Probabilistic Modelling and Reasoning

School of Informatics, University of Edinburgh

Instructor: Prof Chris Williams

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Assessment By formal examination (80%) and one assignment (20%).

Online material is available through the course web page at
http://www.inf.ed.ac.uk/teaching/courses/pmr.

Resources
The course textbook is "Pattern Recognition and Machine Learning" by Christopher M. Bishop, Springer (2006).
Additional useful texts for some of the material are: "Information Theory, Inference and Learning Algorithms" by D. J. C. MacKay (Cambridge University Press, 2003), and "Artificial Intelligence: A Modern Approach" by S. Russell and P. Norvig (Prentice Hall, second edition 2002).

Syllabus

- Introduction

- Probability

    - random variables, joint, conditional probability

- Discrete belief networks and inference

- Continuous distributions, graphical Gaussian models

- Learning

    - Maximum Likelihood parameter estimation
    - Bayesian methods for parameter estimation

- Decision theory

- Hidden variable models

    - mixture models and the EM algorithm
    - factor analysis
    - ICA, non-linear factor analysis

- Dynamic hidden variable models

    - Hidden Markov models

- – Kalman filters (and extensions)

- Bayesian Learning of Belief Networks

  - – Model comparison

- Inference in discrete belief networks: the Junction Tree Algorithm

- Undirected graphical models

  - – Markov Random Fields
  - – Boltzmann machines

- Information theory

  - – entropy, mutual information
  - – source coding, Kullback-Leibler divergence