FEO3270 Pattern Classification and Machine Learning 8.0 credits

Mönsterigenkänning och maskininlärning

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 FEO3270 valid from Spring 2014

Grading scale

Education cycle

Third cycle

Specific prerequisites

Mainly for PhD students in Electrical Engineering or Computer Science.

It requires solid background in probability theory. The undergraduate course EN2202 Pattern Recognition is a recommended but not compulsory prerequisite.

Language of instruction

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

Intended learning outcomes

After passing this course the student should be able to

- describe the general principles of probabilistic pattern classification and Bayesian parameter estimation,
- analyze previously unsolved problems in data classification or regression, for example problems encountered in the student's own research project, and formulate a theoretical probabilistic model,
- apply Bayesian parameter estimation, by selecting, if necessary, a suitable approximation approach to make the problem computationally tractable,
- understand and critially analyze new probabilistic pattern-recognition and machine-learning methods proposed in the scientific literature by other researchers

Course contents

After an initial review of probabilistic models for multivariate data and the principles of Bayesian learning as opposed to point estimates of model parameters, these models and methods are further developed for various applications in regression and classification. The following main topics are covered:

- Generalized linear models for regression and classification
- Neural networks
- Kernel methods, especially sparse approaches, such as the Relevance Vector Machine (RVM) and Support Vector Machine (SVM)
- Graphical models, incl. Bayesian networks and Markov random fields
- Mixture models and Expectation Maximization
- Approximate inference methods, e.g., variational inference with factorized approximation
- Monte Carlo sampling methods
- Probabilistic (Bayesian) principal component analysis (PCA)
- Models for sequencial data, especially Hidden Markov models

Disposition

About 10 weekly seminars, 2-3 hours each. In each session the discussion is focused on one main topic selected from the course book. Students demonstrate and discuss solutions to selected exercise problems.

Course literature

Bishop, C.M (2006). **Pattern recognition and machine learning**. Springer.

Equipment

Computer with Matlab.

Examination

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.

Examination is based on active participation in course seminars and a final written individual open-book exam.

Other requirements for final grade

Active participation is required in at least 70% of course meetings. Individual 72-hour open-book exam with given advanced problems, of which at least 50% must be correctly solved.

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.