Approximate Inference and Learning in Probabilistic Models (COMP0085)

Description

Aims:
The module will present the foundations of approximate inference and learning in probabilistic graphical models (e.g. Bayesian networks and Markov networks), with particular focus on models composed from conditional exponential family distributions. Both stochastic (Monte Carlo) methods and deterministic approximations will be covered. The methods will be discussed in relation to practical problems in real-world inference in Machine Learning, including problems in tracking and learning.

Learning outcomes:
Students will be able to understand how to derive and implement state-of-the-art approximate inference techniques and be able to make contributions to research in this area.

Content:
-Nonlinear, hierarchical (deep), and distributed models;
-Independent component analysis, Boltzmann machines, Dirichlet topic models, manifold discovery;
-Mean-field methods, variational approximations and variational Bayes;
-Expectation propagation;
-Loopy belief propagation, the Bethe free energy and extensions;
-Convex methods and convexified bounds;
-Monte-Carlo methods: including rejection and importance sampling, Gibbs, Metropolis-Hastings, anealed importance sampling, Hamiltonian Monte-Carlo, slice sampling, sequential Monte-Carlo (particle filtering);
-Other topics as time permits;

Requisites:
In order to be eligible to select this module, a student must be registered on a programme for which it is a formally-approved option or elective choice AND must have taken COMP0086 in Term 1.