Programme syllabus

Master's Programme, Computer Science, 120 credits
Masterprogram, datalogi
120.0 credits

Valid for students admitted to the education from autumn 16 (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 possiblity 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 program 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 program 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 program 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.

The programme currently offers specializations within:

Data Science

High Performance Computing

Interaction Design

Cognitive Systems

Software Technology

Theoretical Computer Science

Scientific Computing

Visualization and Interactive Graphics

The students also have the possibility to define an individual track which must be approved by the programme director.

Eligibility and selection

General Admission Requirements: See KTHs admission requirements for Master’s Programmes, link below.

Special Admission Requirements:

The minimum criterias are that the following must be in the bachelor degree

- 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 multivariate analysis is required to follow the tracks Data analysis, Cognitive systems and Scientific computing.

The specific requirements may be considered as not fulfilled if the applicant's average grades are in the lower third of the grading scaleof the applicant graduate university (over the approved level). For example, below C for a university with grades A-F

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
4. merit rating
5. references
6. proficiency in English

The evaluation scale is 1-75.

KTH regulations: http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/

Implementation of the education

Structure of the education

Structure of the education

This programme syllabus decided by the CSC dean 2015-09-17 is valid for students starting the programme during the study year 2016/2017. Which courses that belong a study year is decided in the fall the year before. Please see ”Study year 1” etc. or the appendices. Changes may occur in the contents of the programme and in the KTH regulations, please see www.kth.se/en/student.

The KTH academic year is 40 weeks, divided into four periods.

For details about the structure of the academic year see http://www.kth.se/en/student/schema/

During the first study year, five compulsory courses are taken, totaling 30 ECTS credits.

Beside the compulsory courses, 30 ECTS credits are required in advanced courses within a specific area of computer science. These must either be part of a recommended specialisation or compiled by the student, but in the latter case, the course selection must be approved by the programme coordinator. Within each specialisation, courses can be freely chosen but considering prerequisites, or, in certain cases, places available. A Program 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.

The course goals, prerequisites, contents and examination requirements are found in the course syllabus in the Course and program directory on the KTH student web. For each study year there is a course list.

For elective courses, the following restrictions apply:

- The number of credits that can be chosen per semester can be limited.
- Elective courses may not overlap a course already taken to a considerable extent.
- Courses on lower levels within a subject than the programme courses may not count as elective courses.

Courses are examined in many ways, for example by home assignments that are presented either using oral presentations or written reports, computer assignments, project work or traditional written exams.

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, see the KTH regulations of course analysis: http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/kursanalys

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.

Since the grading systems differ very much between different countries, the grades are not translated from exchange studies abroad.

Conditions for participation in the programme

Term enrollment

At the start of each semester the student is required to make a study enrollment for the next semester at the Personal menu at www.kth.se

The study enrollment is required for taking new courses and for study results to be registered.

Selection of track is done according to instructions from the CSC school.

Selection of courses

The student is required to apply for admission to all courses he/she wishes to take during the next semester. The student is responsibe for having the recommended prerequisites. The application for admission to a course is done according to instructions from the CSC education administration office no later than

- May 15th for the fall semester
- November 15th for the spring semester

Applications made after this date are only granted if there are vacancies in the courses. Applications to language courses with prerequisites should be preceded by a qualification test.

In a few courses, the number of participants is limited. Selection is done by the school responsible for the course and the criteria is published on the course web page.

A student may only take courses that are included in the study plan.

Course registration

The student must, at course start, register for each course. Course registration for compulsory as well as elective courses must be done individually. If the student registers for a course and then decides to not continue, the student must remove the registration within three weeks via the personal menu. If the student fail to do this the course must be completed.

Registration to a course requires formal acceptance to the course (by the school responsible for the course). Applications should be done according to instructions from the CSC school.

Promotion to second year

At least 45 ECTS credits have to be completed during the first academic year in order for the student to be promoted to the second year of the program.

Students who do not fulfill these requirements must – in cooperation with the CSC program office – make an individual study plan for continued studies.

Please see the KTH regulations: http://intra.kth.se/en/regelverk/utbildning-forskning/grundutbildning/

Recognition of previous academic studies

Credits for studies at another university can be transferred. An application form can be found on the KTH Student pages.

The application form is submitted to the CSC program office.

For in-depth information about the KTH policy for credit transfer, see http://intra.kth.se/en/regelverk/utbildning-forskning/grundutbildning/prestationer/1.27200

Studies abroad

Students of the program have the possibility to spend one or two semesters of study at a foreign university through agreements KTH has with universities within and outside the EU. It is also possible to make the final degree project abroad.

For more information contact the international coordinator at CSC.

More information can be found on the KTH student web and at http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/utbytesstudier

Degree project

An individual study in the form of a degree project corresponding to 30 ECTS credits is included in the program.

It is the responsibility of the student to find a suitable project task.

More information about the rules for degree projects at KTH can be found at http://intra.kth.se/en/regelverk/utbildning-forskning/grundutbildning/examensarbete/

For students on a Master of science of engineering program not only the requirements set by the selected Master program to begin the degree project apply but also the requirements from the Master of science of engineering program.

Degree

After completing the programme, the student may apply for the degree "Teknologie Masterexamen", translated to English "Master of Science".

Information on the application process can be found on the KTH Student pages.

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

The Degree of Master of Science (Two Years) is obtained after completion of the program. The program 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.

See also the KTH regulations http://intra.kth.se/en/regelverk/utbildning-forskning/grundutbildning/examina/

Appendix 1: Course list

Programme syllabus for studies starting in autumn 2016, Master's Programme, Computer Science, 120 credits (TCSCM)

General courses

Year 1

Mandatory courses (32.0 Credits)

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

Supplementary information

Students from CTFYS or CINTE who miss the equivalent courses in previous degree are also required to take:
- DD1352 Algorithms, Data Structures and Complexity 9 credits or DD2352 Algorithms and Complexity 7.5 cr.
- SF1630 Discrete Mathematics 9 cr or SF1679 Discrete Mathematics 7.5 cr.

Year 2

Mandatory courses (62.0 Credits)

Code	Name	Credits	Edu. level

DA221X	Degree Project in Computer Science and Communication, Second Cycle *Only available for students enrolled at a Master programme at CSC*	30.0 hp	Second cycle
DA222X	Degree Project in Computer Science and Communication, Second Cycle *Only available for students enrolled in an engineering programme at KTH and a Master programme at CSC*	30.0 hp	Second cycle
DD2300	Program Integrating Course in Computer Science *One credit each academic year*	2.0 hp	Second cycle

Supplementary information

Students from CTFYS or CINTE 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.
- SF1630 Discrete Mathematics 9 cr or SF1679 Discrete Mathematics 7.5 cr.

Track, Cognitive Systems (CSCS)

Year 1

Mandatory courses (6.0 Credits)

Code	Name	Credits	Edu. level
DD2431	Machine Learning	6.0 hp	Second cycle

Conditionally elective courses

Code	Name	Credits	Edu. level
DD2424	Deep Learning in Data Science	7.5 hp	Second cycle
DT2112	Speech Technology *Compulsory for the subtrack Speech and Music.*	7.5 hp	Second cycle
DT2119	Speech and Speaker Recognition *Conditionally elective for the subtrack Speech and Music*	7.5 hp	Second cycle
DT2213	Musical Communication and Music Technology *Conditionally elective for the subtrack Speech and Music*	7.5 hp	Second cycle
EQ2340	Pattern Recognition	7.5 hp	Second cycle

Recommended courses

Code	Name	Credits	Edu. level
DD2418	Language Engineering	6.0 hp	Second cycle
DD2423	Image Analysis and Computer Vision	7.5 hp	Second cycle
DD2429	Computational Photography	6.0 hp	Second cycle
DD2434	Machine Learning, Advanced Course	7.5 hp	Second cycle
DD2438	Artificial Intelligence and Multi Agent Systems	15.0 hp	Second cycle

DD2447	Statistical Methods in Applied Computer Science	6.0 hp	Second cycle
DD2476	Search Engines and Information Retrieval Systems	9.0 hp	Second cycle
DT1130	Spectral Transforms	7.5 hp	First cycle
DT2140	Multimodal Interaction and Interfaces	7.5 hp	Second cycle
DT2350	Human Perception for Information Technology	6.0 hp	Second cycle
DT2410	Audio Technology	7.5 hp	Second cycle
EL2320	Applied Estimation	7.5 hp	Second cycle
EQ2320	Speech Signal Processing	6.0 hp	Second cycle
SF2940	Probability Theory	7.5 hp	Second cycle

Supplementary information

The student choose one of the subtrack:

1) Computer Vision and robotics

2) Speech and Music

At least 16,5 credits must be taken from the conditionally elective courses from year one or year two.

Conditionally elective courses from year 1, subtrack Computer vision and Robotics:

DD2424 Deep Learning in data Science

DT2112 Speech Technology

EQ2340 Pattern Recognition

Conditionally elective courses from year 1, subtrack Speech and Music:

DD2424 Deep Learning in data Science

DT2119 Speech and Speaker Recognition

DT2213 Musical Communication and Music Technology

EN2202 Pattern Recognition

Subject to changes.

Year 2

Conditionally elective courses

Code	Name	Credits	Edu. level
DD2423	Image Analysis and Computer Vision *Compulsory for the subtrack Computer vision and Robotics.*	7.5 hp	Second cycle

DD2425	Robotics and Autonomous Systems *Conditionally elective for the subtrack Computer vision and Robotics.*	9.0 hp	Second cycle
DD2429	Computational Photography *Conditionally elective for the subtrack Computer vision and Robotics.*	6.0 hp	Second cycle
DD2434	Machine Learning, Advanced Course	7.5 hp	Second cycle
DD2438	Artificial Intelligence and Multi Agent Systems *Conditionally elective for the subtrack Computer vision and Robotics.*	15.0 hp	Second cycle
DD2447	Statistical Methods in Applied Computer Science	6.0 hp	Second cycle
DM2350	Human Perception for Information Technology	7.5 hp	Second cycle
DT2410	Audio Technology *Conditionally elective for the subtrack Speech and Music.*	7.5 hp	Second cycle
EL2320	Applied Estimation	7.5 hp	Second cycle
EQ2340	Pattern Recognition	7.5 hp	Second cycle

Recommended courses

Code	Name	Credits	Edu. level
DD2418	Language Engineering	6.0 hp	Second cycle
DD2476	Search Engines and Information Retrieval Systems	9.0 hp	Second cycle
DT2140	Multimodal Interaction and Interfaces	7.5 hp	Second cycle
EQ2321	Speech and Audio Processing	7.5 hp	Second cycle
SF2940	Probability Theory	7.5 hp	Second cycle

Supplementary information

At least 16,5 credits of the conditionally elective courses must be taken in year 1 or year 2.

Condtionally elective courses, Subtrack, Computer Vision and Robotics:

DD2425 Robotics and Autonomous Systems 9.0

DD2429 Computational Photography 6.0

DD2434 Machine Learning, Advanced Course 7.5

DD2438 Artificial Intelligence and Multi Agent Systems 15.0

DD2447 Statistical Methods in Applied Computer Science 6.0

DM2350 Human Perception for Information Technology 7,5

EL2320 Applied Estimation 7.5

EN2202 Pattern Recognition 7.5

Condtionally elective courses, Subtrack, Speech and Music:

DD2423 Image Analysis and Computer Vision 7.5

DD2434 Machine Learning, Advanced Course 7.5

DD2447 Statistical Methods in Applied Computer Science 6.0

DT2350 Human Perception for Information Technology 6.0

DT2410 Audio Technology 7.5

EL2320 Applied Estimation 7.5

EN2202 Applied Estimation7.5

Track, Data Science (CSDA)

Year 1

Mandatory courses (6.0 Credits)

Code	Name	Credits	Edu. level
DD2431	Machine Learning	6.0 hp	Second cycle

Conditionally elective courses

Code	Name	Credits	Edu. level
DD2432	Artificial Neural Networks and Other Learning Systems	6.0 hp	Second cycle
DD2471	Modern Database Systems and Their Applications	7.5 hp	Second cycle
DD2476	Search Engines and Information Retrieval Systems	9.0 hp	Second cycle
EQ2340	Pattern Recognition	7.5 hp	Second cycle

Recommended courses

Code	Name	Credits	Edu. level
DD2423	Image Analysis and Computer Vision	7.5 hp	Second cycle
DD2424	Deep Learning in Data Science	7.5 hp	Second cycle
DD2425	Robotics and Autonomous Systems	9.0 hp	Second cycle
DD2429	Computational Photography	6.0 hp	Second cycle
DD2438	Artificial Intelligence and Multi Agent Systems	15.0 hp	Second cycle
DT2112	Speech Technology	7.5 hp	Second cycle
DT2119	Speech and Speaker Recognition	7.5 hp	Second cycle
EL2320	Applied Estimation	7.5 hp	Second cycle

Supplementary information

At least 16,5 credits from the conditionally elective courses from year 1 and year 2 must be taken.

Year 2

Mandatory courses (7.5 Credits)

Code	Name	Credits	Edu. level
DD2434	Machine Learning, Advanced Course	7.5 hp	Second cycle

Conditionally elective courses

Code	Name	Credits	Edu. level
DD2404	Applied Bioinformatics	7.5 hp	Second cycle
DD2418	Language Engineering	6.0 hp	Second cycle
DD2447	Statistical Methods in Applied Computer Science	6.0 hp	Second cycle
SF1811	Optimization	6.0 hp	First cycle
SF2940	Probability Theory	7.5 hp	Second cycle

Recommended courses

Code	Name	Credits	Edu. level
DD2423	Image Analysis and Computer Vision	7.5 hp	Second cycle
DD2424	Deep Learning in Data Science	7.5 hp	Second cycle
DD2425	Robotics and Autonomous Systems	9.0 hp	Second cycle
DD2429	Computational Photography	6.0 hp	Second cycle
DD2438	Artificial Intelligence and Multi Agent Systems	15.0 hp	Second cycle
DT2112	Speech Technology	7.5 hp	Second cycle
DT2119	Speech and Speaker Recognition	7.5 hp	Second cycle
EL2320	Applied Estimation	7.5 hp	Second cycle
EQ2340	Pattern Recognition	7.5 hp	Second cycle

Supplementary information

At least 16,5 credits from the conditionally elective courses from year 1 and year 2 must be taken.

Track, High Performance Computing (CSHP)

Year 1

Mandatory courses (15.0 Credits)

Code	Name	Credits	Edu. level
DD2356	Methods in High Performance Computing	7.5 hp	Second cycle
DD2443	Parallel and Distributed Computing	7.5 hp	Second cycle

Recommended courses

Code	Name	Credits	Edu. level
DD2363	Methods in Scientific Computing	7.5 hp	Second cycle
DD2431	Machine Learning	6.0 hp	Second cycle
DD2432	Artificial Neural Networks and Other Learning Systems	6.0 hp	Second cycle
DD2434	Machine Learning, Advanced Course	7.5 hp	Second cycle
DD2447	Statistical Methods in Applied Computer Science	6.0 hp	Second cycle
EN2500	Information Theory and Source Coding	7.5 hp	Second cycle
EQ1270	Stochastic Signals and Systems	6.0 hp	First cycle
SF1811	Optimization	6.0 hp	First cycle
SF2950	Applied Mathematical Statistics	7.5 hp	Second cycle
SF2955	Computer Intensive Methods in Mathematical Statistics	7.5 hp	Second cycle

Supplementary information

Subjects to changes.

Year 2

Recommended courses

Code	Name	Credits	Edu. level
DD2360	Applied GPU Programming	7.5 hp	Second cycle
DD2421	Machine Learning	7.5 hp	Second cycle
DD2434	Machine Learning, Advanced Course	7.5 hp	Second cycle
DD2437	Artificial Neural Networks and Deep Architectures	7.5 hp	Second cycle
DD2447	Statistical Methods in Applied Computer Science	6.0 hp	Second cycle
EQ1270	Stochastic Signals and Systems	6.0 hp	First cycle
EQ2845	Information Theory and Source Coding	7.5 hp	Second cycle
SF1811	Optimization	6.0 hp	First cycle
SF2955	Computer Intensive Methods in Mathematical Statistics	7.5 hp	Second cycle

Track, Interaction Design (CSID)

Year 1

Mandatory courses (15.0 Credits)

Code	Name	Credits	Edu. level
DH2628	Interaction Design Methods	7.5 hp	Second cycle
DH2629	Interaction Design as a Reflective Practice	7.5 hp	Second cycle

Conditionally elective courses

Code	Name	Credits	Edu. level
DH2400	Physical Interaction Design and Realization	7.5 hp	Second cycle
DH2408	Evaluation Methods in Human-Computer Interaction	6.0 hp	Second cycle
DH2466	Advanced, Individual Course in Human-Computer Interaction	6.0 hp	Second cycle
DH2627	Interaction Design 2	15.0 hp	Second cycle
DH2632	Human-Computer Interaction, Research Seminars	3.0 hp	Second cycle
DH2655	Cooperative IT-design	9.0 hp	Second cycle
DT2140	Multimodal Interaction and Interfaces	7.5 hp	Second cycle
DT2350	Human Perception for Information Technology	6.0 hp	Second cycle

Supplementary information

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

Subject to changes.

Year 2

Conditionally elective courses

Code	Name	Credits	Edu. level
DH2400	Physical Interaction Design and Realization	7.5 hp	Second cycle
DH2408	Evaluation Methods in Human-Computer Interaction	6.0 hp	Second cycle
DH2466	Advanced, Individual Course in Human-Computer Interaction	6.0 hp	Second cycle
DH2627	Interaction Design 2	15.0 hp	Second cycle
DH2632	Human-Computer Interaction, Research Seminars	3.0 hp	Second cycle
DH2655	Cooperative IT-design	9.0 hp	Second cycle
DT2140	Multimodal Interaction and Interfaces	7.5 hp	Second cycle
DT2350	Human Perception for Information Technology	6.0 hp	Second cycle

Supplementary information

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

Subject to changes.

Track, Scientific Computing (CSSC)

Year 1

Mandatory courses (15.0 Credits)

Code	Name	Credits	Edu. level
DD2363	Methods in Scientific Computing	7.5 hp	Second cycle
SF2561	The Finite Element Method	7.5 hp	Second cycle

Recommended courses

Code	Name	Credits	Edu. level
BB2280	Molecular Modeling	7.5 hp	Second cycle
BB2540	Multiscale Modelling in Chemistry and Biology	10.0 hp	Second cycle
DD2365	Advanced Computation in Fluid Mechanics	7.5 hp	Second cycle
DD2398	Quantitative Systems Biology	7.5 hp	Second cycle
DD2401	Neuroscience	7.5 hp	Second cycle
DD2431	Machine Learning	6.0 hp	Second cycle
DD2432	Artificial Neural Networks and Other Learning Systems	6.0 hp	Second cycle
HL2008	Simulation Methods in Medical Engineering	7.5 hp	Second cycle
IF1603	Classical physics, mechanics and waves	7.5 hp	First cycle
SF1811	Optimization	6.0 hp	First cycle
SI2710	Molecular Modelling	7.5 hp	Second cycle

Year 2

Conditionally elective courses

Code	Name	Credits	Edu. level
BB2280	Molecular Modeling	7.5 hp	Second cycle
DD2365	Advanced Computation in Fluid Mechanics	7.5 hp	Second cycle
DD2421	Machine Learning	7.5 hp	Second cycle
DD2435	Mathematical Modelling of Biological Systems	9.0 hp	Second cycle
DD2437	Artificial Neural Networks and Deep Architectures	7.5 hp	Second cycle
EL2820	Modelling of Dynamical Systems	7.5 hp	Second cycle
HL2008	Simulation Methods in Medical Engineering	7.5 hp	Second cycle
SF1811	Optimization	6.0 hp	First cycle
SF2568	Parallel Computations for Large- Scale Problems	7.5 hp	Second cycle
SF2720	Chaotic Dynamical Systems	7.5 hp	Second cycle

Recommended courses

Code	Name	Credits	Edu. level
DD2360	Applied GPU Programming	7.5 hp	Second cycle
DD2401	Neuroscience	7.5 hp	Second cycle
SK1108	Classical physics, mechanics and waves	7.5 hp	First cycle

Supplementary information

At least 15 credits must be taken from the conditionally elective courses

Track, Software Technology (CSST)

Year 1

Mandatory courses (7.5 Credits)

Code	Name	Credits	Edu. level
DD2459	Software Reliability	7.5 hp	Second cycle

Conditionally elective courses

Code	Name	Credits	Edu. level
DD2386	Patterns for Large-scale Development	7.5 hp	Second cycle
DD2448	Foundations of Cryptography *Compulsory for the subtrack Computer Security*	7.5 hp	Second cycle
DD2457	Program Semantics and Analysis	6.0 hp	Second cycle
DD2460	Software Safety and Security *Compulsory for the subtrack Computer Security*	7.5 hp	Second cycle
DD2471	Modern Database Systems and Their Applications	7.5 hp	Second cycle

Recommended courses

Code	Name	Credits	Edu. level
DD2431	Machine Learning	6.0 hp	Second cycle
DD2443	Parallel and Distributed Computing	7.5 hp	Second cycle
DD2458	Problem Solving and Programming under Pressure	9.0 hp	Second cycle
DD2476	Search Engines and Information Retrieval Systems	9.0 hp	Second cycle
EP2500	Networked Systems Security	7.5 hp	Second cycle
EP2510	Advanced Networked Systems Security	7.5 hp	Second cycle
EP2520	Building Networked Systems Security	7.5 hp	Second cycle
ID1217	Concurrent Programming	7.5 hp	First cycle

Supplementary information

Compulsory course, year 1:

DD2459 Software Reliability

One of the following subtracks must be choosen:

1. Programming languages
2. Computer Security

Compulsory courses, subtrack Computer Security:

DD2448 Foundations of Cryptography

DD2460 Software Safety and Security

At least one of the condionally elective courses must be taken in the subtrack Programming languages:

DD2386 Patterns for Large-scale Development 7,5 hp

DD2471 Modern Database Systems and Their Applications 7,5 hp

DD2459 Software Reliability 7,5 hp

DD2460 Software Safety and Security 7,5 hp

At least one of the courses below must be taken in the subtrack Programming languages:

DD2372 Automata and Languages 6,0 hp

DD2457 Program Semantics and Analysis 6,0 hp

Year 2

Conditionally elective courses

Code	Name	Credits	Edu. level
DD2488	Compiler Construction *Compulsory for the subtrack Programming Languages*	9.0 hp	Second cycle
DD2496	Privacy Enhancing Technologies *Conditionally elective for the subtrack Computer Security*	7.5 hp	Second cycle
EP2500	Networked Systems Security *Conditionally elective for the subtrack Computer Security*	7.5 hp	Second cycle

Recommended courses

Code	Name	Credits	Edu. level
DD1388	Program System Construction Using C++	7.5 hp	First cycle
DD1389	Internet Programming	6.0 hp	First cycle
DD2421	Machine Learning	7.5 hp	Second cycle
DD2443	Parallel and Distributed Computing	7.5 hp	Second cycle
DD2458	Problem Solving and Programming under Pressure	9.0 hp	Second cycle
DD2476	Search Engines and Information Retrieval Systems	9.0 hp	Second cycle
EP2510	Advanced Networked Systems Security *Recommended for the subtrack Computer Security*	7.5 hp	Second cycle
EP2520	Building Networked Systems Security	7.5 hp	Second cycle

ID1217	Concurrent Programming	7.5 hp	First cycle

Supplementary information

Subtrack Programming languages:

Compulsory course:

DD2488 Compiler Construction, 9 hp

Subtrack Computer Security:

At least one of the coures must be taken:

DD2496 Privacy-Enhancing Technologies, 7,5 hp

EP2500 Networked Systems Security, 7.5

Track, Theoretical Computer Science (CSTC)

Year 1

Conditionally elective courses

Code	Name	Credits	Edu. level
DD2443	Parallel and Distributed Computing	7.5 hp	Second cycle
DD2448	Foundations of Cryptography *Compulsory for the subtrack Cryptography*	7.5 hp	Second cycle
DD2457	Program Semantics and Analysis	6.0 hp	Second cycle
DD2459	Software Reliability	7.5 hp	Second cycle
DD2460	Software Safety and Security *Compulsory for the subtrack Formal Methods*	7.5 hp	Second cycle
SF2723	Topics in Mathematics III *Conditionally elective course in Mathematics*	7.5 hp	Second cycle
SF2724	Topics in Mathematics IV *Conditionally elective course in Mathematics*	7.5 hp	Second cycle
SF2730	Topics in Mathematics V *Conditionally elective course in Mathematics*	7.5 hp	Second cycle
SF2741	Enumerative Combinatorics *Conditionally elective course in Mathematics*	7.5 hp	Second cycle
SF2940	Probability Theory *Conditionally elective course in Mathematics*	7.5 hp	Second cycle
SF2955	Computer Intensive Methods in Mathematical Statistics *Conditionally elective course in Mathematics*	7.5 hp	Second cycle

Recommended courses

Code	Name	Credits	Edu. level
DD2447	Statistical Methods in Applied Computer Science	6.0 hp	Second cycle
DD2458	Problem Solving and Programming under Pressure	9.0 hp	Second cycle
ID1217	Concurrent Programming	7.5 hp	First cycle

Supplementary information

One of the following subtracks must be choosen:

1. Algorithms and Complexity
2. Formal Methods
3. Cryptography

At least 7,5 credits from the courses below must be taken:

DD2448 Foundations of Cryptography 7,5 hp

DD2459 Software Reliability 7,5 hp

DD2372 Automata and Languages 6,0 hp

DD2443 Parallel and Distributed Computing 7,5 hp

DD2457 Program Semantics and Analysis 6,0 hp

Subtrack Formal Methods:

Compulsory course:

DD2460 Software Safety and Security, 7.75 credits

Recommended courses for the subtrack:

DD2372 Automata and Languages 6,0 hp

DD2457 Program Semantics and Analysis 6,0 hp

At least one of the following courses in Mathematics must be taken:

SF2713 Foundations of Analysis 7,5 hp

SF2741 Enumerative Combinatorics 7,5 hp

SF2729 Groups and Rings 7,5 hp

SF2723 Topics in Mathematics III 7,5 hp

SF2724 Topics in Mathematics IV 7,5 hp

SF2730 Topics in Mathematics V 7,5 hp

SF2940 Probability Theory 7,5 hp

SF2955 Computer Intensive Methods in Mathematical Statistics 7,5 hp

Year 2

Mandatory courses (7.5 Credits)

Code	Name	Credits	Edu. level
DD2467	Individual Project in Theoretical Computer Science	7.5 hp	Second cycle

Conditionally elective courses

Code	Name	Credits	Edu. level
DD2442	Seminars on Theoretical Computer Science *Conditionally elective for the subtrack Algorithms and Complexity*	7.5 hp	Second cycle
SF2723	Topics in Mathematics III *Conditionally elective course in Mathematics*	7.5 hp	Second cycle
SF2724	Topics in Mathematics IV *Conditionally elective course in Mathematics*	7.5 hp	Second cycle
SF2730	Topics in Mathematics V *Conditionally elective course in Mathematics*	7.5 hp	Second cycle
SF2741	Enumerative Combinatorics *Conditionally elective course in Mathematics*	7.5 hp	Second cycle
SF2940	Probability Theory *Conditionally elective course in Mathematics*	7.5 hp	Second cycle
SF2955	Computer Intensive Methods in Mathematical Statistics *Conditionally elective course in Mathematics*	7.5 hp	Second cycle

Recommended courses

Code	Name	Credits	Edu. level
DD2443	Parallel and Distributed Computing	7.5 hp	Second cycle
DD2447	Statistical Methods in Applied Computer Science	6.0 hp	Second cycle
DD2458	Problem Solving and Programming under Pressure	9.0 hp	Second cycle
ID1217	Concurrent Programming	7.5 hp	First cycle

Supplementary information

Subtrack Algorithms and Complexity:

At least one of the courses below must be taken year one or year two

DD2445 Complexity Theory 7,5 hp (Will be offered Autumn 2019)

DD2442 Seminars on Theoretical Computer Science 7,5 hp

At least one of the following courses in Mathematics must be taken:

SF2713 Foundations of Analysis 7,5 hp

SF2741 Enumerative Combinatorics 7,5 hp

SF2729 Groups and Rings 7,5 hp

SF2723 Topics in Mathematics III 7,5 hp

SF2724 Topics in Mathematics IV 7,5 hp

SF2730 Topics in Mathematics V 7,5 hp

SF2940 Probability Theory 7,5 hp

SF2955 Computer Intensive Methods in Mathematical Statistics 7,5 hp

Track, Visualization and Interactive Graphics (CSVG)

Year 1

Mandatory courses (13.5 Credits)

Code	Name	Credits	Edu. level
DD2257	Visualization	7.5 hp	Second cycle
DH2323	Computer Graphics and Interaction	6.0 hp	Second cycle

Conditionally elective courses

Code	Name	Credits	Edu. level
DH2320	Introduction to Visualization and Computer Graphics *Conditionally elective for the subtrack Visualization and modelling*	6.0 hp	Second cycle
DH2321	Information Visualization *Conditionally elective for the subtrack Visualization and modelling*	6.0 hp	Second cycle

Recommended courses

Code	Name	Credits	Edu. level
DD2423	Image Analysis and Computer Vision	7.5 hp	Second cycle
DD2424	Deep Learning in Data Science	7.5 hp	Second cycle
DD2429	Computational Photography	6.0 hp	Second cycle
DT2350	Human Perception for Information Technology	6.0 hp	Second cycle

Supplementary information

One of the following subtracks must be choosen:

1. Visualization and modelling
2. Graphics and Interactions

One of the condiotionally elective courses in the subtrack visualization and modelling must be taken

Year 2

Conditionally elective courses

Code	Name	Credits	Edu. level
DD2470	Advanced Topics in Visualization and Computer Graphics *Compulsory for the subtrack Visualization and modelling*	6.0 hp	Second cycle
DH2413	Advanced Graphics and Interaction *Compulsory for the subtrack Graphics and Interactions*	9.0 hp	Second cycle
DH2650	Computer Game Design *Compulsory for the subtrack Graphics and Interactions*	6.0 hp	Second cycle

Recommended courses

Code	Name	Credits	Edu. level
DD2423	Image Analysis and Computer Vision	7.5 hp	Second cycle
DD2424	Deep Learning in Data Science	7.5 hp	Second cycle
DD2429	Computational Photography	6.0 hp	Second cycle
DH2321	Information Visualization	6.0 hp	Second cycle
DM2350	Human Perception for Information Technology	7.5 hp	Second cycle

Appendix 2: Specialisations

Programme syllabus for studies starting in autumn 2016, Master's Programme, Computer Science, 120 credits (TCSCM)

Track, Cognitive Systems (CSCS)

The specialization incognitive systemsis aboutdeveloping applications withartificial intelligence, ie, abilities traditionally associated with people. 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, High Performance Computing (CSHP)

Students receive both theoretical and practical knowledge of how to use modern supercomputers for high-performance computing. The focus is on parallel computing, brain-inspired algorithms and the use of specialized hardware, such as GPU processors.

Track, Interaction Design (CSID)

Students learn to developi nteractive 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, for example, for computer games.

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.