FEO3274 Pattern Recognition, Machine Learning and Data Analysis 12.0 credits

Mönsterigenkänning, maskininlärning och data analys

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 FEO3274 valid from Spring 2019

Grading scale

P, F

Education cycle

Third cycle

Specific prerequisites

Language of instruction

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

Intended learning outcomes

After the successful completion of course, the students should be able to

1. Identify and formulate recognition, learning and analysis problems given a dataset.
2. Design systems and algorithms. Critically compare the algorithms in a tradeoff between complexity and performance. Finally report the results.
3. Implement algorithms through convex optimization and Bayesian learning approaches.
4. Contribute to the frontier research area.

Course contents

Theoretical content: Bayes minimum risk criterion, maximum likelihood (ML), maximum-a-posteriori (MAP), recognition for sequence of vectors, hidden Markov model (HMM), graphical models, Gaussian process, expectation-maximization (EM), approximate inference, variational Bayes, artificial neural network (ANN), back propagation, vanishing gradient problem, deep learning, restricted Boltzman machines (RBM), sparse representations, dictionary learning, convex optimization, greedy methods, sparse kernel machines – relevance vector machine (RVM) and support vector machine (SVM), graphical models, message passing, approximate message passing, adaptive learning, online learning, learning over networks, doubly stochastic networks, adaptation over networks.
Project content: Multimedia, gene sequence and financial data pre-processing, feature extraction, and machine learning problems.

Disposition

24 lectures span over two study periods, 12 tutorials for exercise, 3-4 master tests (sudden short tests and 2 of them mandatory), mid-term written exam of 5 hours (mandatory), 3 given projects (mandatory), 1 research project, presentation of one research paper.

Course literature

1. Pattern Recognition, Compendium by Arne Leijon and Gustav Henter.

2. Pattern Recognition and Machine Learning, by C.M. Bishop.

3. Deep learning methods and applications, by L. Deng and D, Yu.

4. Adaptation, learning and optimization over networks, by A.H. Sayed.

5. Sparse and redundant representations: from theory to applications in signal

and image processing, by M. Elad.

6. Advanced data analysis from an elementary point of view, by C.R. Shalizi.

7. Research paper handouts

Examination

- EXA1 - Examination, 12.0 credits, grading scale: P, F

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.

Other requirements for final grade

1. Must need to pass the mid-term exam.

2. Must need to perform 3 given projects.

3. Must need to pass 2 master tests.

4. At-least 75% attendance in teaching classes.

5. Satisfactory performance in research project (preferably in own research area).

Expectation is to find innovative publishable research result and proper report.

6. Satisfactory performance in paper presentation.

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.