Bayesian Learning

Programme course

6 credits

Bayesianska metoder

TDDE07

Valid from: 2017 Spring semester

Determined by
Board of Studies for Computer Science
and Media Technology

Date determined
2017-01-25

Main field of study
Computer Science and Engineering, Computer Science

Course level
Second cycle

Advancement level
A1F

Course offered for
- Computer Science and Engineering, M Sc in Engineering
- Information Technology, M Sc in Engineering
- Computer Science and Software Engineering, M Sc in Engineering

Entry requirements
Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

Prerequisites
Mathematical analysis; Linear Algebra; Probability and Statistics; Machine Learning; Basic programming.

Intended learning outcomes
The course gives a solid introduction to Bayesian learning, with special emphasis on theory, models and methods used in machine learning applications. The student will learn about the basic ideas and concepts in Bayesian analysis from detailed analysis of simple probability models. The course presents simulation algorithms typically used in practical Bayesian work, and course participants will learn how to apply those algorithms to analyze complex machine learning models. After completing the course the student should be able to:

- derive the posterior distribution for a number of basic probability models
- use simulation algorithms to perform a Bayesian analysis of more complex models
- perform Bayesian prediction and decision making
- perform Bayesian model inference.

Course content

Likelihood, Subjective probability, Bayes theorem, Prior and posterior distribution, Bayesian analysis of the following models: Bernoulli, Normal, Multinomial, Multivariate normal, Linear and nonlinear regression, Binary regression, Mixture models; Regularization priors, Classification, Naïve Bayes, Marginalization, Posterior approximation, Prediction, Decision theory, Markov Chain Monte Carlo, Gibbs sampling, Bayesian variable selection, Model selection, Model averaging.

Teaching and working methods

The course consists of lectures, exercises, seminars and computer labs. The lectures introduce concepts and theories that students then use in problem solving at the exercises and computer labs. The seminars are used for student presentations of the computer lab reports and discussions.

Examination

UPG1	Computer assignments	3 credits	U, G
DAT1	Computer examination	3 credits	U, 3, 4, 5

DAT1 is an exam in a computer hall that tests students' theoretical knowledge and problem-solving skills in Bayesian learning.
UPG1 consists of computer exercises that tests the students' ability to translate theoretical knowledge into practical problem solving in Bayesian learning.

Grades

Four-grade scale, LiU, U, 3, 4, 5

Other information

Supplementary courses:
Advanced Machine Learning, Text Mining, Visual Object Recognition and Detection

Department

Institutionen för datavetenskap

Director of Studies or equivalent

Ann-Charlotte Hallberg

Examiner

Mattias Villani

Education components

Preliminary scheduled hours: 48 h
Recommended self-study hours: 112 h

Course literature

Additional literature

Books

Gelman, A., Carlin, J.B., Stern, H. S., Dunson, D. B., Vehtari, A., and Donald Rubin, D.B., (2013) *Bayesian Data Analysis* 3rd edition Chapman & Hall