



# EQ2415 Machine Learning and Data Science 7.5 credits

Maskininlärning och dataanalys

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

If the course is discontinued, students may request to be examined during the following two academic years

## Establishment

Course syllabus for EQ2415 valid from Spring 2019

## Grading scale

A, B, C, D, E, FX, F

## Education cycle

Second cycle

## Main field of study

Electrical Engineering

## Specific prerequisites

For single course students: 180 credits and documented proficiency in English B or equivalent.

## Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

## Intended learning outcomes

After passing the course, students should be able to:

- (1) Describe models for advanced machine learning methods and formulate necessary cost functions. Then analytically and experimentally estimate performance of learning methods.
- (2) Describe a machine learning problem in generative and discriminative setups for data analysis.
- (3) Design systems and algorithms for machine learning. Critically compare the algorithms in a trade-off between complexity and performance, for a data analysis task. Present and report the results.
- (4) Implement and analyze machine learning based methods for automatic training from data.

## Course contents

The course considers advanced machine learning methods for analysis of data. We take both generative and discriminative approaches. Example applications can be identification of a species in biological data, gene sequence analysis, face recognition, financial or multimedia data analysis, or recognition of disease from patient data.

The course covers:

- (1) Graphical models in a Bayesian framework
- (2) Approximate machine learning, such as variational Bayes
- (3) Sparse representation and dictionary learning, sparse kernel machines
- (4) Deep neural networks, restricted Boltzmann machines
- (5) Inference over networks, consensus principle

## Disposition

Preliminary course structure: 12 lectures + 10 tutorials

## Course literature

Will be announced on the course homepage before the course starts. Preliminary literature:

- (1) Pattern recognition and machine learning, by C.M. Bishop

- (2) Deep learning methods and applications, by L. Deng and D. Yu.
- (3) Adaptation, learning and optimization over networks, by A.H. Sayed.
- (4) Sparse and redundant representations: from theory to applications in signal and image processing, by M. Elad.
- (5) Advanced data analysis from an elementary point of view, by C.R. Shalizi.
- (6) Research paper handouts

## Examination

- PRO1 - Project assignments, 4.5 credits, grading scale: A, B, C, D, E, FX, F
- TEN1 - Exam, 3.0 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

## Other requirements for final grade

There are three assessment components for the course.

- (1) Master test: There will be one master test in the span of teaching 12 classes. The test is of 20-30 minutes. The master test is intended to check concepts. The test requires sustained (or regular) study at home as the teachers cover topics in class. The test will use short conceptual questions, and no lengthy problem. Grades for master test: A-F.
- (2) Projects: There are three practical projects that are examined via presentations. Projects can be performed in groups of two persons. However, the grades are on the basis of individual performance. Grades for projects: A-F.
- (3) Final exam: There is a final written exam. Grades for the final exam: A-F.

The overall grade of the course is based on collective performance. The teacher will provide weights to all tests for the overall grade. To pass the course, master tests are not mandatory, but the projects and final test are mandatory. To achieve a good course grade, a student is expected to perform well in all the three assessment components. The projects are reported as PRO1, 4.5 hp, the master tests and final test are jointly reported as TEN1, 3 hp.

## Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.

- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.