



Programme syllabus

Master's Programme, Machine Learning, 120 credits

Masterprogram, maskininlärning

120.0 credits

Valid for students admitted to the education from autumn 18 (HT - Autumn term; VT - Spring term).

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

Programme objectives

Machine Learning is an area within Computer Science where computer systems are designed to learn from large sets of examples, similarly to the learning strategies of biological systems (like humans). Recently, Machine Learning has gained great importance for the design of search engines, robots, and sensor systems, and for the processing of large scientific data sets.

The focus of the Master's programme in Machine Learning is on mathematical foundations and methods for Machine Learning. These application areas include topics such as computervision, speech communication, robotics, information retrieval and/or computational biology.

In addition to this comes the Higher Education Ordinance goals for the degree.

Knowledge and understanding

A Master of Science in Machine Learning will be able to:

- present a good knowledge of mathematical methods for Machine Learning, as well as how these are applied in a number of application domains.
- understand different Machine Learning problems deeply enough to select and apply suitable methods and computer tools to solve them,
- formulate and approach new Machine Learning problem settings in a scientific manner; in a creative, critical and systematic way.

Skills and abilities

A Master of Science in Machine Learning will be able to:

- work out solution strategies to different Machine Learning problems, knowing the capabilities and limitations of different methods and tools,

- work efficiently in a teamwork environment in groups with people from different scientific and engineering background,
- communicate with scientists and people active in engineering development in a competent manner both orally and in writing,
- follow and participate in research and development related to the chosen track.

Ability to make judgements and adopt a standpoint

A Master of Science in Machine Learning will be able to:

- critically judge a problem and in an independent manner acquire the information and knowledge that is necessary to establish a qualified opinion,
- formulate and approach new Machine Learning problem settings in a scientific manner; in a creative, critical and systematic way,
- identify the need for further knowledge in the field and take responsibility for keeping her/his personal knowledge up to date.

In addition to this the similar objectives for master degree defined in the Higher Education Ordinance (Högskoleförordningen) are applicable.

Extent and content of the programme

Machine Learning is a two-year (120 ECTS credits) master programme on the advanced level (second cycle). The instruction language is English.

The curriculum consists of a basic block of courses, followed by two blocks, 1.2.1-Application domains and 1.2.2-Theory.

At least 25 credits must be taken from the block 1.2.1-Application domains and at least 13,5 credits from the group in 1.2.2-Theory.

Eligibility and selection

General admission requirements: See the KTH general admission requirements for Master's programmes

Specific admission requirements: The prerequisites for the Master's programme in Machine Learning is a Swedish or foreign degree equivalent to Bachelor's degree of 180 ECTS credits, with a level in Mathematics and Computer Science equal, or higher, than that of the following courses at KTH: SF1624 Algebra and geometry, SF1625 Calculus in one variable, SF1626 Calculus in several variables, SF1901 Probability theory and statistics, DD1337 Programming and DD1338 Algorithms and Data Structures.

Selection: If the number of applicants exceeds the number of places there will be 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

This programme syllabus, decided by the CSC dean 2017-09-01 is valid for students starting the programme during the study year 2018/2019. Which courses that belong a study year is decided in the fall the year before. Changes may occur in the contents of the programme and in the KTH regulations, please see www.kth.se/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/>

The first semester in the programme is dedicated to the compulsory courses in the basic curriculum. The second and the third semester consist of the blocks and the elective courses. The last semester is dedicated to the degree project.

Courses

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

Courses

The course goals, prerequisites, contents and examination requirements are found in the course syllabus in the Course and programme 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.

The basic curriculum common to both tracks corresponds to around 30 ECTS credits.

A student in the Machine learning programme is required to take at least 25 credits listed in 1.2.1, which applied machine learning to particular application domains. He must also take at least 13,5 credits from those listed in 1.2.2-Theory. The remaining credits are obtained from freely elected courses. These courses may be chosen from among the profile courses of the track, other second cycle courses at KTH, or language courses at KTH. Undergraduate courses at KTH can also be chosen, upon permission from the Programme Director.

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 analysed by the course leader in the course analysis document, which is normally published on the web, see the KTH regulations of course analyses: <http://www.kth.se/en/>

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

Participation requires admission to courses within the programme and course registration. Course registration is done via the personal menu at www.kth.se

Selection of courses

Application to the course is done:

- 1 to 15 May for the autumn semester
- 1 to 15 November for the spring semester

with student kth.se account via universityadmissions.se

If the student is not doing their course selections by this system his/her application is only considered upon availability.

In a few courses, the number of participants is limited. Selection is done by the school responsible for the course.

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

Promotion for further studies

For students starting their education from the autumn semester 2018, previous promotion requirements have been replaced with special admission requirements to each course. Admission requirements are specified in the course syllabus.

Please see the KTH regulations: <http://www.kth.se/en/>

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 Programme Office.

For in-depth information about the KTH policy for credit transfer, see <http://www.kth.se/en/>

Studies abroad

Students of the programme have the possibility to spend one or two semesters of study at a foreign university, or do their degree project abroad.

For more information, contact the person responsible for International Relations at CSC.

Degree project

The degree project is the final part of the education och comprises 30 higher education credits. The project work may begin when special admission requirements for the course are fulfilled.

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://www.kth.se/en/>

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

The Degree of Master of Science is obtained after completion of the Machine Learning programme. The programme is designed so that students, when they graduate, have fulfilled 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 in depth studies in the main field of study.

See also the KTH regulations at <http://www.kth.se/en/>

[Appendix 1 - Course list](#)

[Appendix 2 - Programme syllabus descriptions](#)



Appendix 1: Course list

Master's Programme, Machine Learning, 120 credits (TMAIM),
Programme syllabus for studies starting in autumn 2018

General courses

Year 1

Mandatory courses (31.5 Credits)

Course code	Course name	Credits	Edu. level
DA2205	Introduction to the Philosophy of Science and Research Methodology	7.5 hp	Second cycle
DD2301	Program Integrating Course in Machine Learning	3.0 hp	Second cycle
DD2380	Artificial Intelligence	6.0 hp	Second cycle
DD2421	Machine Learning	7.5 hp	Second cycle
DD2434	Machine Learning, Advanced Course	7.5 hp	Second cycle

Conditionally elective courses

Course code	Course name	Credits	Edu. level
DD2257	Visualization	7.5 hp	Second cycle
DD2401	Neuroscience	7.5 hp	Second cycle
DD2402	Advanced Individual Course in Computational Biology	6.0 hp	Second cycle
DD2410	Introduction to Robotics	7.5 hp	Second cycle
DD2411	Research project in Robotics, Perception and Learning	15.0 hp	Second cycle
DD2418	Language Engineering	6.0 hp	Second cycle
DD2420	Probabilistic Graphical Models	7.5 hp	Second cycle
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
DD2435	Mathematical Modelling of Biological Systems	9.0 hp	Second cycle

DD2437	Artificial Neural Networks and Deep Architectures	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
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
EL2805	Reinforcement Learning	7.5 hp	Second cycle
EQ2341	Pattern Recognition and Machine Learning	7.5 hp	Second cycle
ID2222	Data Mining	7.5 hp	Second cycle
ID2223	Scalable Machine Learning and Deep Learning	7.5 hp	Second cycle
SF1811	Optimization	6.0 hp	First cycle
SF2930	Regression Analysis	7.5 hp	Second cycle
SF2940	Probability Theory	7.5 hp	Second cycle
SF2943	Time Series Analysis	7.5 hp	Second cycle

Recommended courses

Course code	Course name	Credits	Edu. level
DD1388	Program System Construction Using C++	7.5 hp	First cycle
DD2352	Algorithms and Complexity	7.5 hp	Second cycle
DD2395	Computer Security	6.0 hp	Second cycle
DD2448	Foundations of Cryptography	7.5 hp	Second cycle
DH2642	Interaction Programming and the Dynamic Web	7.5 hp	Second cycle
ID2213	Logic Programming	7.5 hp	Second cycle
ID2221	Data-Intensive Computing	7.5 hp	Second cycle
SF2568	Parallel Computations for Large- Scale Problems	7.5 hp	Second cycle

Supplementary information

During year 1 and year 2 students must take at least complete 25 credits from the grouping listed in 1.2.1 and at least 13,5 credits from the group of courses in 1.2.2.

1.2.1 Conditionally Elective Courses - Application Domains

COMPUTER VISION:

DD2423 Image Analysis and Computer Vision, 7,5 hp,

DD2424 Deep learning in Data Science, 7,5 hp,

DD2429 Computational photography, 6 hp.

LANGUAGE PROCESSING: SPEECH & TEXT

DT2112 Speech Technology, 7,5 hp,
DT2119 Speech and Speaker Recognition, 7,5 hp
DD2418 Language Engineering, 6.0 hp

VISUALIZATION:

DD2257 Visualization, 7,5 hp

ROBOTICS:

DD2410 Introduction to Robotics, 7,5 credits
DD2438 Artificial Intelligence and Multi Agent Systems, 15 credits
DD2425 Robotics and Autonomous Systems, 9 credits
DD2411 Research project in Robotics, Perception, and Learning, 15 credits

DATABASES/INFORMATION RETRIEVAL:

DD2476 Search Engines and Information Retrieval Systems, 9 hp

COMPUTATIONAL BIOLOGY:

DD2435 Mathematical Modelling of Biological Systems, 9 hp,
DD2401 Neuroscience, 7,5 hp,
DD2402 Advanced Individual Course in Computational Biology, 6 hp,
DD2404 Applied Bioinformatics, 7,5 hp.

1.2.2 Conditionally Elective Courses - Theory

MATHEMATICS:

EL2320 Applied Estimation, 7,5 hp
SF1811 Optimization, 6 hp

STATISTICS & PROBABILITY:

DD2447 Statistical Methods in Applied Computer Science, 6 hp,
SF2930 Regression Analysis, 7,5 hp,
SF2943 Time Series Analysis, 7,5 hp,
SF2940 Probability theory, 7,5 hp.

MACHINE LEARNING:

EQ2341 Pattern Recognition and Machine Learning, 7,5 hp
DD2437 Artificial Neural Networks and Deep Architectures, 7,5 hp
ID2222 Data Mining 7.5
ID2223 Scalable Machine Learning and Deep Learning 7.5
DD2420 Probabilistic Graphical Models, 7,5 credits
EL2805 Reinforcement Learning, 7,5 credits

Common Elective Courses

Elective courses are selected freely from all Second cycle courses and language courses given at KTH. First cycle courses at KTH may be taken upon permission from the Programme Director. Not more than 30 ECTS credits in total can be acquired from First cycle courses.

Year 2

Mandatory courses (93.0 Credits)

Course code	Course name	Credits	Edu. level
DA233X	Degree Project in Computer Science and Engineering, specializing in Machine Learning, Second Cycle	30.0 hp	Second cycle
DD2301	Program Integrating Course in Machine Learning	3.0 hp	Second cycle
SF288X	Degree Project in Optimization and Systems Theory, Second Cycle	30.0 hp	Second cycle
SF299X	Degree Project in Mathematical Statistics, Second Cycle	30.0 hp	Second cycle

Conditionally elective courses

Course code	Course name	Credits	Edu. level
DD2257	Visualization	7.5 hp	Second cycle
DD2401	Neuroscience	7.5 hp	Second cycle
DD2402	Advanced Individual Course in Computational Biology	6.0 hp	Second cycle
DD2410	Introduction to Robotics	7.5 hp	Second cycle
DD2411	Research project in Robotics, Perception and Learning	15.0 hp	Second cycle
DD2418	Language Engineering	6.0 hp	Second cycle
DD2420	Probabilistic Graphical Models	7.5 hp	Second cycle
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
DD2435	Mathematical Modelling of Biological Systems	9.0 hp	Second cycle
DD2437	Artificial Neural Networks and Deep Architectures	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
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
EL2805	Reinforcement Learning	7.5 hp	Second cycle
ID2222	Data Mining	7.5 hp	Second cycle
ID2223	Scalable Machine Learning and Deep Learning	7.5 hp	Second cycle
SF1811	Optimization	6.0 hp	First cycle
SF2930	Regression Analysis	7.5 hp	Second cycle

SF2940	Probability Theory	7.5 hp	Second cycle
SF2943	Time Series Analysis	7.5 hp	Second cycle

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SF2568	Parallel Computations for Large- Scale Problems	7.5 hp	Second cycle

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DT2112 Speech Technology, 7,5 hp,
 DT2119 Speech and Speaker Recognition, 7,5 hp
 DD2418 Language Engineering, 6.0 hp

VISUALIZATION:

DD2257 Visualization, 7,5 hp

ROBOTICS:

DD2410 Introduction to Robotics, 7,5 credits
 DD2438 Artificial Intelligence and Multi Agent Systems, 15 hp
 DD2425 Robotics and Autonomous Systems, 9 hp
 DD2411 Research project in Robotics, Perception, and Learning, 15 credits

DATABASES/INFORMATION RETRIEVAL:

DD2476 Search Engines and Information Retrieval Systems, 9 hp

COMPUTATIONAL BIOLOGY:

DD2435 Mathematical Modelling of Biological Systems, 9 hp,
DD2401 Neuroscience, 7,5 hp,
DD2402 Advanced Individual Course in Computational Biology, 6 hp,
DD2404 Applied Bioinformatics, 7,5 hp.

1.2.2 Conditionally Elective Courses - Theory

MATHEMATICS:

EL2320 Applied Estimation, 7,5 hp
SF1811 Optimization, 6 hp

STATISTICS & PROBABILITY:

DD2447 Statistical Methods in Applied Computer Science, 6 hp,
SF2930 Regression Analysis, 7,5 hp,
SF2943 Time Series Analysis, 7,5 hp,
SF2940 Probability theory, 7,5 hp.

MACHINE LEARNING:

EQ2340 Pattern Recognition 7,5 hp
DD2437 Artificial Neural Networks and Deep Architectures, 7,5 hp
ID2222 Data Mining 7.5
ID2223 Scalable Machine Learning and Deep Learning 7.5
DD2420 Probabilistic Graphical Models, 7,5 credits
EL2805 Reinforcement Learning, 7,5 credits

Common Elective Courses

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Appendix 2: Specialisations

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This programme has no specialisations.