

Detailed Lecture Schedule

1/14 - Introduction

- Administrative issues
- Motivation for probabilistic graphical models
 - Why symbolic, monotonic reasoning fails
 - Bayesian reasoning
 - Frequentist vs. Bayesian
 - Dutch book argument
 - Success stories

- Learning objectives: PT6

1/16 - Probability

- Primer on probability

- Learning objectives: PT1

1/21 - Bayesian Networks

- Motivation
- Basic components
 - Chains
 - Common parent
 - Common child
- d-separation
- Markov properties
- Markov equivalence

- Learning objectives: PT2, SL3

1/23 - Special Models

- Naive Bayes
 - Conditional probability calculations
- Hidden Markov Models
 - Viterbi algorithm

- Learning objectives: PT3, PL3 (Predictive inference will be covered later)

1/28 - Inference in Simple Models

- Belief Propagation
 - Chains
 - Trees

- Polytrees
- Learning objectives: PT4

1/30 - Inference in General Graphs (Join Tree)

- Definition of join tree (tree decomposition)
- Moralization
- Triangulation (this is NP-complete, and results in a Markov network)
- Cluster graph
- Join tree
- Learning objectives: PT5

2/4 - Parameter Inference (Multinomial)

- Single multinomial, with and without priors
 - Maximum likelihood
 - Maximum posterior with (symmetric) Dirichlet prior
- Bayesian network
 - MLE
 - MAP
- Discussion of how priors affect the resulting parameters
- Learning objectives: PL1, PL2, PL4 (Predictive inference will be covered later)

2/6 - Predictive Inference

This may not take the entire time, so some of this class meeting could be used to catch up if previous material takes longer than expected.

- Single multinomial
- Naive Bayes
- Bayesian network
- Learning objectives: PL3, PL4

2/11 - Expectation-Maximization

- Introduction to hidden variables and missing data
- Expectation
- Maximization
- Learning objectives: PL6

2/13 - Parameter Inference (Topic Models)

If the other lectures takes longer than expected, this lecture could be skipped.

- Introduction to topic models (probabilistic latent semantic analysis)
- Parameter estimation using EM

- Learning objectives: PL5, PL6

2/18 - Model Selection

- Model selection and overfitting
- Scoring functions
- Marginal likelihood (with Dirichlet assumption on parameters)

- Learning objectives: SL1, SL2, SL4, SL6, SL7

2/20 - Structure Learning

- Approximate
 - Simple greedy hill climbing
 - Greedy equivalence search
- Exact
 - Dynamic programming

- Learning objectives: SL3, SL5