**STANFORD UNIVERSITY**

**DEPARTMENT OF STATISTICS**

# DEPARTMENTAL SEMINAR

4:15 p.m., Tuesday, February 17, 2004
Sequoia Hall Room 200
(Cookies at 3:45 in 1st Floor Lounge)

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## Graphical models, variational methods, and their applications

Abstract:

Graphical models are used and studied in a variety of applied statistical and computational fields, including bioinformatics, statistical physics, signal and image processing, communication theory, and machine learning. Many large-scale inference problems that arise in specific instances, including the key problems of computing likelihoods, marginals and modes associated with probability distributions, are best studied in the general setting.

Variational methods provide a complementary alternative to Markov chain Monte Carlo as a general source of approximation methods for inference in large-scale statistical models. Underlying a variety of these methods (e.g., mean field, belief propagation) is a classical variational principle from statistical physics, which involves a "free energy" optimization problem over the set of all distributions. We describe an alternative view, that exploits the framework of exponential families and associated conjugate duality relations, in which the optimization takes place over the (typically) much lower-dimensional space of mean parameters. This viewpoint clarifies the essential ingredients of known variational techniques, and also suggests novel methods based on convex relaxations. We discuss applications of graphical models and variational methods to problems including natural image statistics, and decoding of error-control codes.