

# Probabilistic Models and Belief Propagation

*Under the aegis of* MHRD—Global Initiative of Academic Networks

URL: <http://cse.iiti.ac.in/gian.html>, <http://iiti.ac.in/GIAN/home.html>

## Overview

A probabilistic model (also sometimes referred as graphical model), provides a statistical analysis tool in which a graph expresses the conditional dependence structure between random variables. It has the ability to estimate the probability of an event occurring again on the basis of past data. Belief propagation deals with performing inference on probabilistic models, such as Bayesian networks and Markov random fields. Probabilistic models and Belief propagation are commonly used in artificial intelligence, machine learning and information theory. It has been successfully applied in the development numerous applications in the field on computer vision, artificial intelligence, machine learning, statistical physics and coding theory.

Objective of this course is to understand and learn how to use probabilistic models and belief propagation in creating artificial intelligence systems. It aims at providing the advance knowledge on probabilistic models and belief propagation. The courses will be useful for the people working in the research areas such as image analysis, computer vision applications, biometrics, target recognition, space applications, speech processing, neural computing, forensics, bioinformatics and coding theory.

## Schedule of the Course

<b>Schedule of the course</b>	: August 1 -10, 2016
<b>Total Number of days/lectures</b>	: 10 days / 30 lectures

## Registration Fee

<b>Participant from outside India</b>	: USD 500
<b>Industry/ Business organization</b>	: Rs. 20,000
<b>Academic Institutions</b>	: Rs. 5,000

The fee includes all instructional materials, computer use for tutorials, and lunch. The participants will be provided with single bedded accommodation on payment basis.

## Topics Covered

- 1. Review of Basics:** Basic probability concepts, probability spaces and events, independence and conditional independence, Bayes rule, discrete and continuous probability distributions, joint, conditional, and marginal distributions.
- 2. Probabilistic Models:** IID models, Mixture models, Markov Chains and Processes. Hidden Markov Models (HMMs), Stochastic Context
- 3. Inference and Parameter Estimation:** Clustering using mixture models, Expectation Maximization (EM), Viterbi and Forward-Backward recursions for Hidden Markov Models, Inside-Out and Cocke–Younger–Kasami (CYK) algorithms for Stochastic Context Free Grammars.

4. **Dynamic Programming and Belief Propagation:** Dynamic programming and Belief Propagation as generalized abstractions for common algorithms, Implementation issues: scaling and computational scheduling options.
5. **Applications and Approximation:** Decoding of Convolutional, Low-Density Parity-Check (LDPC), and Turbo Codes as an instance of Belief Propagation, Natural language processing and biomolecular sequence and structure modeling using HMMs and SCFGs.

## Faculty Information



**Professor Gaurav Sharma** is with the University of Rochester, where he is a Professor in the Department of Electrical and Computer Engineering, Department of Computer Science, Department of Biostatistics and Computational Biology, and Department of Oncology. From 2008-2010, he served as the Director for the Center for Emerging and Innovative Sciences (CEIS), a New York state supported center for promoting joint university-industry research and technology development, which is housed at the University of Rochester. From 1996 through 2003, he was with Xerox Research and Technology in Webster, NY first as a member of research and technology staff and then as a Principal Scientist and Project Leader. He received the Ph.D. in Electrical and Computer Engineering from North Carolina State University, Raleigh, NC, and masters degrees in Applied Mathematics from NCSU and in Electrical Communication Engineering from the Indian Institute of Science, Bangalore, India. He received his bachelor of engineering degree in Electronics and Communication Engineering from Indian Institute of Technology, Roorkee (formerly, Univ. of Roorkee). Professor Sharma is a fellow of the IEEE, a fellow of SPIE, and a fellow of the Society for Imaging Science and Technology (IS&T). For more information visit: <http://www.ece.rochester.edu/~gsharma/>



**Dr. Surya Prakash** is currently an Assistant Professor in Discipline of Computer Science and Engineering at Indian Institute of Technology Indore, India. He received his MS and PhD degrees in computer science and engineering from Indian Institute of Technology Madras, India and Indian Institute of Technology Kanpur, India respectively. His research interest includes image processing, computer vision, pattern recognition, biometrics, and identity and infrastructure management. He has published several research articles in peer-reviewed international journals and conferences. He has also co-authored two books titled "IT Infrastructure and Its Management" published by Tata McGraw-Hill, India and "Ear Biometrics in 2D and 3D: Localization and Recognition" published by Springer. He has also been in the program committees of several international conferences in the field of pattern recognition, image processing and intelligent computing. For more information please visit: <http://iiti.ac.in/people/~surya/>

## Who should attend this course?

1. Research scholars, graduate students, researchers from different organization across the country working in the field of machine learning, computer vision, image analysis and coding theory.
2. Young researchers working in R & D laboratories related to machine learning, computer vision, image analysis, and coding theory across the country.
3. Faculty members and academicians interested in research in the field of machine learning, computer vision, image analysis, pattern recognition and coding theory.

## Course Co-ordinator

**For any further information and registration, please contact:**

**Dr. Surya Prakash**

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