a href="#">Security Analysis of Large-Scale Computer Systems</a>	7.5 hp	Second cycle
<a href="#">ID2218</a>	<a href="#">Design of Fault-tolerant Systems</a>	7.5 hp	Second cycle

### Supplementary information

#### Mandatory course:

DD2520 Applied Cryptography, 7,5 hp.

#### Conditionally elective courses:

- at least *two* must be taken of following: DD2448, DD2525, DD2496, DD2443, and also
- at least *one* must be taken of following: DD2497, EP2510.

#### Recommended elective courses:

DD2460, EN2720, ID2218, EP2520, EP2790.

## Year 2

### Mandatory courses (32.0 Credits)

Code	Name	Credits	Edu. level
<a href="#">DA231X</a>	<a href="#">Degree Project in Computer Science and Engineering, Second Cycle</a>	30.0 hp	Second cycle
<a href="#">DD2300</a>	<a href="#">Program Integrating Course in Computer Science</a>	2.0 hp	Second cycle

### Conditionally elective courses

Code	Name	Credits	Edu. level
<a href="#">DD2443</a>	<a href="#">Parallel and Distributed Computing</a>	7.5 hp	Second cycle
<a href="#">DD2496</a>	<a href="#">Privacy Enhancing Technologies</a>	7.5 hp	Second cycle
<a href="#">DD2497</a>	<a href="#">Project course in System Security</a>	7.5 hp	Second cycle
<a href="#">EP2510</a>	<a href="#">Advanced Networked Systems Security</a>	7.5 hp	Second cycle

### Recommended courses

Code	Name	Credits	Edu. level
<a href="#">EN2720</a>	<a href="#">Ethical Hacking</a>	7.5 hp	Second cycle

[EP2790 Security Analysis of Large-Scale Computer Systems](#) 7.5 hp Second cycle

### Supplementary information

#### Mandatory course:

DD2520 Applied Cryptography, 7,5 hp.

#### Conditionally elective courses:

- at least *two* must be taken of following: DD2448, DD2525, DD2496, DD2443, and also
- at least *one* must be taken of following: DD2497, EP2510.

## Track, Software Technology (CSST)

### Year 1

#### Mandatory courses (7.5 Credits)

Code	Name	Credits	Edu. level
<a href="#">DD2480</a>	<a href="#">Software Engineering Fundamentals</a>	7.5 hp	Second cycle

#### Conditionally elective courses

Code	Name	Credits	Edu. level
<a href="#">DD2372</a>	<a href="#">Automata and Languages</a> <i>Conditionally elective for the subtrack Programming Languages</i>	6.0 hp	Second cycle
<a href="#">DD2459</a>	<a href="#">Software Reliability</a> <i>Conditionally elective for the subtrack Software Engineering</i>	7.5 hp	Second cycle
<a href="#">DD2460</a>	<a href="#">Software Safety and Security</a> <i>Conditionally elective for the subtrack Software Engineering</i>	7.5 hp	Second cycle
<a href="#">DD2481</a>	<a href="#">Principles of Programming Languages</a> <i>Mandatory for the subtrack Programming Languages, conditionally elective for the subtrack Software Engineering</i>	7.5 hp	Second cycle
<a href="#">DD2482</a>	<a href="#">Automated Software Testing and DevOps</a> <i>Conditionally elective for the subtrack Software Engineering</i>	7.5 hp	Second cycle

#### Recommended courses

Code	Name	Credits	Edu. level
<a href="#">DD2421</a>	<a href="#">Machine Learning</a>	7.5 hp	Second cycle
<a href="#">DD2458</a>	<a href="#">Problem Solving and Programming under Pressure</a>	9.0 hp	Second cycle
<a href="#">DD2476</a>	<a href="#">Search Engines and Information Retrieval Systems</a>	9.0 hp	Second cycle
<a href="#">ID1217</a>	<a href="#">Concurrent Programming</a>	7.5 hp	First cycle

### Supplementary information

One of the two subtracks must be taken:

### 1. Programming Languages

- Mandatory courses: DD2481 and DD2488.
- Conditionally elective courses (one of the courses must be taken): DD2372, DD2457.

### 2. Software Engineering

- Conditionally elective courses (at least two must be taken): DD2443, DD2459, DD2460, DD2481, DD2482, DD2528.
- Conditionally elective courses (at least one must be taken): DD2487, DD2497.

## Year 2

### Mandatory courses (32.0 Credits)

Code	Name	Credits	Edu. level
<a href="#">DA231X</a>	<a href="#">Degree Project in Computer Science and Engineering, Second Cycle</a>	30.0 hp	Second cycle
<a href="#">DD2300</a>	<a href="#">Program Integrating Course in Computer Science</a>	2.0 hp	Second cycle

### Conditionally elective courses

Code	Name	Credits	Edu. level
<a href="#">DD2443</a>	<a href="#">Parallel and Distributed Computing</a> <i>Conditionally elective for the subtrack Software Engineering</i>	7.5 hp	Second cycle
<a href="#">DD2457</a>	<a href="#">Program Semantics and Analysis</a> <i>Conditionally elective for the subtrack Software Engineering</i>	6.0 hp	Second cycle
<a href="#">DD2487</a>	<a href="#">Large-Scale Software Development</a> <i>Conditionally elective for the subtrack Software Engineering</i>	7.5 hp	Second cycle
<a href="#">DD2488</a>	<a href="#">Compiler Construction</a> <i>Compulsory for the subtrack Programming languages</i>	9.0 hp	Second cycle
<a href="#">DD2497</a>	<a href="#">Project course in System Security</a> <i>Conditionally elective for the subtrack Software Engineering</i>	7.5 hp	Second cycle

### Recommended courses

Code	Name	Credits	Edu. level
<a href="#">DD2421</a>	<a href="#">Machine Learning</a>	7.5 hp	Second cycle
<a href="#">DD2458</a>	<a href="#">Problem Solving and Programming under Pressure</a>	9.0 hp	Second cycle
<a href="#">DD2476</a>	<a href="#">Search Engines and Information Retrieval Systems</a>	9.0 hp	Second cycle
<a href="#">ID1217</a>	<a href="#">Concurrent Programming</a>	7.5 hp	First cycle

### Supplementary information

One of the two subtracks must be taken:



## 1. Programming Languages

- Mandatory courses: DD2481 and DD2488.
- Conditionally elective courses (one of the courses must be taken): DD2372, DD2457.

## 2. Software Engineering

- Conditionally elective courses (at least two must be taken): DD2443, DD2459, DD2460, DD2481, DD2482.
- Conditionally elective courses (at least one must be taken): DD2487, DD2497.

# Track, Theoretical Computer Science (CSTC)

## Year 1

### Conditionally elective courses

Code	Name	Credits	Edu. level
<a href="#">DD2372</a>	<a href="#">Automata and Languages</a> <i>Conditionally elective for the subtrack Formal Methods and Semantics</i>	6.0 hp	Second cycle
<a href="#">DD2448</a>	<a href="#">Foundations of Cryptography</a> <i>Compulsory for the subtrack Algorithms, Complexity and Cryptography; Conditionally elective for the subtrack Formal Methods and Semantics</i>	7.5 hp	Second cycle
<a href="#">DD2459</a>	<a href="#">Software Reliability</a> <i>Conditionally elective for the subtrack Formal Methods and Semantics</i>	7.5 hp	Second cycle
<a href="#">DD2460</a>	<a href="#">Software Safety and Security</a> <i>Conditionally elective for the subtrack Formal Methods and Semantics</i>	7.5 hp	Second cycle

### Recommended courses

Code	Name	Credits	Edu. level
<a href="#">DD2447</a>	<a href="#">Statistical Methods in Applied Computer Science</a>	6.0 hp	Second cycle
<a href="#">DD2458</a>	<a href="#">Problem Solving and Programming under Pressure</a>	9.0 hp	Second cycle
<a href="#">ID1217</a>	<a href="#">Concurrent Programming</a>	7.5 hp	First cycle

### Supplementary information

#### Mandatory courses for all:

- DD2467 Individual Project in Theoretical Computer Science, 7,5 credits,
- SF2xxx, any course in Mathematics, second cycle, 7,5 credits.

#### One of the subtracks must be taken:

##### 1. Algorithms, Complexity and Cryptography:

- Mandatory course: DD2448.
- Conditionally elective courses (at least one of the courses must be taken): DD2445, DD2442.

## 2. Formal Methods and Semantics:

- Mandatory course: DD2452.
- Conditionally elective courses (at least 7,5 credits must be taken): DD2459, DD2448, DD2457, DD2460, DD2372, DD2443, DD2442, DD2445 (ges vartannat år)..

## Year 2

### Mandatory courses (39.5 Credits)

Code	Name	Credits	Edu. level
<a href="#">DA231X</a>	<a href="#">Degree Project in Computer Science and Engineering, Second Cycle</a>	30.0 hp	Second cycle
<a href="#">DD2300</a>	<a href="#">Program Integrating Course in Computer Science</a>	2.0 hp	Second cycle
<a href="#">DD2467</a>	<a href="#">Individual Project in Theoretical Computer Science</a>	7.5 hp	Second cycle

### Conditionally elective courses

Code	Name	Credits	Edu. level
<a href="#">DD2442</a>	<a href="#">Seminars on Theoretical Computer Science</a> <i>Conditionally elective for the subtrack Algorithms, Complexity and Cryptography; Conditionally elective for the subtrack Formal Methods and Semantics</i>	7.5 hp	Second cycle
<a href="#">DD2443</a>	<a href="#">Parallel and Distributed Computing</a> <i>Conditionally elective for the subtrack Formal Methods and Semantics</i>	7.5 hp	Second cycle
<a href="#">DD2452</a>	<a href="#">Formal Methods</a> <i>Compulsory for the subtrack Formal Methods and Semantics</i>	7.5 hp	Second cycle
<a href="#">DD2457</a>	<a href="#">Program Semantics and Analysis</a> <i>Conditionally elective for the subtrack Formal Methods and Semantics</i>	6.0 hp	Second cycle

### Recommended courses

Code	Name	Credits	Edu. level
<a href="#">DD2447</a>	<a href="#">Statistical Methods in Applied Computer Science</a>	6.0 hp	Second cycle
<a href="#">DD2458</a>	<a href="#">Problem Solving and Programming under Pressure</a>	9.0 hp	Second cycle
<a href="#">ID1217</a>	<a href="#">Concurrent Programming</a>	7.5 hp	First cycle

### Supplementary information

#### Mandatory courses for all:

- DD2467 Individual Project in Theoretical Computer Science, 7,5 credits,
- SF2xxx, any course in Mathematics, second cycle, 7,5 credits.

#### One of the subtracks must be taken:

## 1. Algorithms, Complexity and Cryptography:

- Mandatory course: DD2448.
- Conditionally elective courses (at least one of the courses must be taken): DD2445, DD2442.

## 2. Formal Methods and Semantics:

- Mandatory course: DD2452.
- Conditionally elective courses (at least 7,5 credits must be taken): DD2459, DD2448, DD2457, DD2460, DD2372, DD2443, DD2442.

# Track, Visualization and Interactive Graphics (CSVG)

## Year 1

### Mandatory courses (6.0 Credits)

Code	Name	Credits	Edu. level
<a href="#">DH2320</a>	<a href="#">Introduction to Visualization and Computer Graphics</a>	6.0 hp	Second cycle

### Conditionally elective courses

Code	Name	Credits	Edu. level
<a href="#">DD2257</a>	<a href="#">Visualization</a>	7.5 hp	Second cycle
<a href="#">DH2321</a>	<a href="#">Information Visualization</a>	6.0 hp	Second cycle
<a href="#">DH2323</a>	<a href="#">Computer Graphics and Interaction</a>	6.0 hp	Second cycle
<a href="#">DH2413</a>	<a href="#">Advanced Graphics and Interaction</a>	9.0 hp	Second cycle
<a href="#">DH2650</a>	<a href="#">Computer Game Design</a>	6.0 hp	Second cycle

### Recommended courses

Code	Name	Credits	Edu. level
<a href="#">DD2356</a>	<a href="#">Methods in High Performance Computing</a>	7.5 hp	Second cycle
<a href="#">DD2423</a>	<a href="#">Image Analysis and Computer Vision</a>	7.5 hp	Second cycle
<a href="#">DD2424</a>	<a href="#">Deep Learning in Data Science</a>	7.5 hp	Second cycle
<a href="#">DD2429</a>	<a href="#">Computational Photography</a>	6.0 hp	Second cycle
<a href="#">DM2350</a>	<a href="#">Human Perception for Information Technology</a>	7.5 hp	Second cycle

### Supplementary information

At least 18 credits must be taken from the conditionally elective courses.

## Year 2

### Mandatory courses (38.0 Credits)

<b>Code</b>	<b>Name</b>	<b>Credits</b>	<b>Edu. level</b>
<a href="#">DA231X</a>	<a href="#">Degree Project in Computer Science and Engineering, Second Cycle</a>	30.0 hp	Second cycle
<a href="#">DD2300</a>	<a href="#">Program Integrating Course in Computer Science</a>	2.0 hp	Second cycle
<a href="#">DD2470</a>	<a href="#">Advanced Topics in Visualization and Computer Graphics</a>	6.0 hp	Second cycle

### Conditionally elective courses

<b>Code</b>	<b>Name</b>	<b>Credits</b>	<b>Edu. level</b>
<a href="#">DD2257</a>	<a href="#">Visualization</a>	7.5 hp	Second cycle
<a href="#">DH2321</a>	<a href="#">Information Visualization</a>	6.0 hp	Second cycle
<a href="#">DH2323</a>	<a href="#">Computer Graphics and Interaction</a>	6.0 hp	Second cycle
<a href="#">DH2413</a>	<a href="#">Advanced Graphics and Interaction</a>	9.0 hp	Second cycle
<a href="#">DH2650</a>	<a href="#">Computer Game Design</a>	6.0 hp	Second cycle

### Recommended courses

<b>Code</b>	<b>Name</b>	<b>Credits</b>	<b>Edu. level</b>
<a href="#">DD2356</a>	<a href="#">Methods in High Performance Computing</a>	7.5 hp	Second cycle
<a href="#">DD2423</a>	<a href="#">Image Analysis and Computer Vision</a>	7.5 hp	Second cycle
<a href="#">DD2424</a>	<a href="#">Deep Learning in Data Science</a>	7.5 hp	Second cycle
<a href="#">DM2350</a>	<a href="#">Human Perception for Information Technology</a>	7.5 hp	Second cycle

### Supplementary information

At least 18 credits must be taken from the conditionally elective courses.



## Appendix 2: Specialisations

Programme syllabus for studies starting in autumn 2019, Master's Programme, Computer Science, 120 credits (TCSCM)

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### **Track, Cognitive Systems (CSCS)**

The track in cognitive systems is about developing applications with artificial intelligence, ie, abilities traditionally associated with humans. In the specialization you can choose to specialize towards robotics or towards speech and music.

### **Track, Data Science (CSDA)**

Our society produce huge amounts of data. This specialization involves methods for managing and analyzing data from various sources, such as biomolecular sequence data, images and video, text, etc.

### **Track, Interaction Design (CSID)**

Students learn to develop interactive systems with modern development methodology. The specialization also aims to provide deeper knowledge of how to systematically evaluate interactive systems.

### **Track, Scientific Computing (CSSC)**

This specialization focuses on the techniques of mathematical modeling and numerical simulation of physical, chemical and biological systems. This can be the basis for virtual experiments that simulated crash tests, but also to build interactive virtual environments, i.e. for computer games.

### **Track, Security and Privacy (CSSP)**

This track is about the theory and practice of security, ranging from concepts to implementation, at different layers (hardware, network, system, application) and foundations (cryptography, formal methods, systems).

### **Track, Software Technology (CSST)**

Software Engineering is about methods to create and maintain different types of software.

### **Track, Theoretical Computer Science (CSTC)**

Theoretical Computer Science is about the abstract and mathematical methods to study algorithms. Students learn to use formal methods and focus on verifiable properties of software and software systems.

## **Track, Visualization and Interactive Graphics (CSVG)**

This specialization stretches from basic visualization and graphics to modern research in the field. Visualization is mainly about making large and complex data understandable with the help of graphics, but has applications in computer games and other virtual environments.