



## Short Course

پژوهشکده مخابرات نظری و قطب علمی سیستم‌های دسترسی مخابرات

مدرس

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عنوان

# Monte Carlo Methods and Graphical Models

جلسه اول درس

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مکان: کلاس ۳۱۶ - دانشکده مهندسی برق

دانشگاه صنعتی شریف

### **Abstract:**

In this course, we will consider exact and approximate inference on graphical models defined in terms of factor graphs. We will show that the belief propagation (the sum-product message passing) algorithm can efficiently solve this problem when the factor graph is cycle-free. The capacity and information rates of one-dimensional constrained channels (with applications in coding theory) and the free energy of one-dimensional Ising/Potts models (with applications in statistical physics) will be presented as two examples. The belief propagation algorithm for decoding low-density parity-check (LDPC) codes on binary symmetric channels will also be discussed in detail.

We then discuss approximate inference in graphical models with cycles via Markov chain Monte Carlo methods. The methods include importance sampling, rejection sampling, Gibbs sampling, and the Metropolis Algorithm. As examples, we will consider estimating the capacity of the two-dimensional constrained channels and estimating the partition function of the two-dimensional Ising/Potts models. Annealing techniques, auxiliary variable methods (e.g., the Swendsen-Wang algorithm), and factor graph duality will be covered.

### **About Speaker:**

Mehdi Molkaraie received his BS and MS from the Faculty of Engineering, University of Tehran, and his PhD from EPF-Lausanne. Since then he has been with ETH-Zurich, University of Pompeu Fabra, Faculty of Mathematics University of Waterloo, and the Department of Statistical Sciences University of Toronto.