HALMSTAD UNIVERSITY
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School of Information Technology

Bayesian Statistics for Machine Learning 3 credits

Bayesiansk statistik för maskininlärning 3 hp

Second cycle
Main field: Computer Science and Engineering, Second cycle, has only first-cycle course/s as entry requirements (A1N)
Syllabus is adopted by the Research and Education Board (2022-04-28) and is valid for students admitted for the autumn semester 2022.

Placement in the Academic System

The course is given as a single subject course.

Prerequisites and Conditions of Admission

Degree of Bachelor of Science with a major in Computer Science and Engineering or Degree of Bachelor of Science in Engineering, Computer Science and Engineering or the equivalent of 180 Swedish credit points or 180 ECTS credits at an accredited university. Including 5 credits statistics and 5 credits machine learning. Applicants must have written and verbal command of the English language equivalent to English course 6 in Swedish Upper-Secondary School.

Course Objectives

This course aims to provide a broad introduction to Bayesian Statistics, and its use in Machine Learning. The goal is that the student should learn about basic Bayesian concepts, parametric and non-parametric Bayesian estimation and inference, statistical machine learning models, and Bayesian deep neural networks.

Following successful completion of the course the student should be able to:

Knowledge and understanding

- describe the basic concepts of Bayesian statistics and its differences to frequenstic statistics
- state what different methods of Bayesian statistics there are
- independently derive and adjust basic Bayesian methods

Skills and ability

- apply Bayesian methods to real problems
- use standard tools for Bayesian analysis and machine learning
- independently derive and adjust basic Bayesian methods

Judgement and approach

- determine which advantages a Bayesian method bring to a given case
- determine which Bayesian method that would be appropriate in a given case

Primary Contents

The course is broken down into:
Basic Bayesian concepts, selecting priors and deriving some equations, Bayesian inference, parametric model, estimation, sampling based methods, sequential inference (Kalman filters, particle filters), approximate inference, variational inference, model selection (missing data) and Bayesian deep neural networks.

Teaching Formats

Each lecture is delivered through a video conference tool, and followed by a practical lab assignment in Python, provided as a Jupyter notebook, which allows the participants to dig into the concepts presented in the lecture and put them to practice.
Teaching is in English and via the learning platform.

Examination

The overall grades of Fail or Pass will be awarded for the course.
The examination consists of take-home assignments, labs, and exercises, all is done individually. The take-home exam is presented both orally and in writing.

Name of the test		Grading
Take-home Assignment	1 credits	U/G
Labs and Exercises	2 credits	U/G

If there are special reasons, the examiner may make exceptions from the specified examination format and allow a student to be examined in another way. Special reasons can e.g. be a decision on learning support.

For elite sports students according to Riktlinjer för kombinationen studier och elitidrott vid Högskolan i Halmstad, DNR: L 2018/177, the examiner has the right to decide on an adapted examination component or let the student complete the examination in an alternative way.

Course Evaluation

Course evaluation is part of the course. This evaluation should offer guidance in the future development and planning of the course. Course evaluations should be documented and made available to the students.

Course Literature and Other Study Resources

Christopher M. Bishop. *Pattern Recognition and Machine Learning*. Springer, 2011

M. Antónia Amaral Turkman, Carlos Daniel Paulino, Peter Müller. *Computational Bayesian Statistics: An Introduction.* Vol. 11. Cambridge University Press, 2019