Probabilistic Networks:
Randomness, Learning, and Algorithms

CSCI 8610 Topics in Theoretical Computer Science
(Spring 2018)

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   The rising tide of artificial intelligence, especially rapid developments in machine learning underline great potentials of such computational methods. They also highlight the importance of statistical learning from available data for effective modeling of real world problems, where traditional solutions have been predominately deterministic and often not effective. To prepare students for solving challenging problems where effective solutions may require development of probabilistic models and methods, this course offers an opportunity to study fundamental theories and algorithms in probabilistic networks, including model construction from structural and non-structural data and statistical inference and prediction with such models. It is designed to complement a machine learning course that is focused on techniques/software or an algorithm course whose targets are deterministic models.

Prerequisites

Completion of CSCI 4470/6470 (Algorithms) with a decent grade is required, or approval of the instructor.

Content

This course will expose the students to a number of basic topics in probabilistic networks, learning and inference, spanning the following areas:

1. Fundamentals in probability theory, statistics, information theory, and optimization algorithms;

2. Random walk, Markov chain, and randomized algorithms;

3. Markov trees, networks, and Bayesian networks;

4. Model learning, maximum likelihood, posterior probability, and EM algorithm;

5. Inference with probabilistic models and Markov chain Monte Carlo (MCMC) algorithm.

Format

The teaching will be a mix of 2/3 lectures by the instructor and 1/3 presentations by students on their literature-readings and research projects. No textbook will be used. Grading will be based on project reports, presentations, and participation in classroom discussions.

Schedule

Class Times: 12:20 - 1::10 (M) and 12:30 - 1:45 (TR)
Classrooms: 306 Boyd (M) and Forest Resources-1 0303 (TR)
Office hours: 1:15-2:15 (Mondays), 9:45-10:45 (Tuesdays) or by appointment