FSF3964 Bayesian networks and Causal Inference 7.5 credits

Bayesianska nätverk och kausal inferens

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 FSF3964 valid from Autumn 2018

Grading scale

P, F

Education cycle

Third cycle

Specific prerequisites

First or second cycle courses in probability, in differential and integral calculus.
Recommended: FSF3961 Statistical inference, SF2955 Statistical learning, SF2740 Graph theory.

Language of instruction

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

Intended learning outcomes

To pass the course, the student:

- will be able to assess when to use a Bayesian network as a model for an interaction of several variables.
- will be able to identify statements of conditional independence by a DAG.
- will be able to use at least two algorithms to learn the structure of a Bayesian network from data
- will be able to use available software for update of probabilities
- will be able to recognize a situation, where causal inference is required
- will be able to apply intervention calculus
- will be able to identify causal parameters,
- will be able to find the scientific conditions when it is possible to estimate causal parameters from data
- knows the main interpretations counterfactuals and their equivalence
- can place causal inference in the general picture of statistical learning theory
- can present clearly a topic in causal inference

Course contents

- Directed acyclic graphs, and d-separation, conditional independence
- Markov properties for directed acyclic graphs and faithfulness.
- Learning about probabilities
- Structural learning; MDL, predictive inference
- Exponential familes and graphical models (Conditional Gaussian distributions)
- Causality and intervention calculus
- structural causal models, graphical statistical models,
- the adjustment formula, truncated product formula,
- the backdoor criterion, front-door criterion.
- counterfactuals, structural interpretation, axiomatics of counterfactuals, probabilities of counterfactuals, Three interpretations of probability of causation and counterfactuals.

Disposition

Lectures and seminars

Course literature

• T. Koski & J.Noble: Bayesian Networks and Causal Probability Calculus. 2009.Bayesian Networks: An Introduction. J.Wiley & Sons 2009. ISBN : 978-0-470-74304-1 Press, 2015,

ISBN 978-1-107-06507-9
• Adnan Darwiche: Modeling and reasoning with Bayesian networks. 2009, Cambridge University Press ISBN: 0-521-88438-1 (hardback)
• David Poole & Alan Mackworth: Artificial Intelligence: Foundations of Computational Agents. Cambridge University Press, 2010. Online ISBN 9780511794797
• S.L. Morgan & C.Winship: Counterfactuals and causal inference. 2nd Edition. Cambridge Univ.
• J.Pearl, M. Glymour & N.P: Jewell: Causal inference in statistics. A Primer. J.Wiley & Sons 2016, ISBN: 9781119186847

Examination

• HEM1 - Homework assignments, 7.5 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.

The examination is computer homework project, homework assignments and presentations

Other requirements for final grade

Accept Homework assignments

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.