FALL 2022 COURSE ANNOUNCEMENT

ECSE 4810/6810
Introduction to Probabilistic Graphical Models

Course Objectives:

As a marriage between probability theory and graph theory, Probabilistic Graphical Models (PGMs) provide a tool for dealing with two problems that occur throughout applied mathematics and engineering – uncertainty and complexity. Under probabilistic models, data are modeled as a collection of random variables with a particular pattern of possible dependences among them. Using PGM model, we can discover knowledge, predict future events, and infer hidden causes.

This 3-credit level course will introduce theories and applications of both directed and undirected PGMs, including Bayesian Networks, Markov Random Fields, Hidden Markov Models, Dynamic Bayesian Networks, Influence Diagram, and Factor Graph. Theoretically, we will discuss various model learning and inference methods. For learning, the course will cover parameter and structure learning under both complete and incomplete data. For inference, the course will cover exact inference methods, approximated methods (e.g. Loopy belief propagation), the variational methods, and the numerical sampling methods (e.g. MCMC). Application-wise, we will demonstrate the application of PGMs to different fields including computer vision and deep learning. Through this course, students will learn and understand the basic theories underlying different graphical models, implement certain important PGM learning and inference techniques, and solve real world problems using PGMs.

Textbook:

- Probabilistic Graphical Models for Computer Vision, Qiang Ji

Optional Textbook:

- Probabilistic Graphical Models: Principles and Techniques, Daphne Koller and Nir Friedman

Course Coordinator: Qiang Ji, Professor, Dept. Electrical, Computer, and Systems Eng.

Meeting Times: 12:30-1:50 pm, TBD, Tuesdays and Fridays

Prerequisites: ECSE-2500 or equivalent and proficiency in computer programming. Students taking the class should have a pre-existing working knowledge of probability, statistics, and adequate programing skills, though the class has been structured to allow students with a strong analytic background to catch up and fully participate.

Topics: Probability Calculus, Bayesian Networks, Learning and Inference in Bayesian Networks, Dynamic Bayesian Networks, Influence Diagram, Hidden Markov Model, Markov Network, Factor Graph, and various application examples of different graphical models.

Course Evaluation:

The evaluation of this course will be based on homework assignments (15%), a midterm exam (25%), class projects (40%) and the final project (20%).