GÖTEBORG UNIVERSITY
The Board of the IT Faculty

DIT380, Algorithms for Machine Learning and Inference, 7,5 higher education credits

Second Cycle/A1F

This syllabus in English is a binding document.

1. Confirmation

The syllabus was confirmed by the Faculty Board of IT Faculty/The Dean on 2006-11-17 and revised on 2009-10-15 to be valid from spring semester, 2010.

Field of education: Sciences.

Responsible department: Computer Science and Engineering.

2. Position in the educational system

The course is a part of the Computer Science Master´s programme and a single subject course at the University of Gothenburg.

3. Entrance qualifications

The requirement for the course is to have successfully completed a first year studies within the subject Computer Science or equivalent. Specifically the course DIT600 Algorithms is mandatory.

4. Course content

The course discusses learning and inference from data as a type of algorithmic problems. After introducing the basic notation and stressing the role of model assumptions we go through some of the most common approaches to algorithmic learning. Critical evaluation of learning algorithms and their outcomes is as important as the technical side.

5. Learning outcomes

After completion of the course the student is expected to be able to:

- Distinguish "learning" in an Artificial Intelligence perspective from human learning
- Explain the notions of concept learning (training data, hypothesis, version space, generalization, etc.) and apply these terms properly to new concept learning problems, including some analysis and modeling of real-world scenarios
- Recognize the implicit model assumptions (inductive bias) in learning algorithms, and be aware that the result s crucially depend on them
- Represent hypothesis in different forms (decision trees, Boolean formulae, rule sets), transform such representations, infer them with data by some exemplary methods (e.g., decision tree learning), know the advantages, drawbacks and some variations of the methods
- Relate the complexity of models and hypotheses (e.g., description length) to the amount of training data, explain the phenomenon of overfitting and counteract it
- Explain the basic principles of some types of artificial neural networks and what they can represent, in particular, explain certain network training algorithms as local search algorithms for error minimization
- Explain the basic notions and rules of Bayesian inference: conditional probability, a priori and posteriori probability, maximum-likelihood hypothesis, etc., explain Bayesian classification methods, their underlying ideas and computational aspects
- Do calculations for specific problems in the Bayesian framework, represent knowledge in form of Bayesian belief networks and other probabilistic models
- Apply instance –based learning, especially nearest-neighbor learning and clustering, being aware of some problems involved (choice of parameters, dimensionality, implementation issues)
- Evaluate the quality of hypotheses in a statistically sound way, and estimate the necessary sample size for learning a given hypothesis space, using suitable mathematical concepts
- See connections to related fields like pattern recognition, data mining, commerce, bioinformatics, etc. (depending on your interest)

6. Required reading

See separate literature list.

7. Assessment

Hand-in exercises are obligatory. In a homework exam, every student has to cover the main topics by answering to certain questions. Part of it may be replaced with a course project.

A student who has failed a test twice has the right to change examiners, if it is possible. A written application should be sent to the Department.

8. Grading scale

The grades are Pass, Pass with distinction or Fail.

9. Course evaluation

The course is evaluated through meetings both during and after the course between teachers and student representatives. Further, an anonymous questionnaire can be used to ensure written information. The outcome of the evaluations serves to improve the course by indicating which parts could be added, improved, changed or removed.

10. Additional information

The course is given in English.