

## Machine Learning

Maskininlärning

9 credits

Single subject and programme course

732A99

Valid from: 2018 Autumn semester

<b>Determined by</b>	<b>Main field of study</b>	
The Quality Board at the Faculty of Arts and Sciences	Statistics	
<b>Date determined</b>	<b>Course level</b>	<b>Progressive specialisation</b>
2016-04-01	Second cycle	A1N
<b>Revised by</b>	<b>Disciplinary domain</b>	
	Technology	
<b>Revision date</b>	<b>Subject group</b>	
	Statistics	
<b>Offered first time</b>	<b>Offered for the last time</b>	
Autumn semester 2017		
<b>Department</b>	<b>Replaced by</b>	
Institutionen för datavetenskap		

## Course offered for

- Master's Programme in Statistics and Machine Learning

## Entry requirements

- Bachelor's degree equivalent to a Swedish Kandidatexamen of 180 ECTS credits in one of the following subjects:
  - statistics
  - mathematics
  - applied mathematics
  - computer science
  - engineering
- Passed courses in
  - calculus
  - linear algebra
  - statistics
  - programming
- English corresponding to the level of English in Swedish upper secondary education (Engelska 6)  
Exemption from Swedish

## Intended learning outcomes

After completion of the course the student should at an advanced level be able to:

- use relevant concepts and methods from machine learning in order to formulate, structure and solve practical problems that involve large or complex data,
- make an inference for the parameter values for commonly used machine learning models,
- use machine learning models for prediction and decision making,
- estimate the quality of the machine learning models,
- select a suitable model in situations with a limited or no information about the underlying dependencies in the data,
- implement machine learning models in a programming language and use existing machine learning software in order to analyze large and/or complex datasets, make predictions and estimate the uncertainty of these predictions.

## Course content

The course introduces main concepts and tools in probabilistic machine learning which are necessary for professional work and research in data analytics.

- introduction to and overview of machine learning (including regression, classification, supervised and unsupervised learning) and its application areas,
- Nearest Neighbors and Naïve Bayes,
- discriminant analysis, logistic regression and decision trees,
- model selection and uncertainty estimation: holdout method, cross-validation, AIC, bootstrap confidence intervals,
- linear regression and regularization methods (Ridge, LASSO),
- splines, generalized linear and additive models,
- Principal component analysis (PCA) and Principal component regression (PCR),
- kernel smoothers, kernel trick and support vector machines,
- neural networks,
- bagging, boosting and random forests,
- Online learning and mixture models. .

## Teaching and working methods

The teaching comprises lectures, seminars, and computer exercises, complemented by self-studies. Lectures are devoted to presentations of theories, concepts and methods. Computer exercises provide practical experience of data analysis in some machine learning software. The seminars comprise student presentations and discussions of computer assignments.

Language of instruction: English. .

## Examination

Written reports on the computer assignments. Active participation in the seminars. One final written examination. Detailed information about the examination can be found in the course's study guide.

Students failing an exam covering either the entire course or part of the course two times are entitled to have a new examiner appointed for the reexamination.

Students who have passed an examination may not retake it in order to improve their grades.

If special circumstances prevail, and if it is possible with consideration of the nature of the compulsory component, the examiner may decide to replace the compulsory component with another equivalent component.

If the LiU coordinator for students with disabilities has granted a student the right to an adapted examination for a written examination in an examination hall, the student has the right to it.

If the coordinator has recommended for the student an adapted examination or alternative form of examination, the examiner may grant this if the examiner assesses that it is possible, based on consideration of the course objectives.

An examiner may also decide that an adapted examination or alternative form of examination if the examiner assessed that special circumstances prevail, and the examiner assesses that it is possible while maintaining the objectives of the course.

Students failing an exam covering either the entire course or part of the course twice are entitled to have a new examiner appointed for the reexamination.

Students who have passed an examination may not retake it in order to improve their grades.

## Grades

ECTS, EC

## Other information

Planning and implementation of a course must take its starting point in the wording of the syllabus. The course evaluation included in each course must therefore take up the question how well the course agrees with the syllabus.

The course is carried out in such a way that both men's and women's experience and knowledge is made visible and developed.

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If special circumstances prevail, the vice-chancellor may in a special decision specify the preconditions for temporary deviations from this course syllabus, and delegate the right to take such decisions.