



# Programme syllabus

Master's Programme, Machine Learning, 120 credits

Masterprogram, maskininlärning

*120.0 credits*

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*Valid for students admitted to the education from autumn 20 (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 datasets.

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

## Knowledge and understanding

A student at the programme of 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 team environment with people from different cultural, scientific and engineering backgrounds,
- 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 objectives, defined in the Higher Education Ordinance, for a master's degree 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:

- Mandatory courses,
- Courses within Machine Learning: Application domains,
- Courses within Machine Learning: Theory.

## **Eligibility and selection**

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

- a Swedish or foreign degree equivalent to a 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 criteria:

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. The first semester in the programme is dedicated to the compulsory courses. The second and the third semester consist of the courses within the two tracks 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](#).

The programme is course-based. The lists of courses are included in Appendix A. 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.

## 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 admission requirements for the course are fulfilled.

## **Degree**

Master of Science.

### Minimum Requirements for the Degree of Master of Science

The student can apply for a degree of Master of Science after completion of the 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.

[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 2020

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## General courses

### Year 1

#### Mandatory courses (31.5 Credits)

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

#### Conditionally elective courses

Course code	Course name	Credits	Edu. level
<a href="#">DD2257</a>	<a href="#">Visualization</a> Included in Application Domain Visualization	7.5 hp	Second cycle
<a href="#">DD2401</a>	<a href="#">Neuroscience</a> Included in Application Domain, Computational Biology	7.5 hp	Second cycle
<a href="#">DD2402</a>	<a href="#">Advanced Individual Course in Computational Biology</a> Included in Application Domain, Computational Biology	6.0 hp	Second cycle
<a href="#">DD2410</a>	<a href="#">Introduction to Robotics</a> Included in Application Domain, Robotics	7.5 hp	Second cycle
<a href="#">DD2411</a>	<a href="#">Research project in Robotics, Perception and Learning</a> Included in Application Domain, Robotics	15.0 hp	Second cycle
<a href="#">DD2412</a>	<a href="#">Deep Learning, Advanced Course</a> Included in Theory, Machine Learning	6.0 hp	Second cycle
	<a href="#">Language Engineering</a>		

<a href="#">DD2418</a>	Included in Application Domain Language Processing; Speech & Text	6.0 hp	Second cycle
<a href="#">DD2419</a>	<a href="#">Project Course in Robotics and Autonomous Systems</a> Included in Application Domain, Robotics	9.0 hp	Second cycle
<a href="#">DD2420</a>	<a href="#">Probabilistic Graphical Models</a> Included in Theory, Statistics & Probability	7.5 hp	Second cycle
<a href="#">DD2423</a>	<a href="#">Image Analysis and Computer Vision</a> Included in Application Domain Computer Vision	7.5 hp	Second cycle
<a href="#">DD2424</a>	<a href="#">Deep Learning in Data Science</a> Included in Application Domain Computer Vision	7.5 hp	Second cycle
<a href="#">DD2435</a>	<a href="#">Mathematical Modelling of Biological Systems</a> Included in Application Domain, Computational Biology	9.0 hp	Second cycle
<a href="#">DD2437</a>	<a href="#">Artificial Neural Networks and Deep Architectures</a> Included in Theory, Machine Learning	7.5 hp	Second cycle
<a href="#">DD2438</a>	<a href="#">Artificial Intelligence and Multi Agent Systems</a> Included in Application Domain, Robotic	15.0 hp	Second cycle
<a href="#">DD2447</a>	<a href="#">Statistical Methods in Applied Computer Science</a> Included in Theory, Statistics & Probability	6.0 hp	Second cycle
<a href="#">DD2476</a>	<a href="#">Search Engines and Information Retrieval Systems</a> Included in Application Domain Databases/Information Retrieval	9.0 hp	Second cycle
<a href="#">DT2112</a>	<a href="#">Speech Technology</a> Included in Application Domain, Language Processing; Speech & Text	7.5 hp	Second cycle
<a href="#">DT2119</a>	<a href="#">Speech and Speaker Recognition</a> Included in Application Domain, Language Processing; Speech & Text	7.5 hp	Second cycle
<a href="#">EL2320</a>	<a href="#">Applied Estimation</a> Included in Theory, Mathematics	7.5 hp	Second cycle
<a href="#">EL2805</a>	<a href="#">Reinforcement Learning</a> Included in Theory, Machine Learning	7.5 hp	Second cycle
<a href="#">EQ2341</a>	<a href="#">Pattern Recognition and Machine Learning</a> Included in Theory, Machine Learning	7.5 hp	Second cycle
<a href="#">EQ2425</a>	<a href="#">Analysis and Search of Visual Data</a> Included in Application Domain Computer Vision	7.5 hp	Second cycle
<a href="#">ID2222</a>	<a href="#">Data Mining</a> Included in Theory, Machine Learning	7.5 hp	Second cycle
<a href="#">ID2223</a>	<a href="#">Scalable Machine Learning and Deep Learning</a> Included in Theory, Machine Learning	7.5 hp	Second cycle
<a href="#">SF1811</a>	<a href="#">Optimization</a> Included in Theory, Mathematics	6.0 hp	First cycle
<a href="#">SF2930</a>	<a href="#">Regression Analysis</a> Included in Theory, Statistics & Probability	7.5 hp	Second cycle
	<a href="#">Probability Theory</a>		

<a href="#">SF2940</a>	Included in Theory, Statistics & Probability	7.5 hp	Second cycle
<a href="#">SF2943</a>	<a href="#">Time Series Analysis</a> Included in Theory, Statistics & Probability	7.5 hp	Second cycle

## Recommended courses

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

## Supplementary information

Courses that run in periods 1 and 2 of Year 2 can potentially be taken in period 1 and period 2 of Year 1 if it leads to a manageable workload for the student.

Apart from the mandatory and conditionally elective course requirements the student is free to choose from all the second cycle and language courses given at KTH to take his/her number of completed course credits to 90 ECTS. First cycle courses may be taken (though we prefer if students take second-cycle courses) but no more than 30 ECTS points can be counted towards graduation. Recommended courses are for those who would like to extend their competency and knowledge in Computer Science and Software Engineering. A final degree project must also be completed.

## Information regarding conditionally elective courses

**Choose among the conditionally elective courses, so that the following conditions are fulfilled:**

- at least 6 courses from Application Domains + Theory, and
- at least 2 courses from Application Domains, and also
- at least 2 courses from Theory.

Examples of possible combinations of courses:

- at least 2 courses from Application Domains, and at least 4 courses from Theory,
- at least 3 courses from Application Domains, and at least 3 courses from Theory,
- at least 4 courses from Application Domains, and at least 2 courses from Theory.

## Year 2

### Mandatory courses (33.0 Credits)

Course code	Course name	Credits	Edu. level
<a href="#">DA233X</a>	<a href="#">Degree Project in Computer Science and Engineering, specializing in Machine Learning, Second Cycle</a>	30.0 hp	Second cycle
<a href="#">DD2301</a>	<a href="#">Program Integrating Course in Machine Learning</a>	3.0 hp	Second cycle

### Conditionally elective courses

Course code	Course name	Credits	Edu. level
<a href="#">DD2257</a>	<a href="#">Visualization</a> Included in Application Domain Visualization	7.5 hp	Second cycle
<a href="#">DD2410</a>	<a href="#">Introduction to Robotics</a> Included in Application Domain, Robotics	7.5 hp	Second cycle
<a href="#">DD2411</a>	<a href="#">Research project in Robotics, Perception and Learning</a> Included in Application Domain, Robotics	15.0 hp	Second cycle
<a href="#">DD2412</a>	<a href="#">Deep Learning, Advanced Course</a> Included in Theory, Machine Learning	6.0 hp	Second cycle
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<a href="#">DD2430</a>	<a href="#">Project Course in Data Science</a> Included in Application Domain	7.5 hp	Second cycle
<a href="#">DD2435</a>	<a href="#">Mathematical Modelling of Biological Systems</a> Included in Application Domain, Computational Biology	9.0 hp	Second cycle
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### Examples of possible combinations of courses:

- at least 2 courses from Application Domains, and at least 4 courses from Theory,
- at least 3 courses from Application Domains, and at least 3 courses from Theory,
- at least 4 courses from Application Domains, and at least 2 courses from Theory.





## Appendix 2: Specialisations

Master's Programme, Machine Learning, 120 credits (TMAIM),  
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This programme has no specialisations.