Advanced Machine Learning

Advanced Machine Learning
6 credits

Single subject and programme course

732A96

Valid from: 2017 Autumn semester

Determined by	**Main field of study**	
The Quality Board at the Faculty of Arts and Sciences	Statistics	
Date determined	**Course level**	**Progressive specialisation**
2016-04-13	Second cycle	A1N
Revised by	**Disciplinary domain**	
	Technology	
Revision date	**Subject group**	
	Statistics	
Offered first time	**Offered for the last time**	
Autumn semester 2017		
Department	**Replaced by**	
Institutionen för datavetenskap		

Course offered for

- Master's Programme in Statistics and Machine Learning

Entry requirements

- 180 ECTS credits passed including 90 ECTS credits in one of the following subjects:
    - statistics
    - mathematics
    - applied mathematics
    - computer science
    - engineering
- Passed courses in:
    - calculus
    - linear algebra
    - statistics
    - programming
- Passed course in Bayesian Learning of at least 6 ECTS credits
- Passed course in Computational Statistics of at least 6 ECTS credits or equivalent
- 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 on an advanced level be able to:

- account for the principles of machine learning used in the Bayesian tradition of machine learning,
- construct a suitable probabilistic model describing the data structure and the prior,
- compare between models in order to select the best one,
- implement machine learning models in a programming language and also use standard machine learning libraries in order to perform the model inference, make predictions based on these models and estimate the uncertainty of these predictions.

Course content

The course covers some advanced methods in machine learning that allow for modelling complex phenomena and predicting the outcomes of these phenomena.

The following topics are included in the course:

- Introduction to Bayesian Learning: likelihood, prior, posterior, marginal likelihood, posterior predictive distribution. Generative and discriminative models,
- Gaussian process,
- State-space models,
- Kalman filtering and smoothing,
- particle methods,
- Markov models and hidden Markov models,
- graphical models, such as Bayesian networks and Markov random fields.

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.

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 conducted in such a way that there are equal opportunities with regard to sex, transgender identity or expression, ethnicity, religion or other belief, disability, sexual orientation and age.

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.