

MHRD Scheme on Global Initiative on Academic Network (GIAN) Graphical Models for Machine Learning

Overview

Graphical models provide a powerful framework for machine learning that allows effective representation of dependency between disparate factors and enables the use of principled probabilistic methods for inference and parameter estimation. This course provides an introduction to graphical models. The models have emerged as standard workhorses in machine learning with applications in many diverse areas such as computer vision, image/video processing, pattern recognition and classification, communications and error correction coding, and bioinformatics. Several of these applications will be used through the course to illustrate the application of graphical models in practice. The course will also feature a set of hands on computational assignments that will help students develop deeper familiarity with the models.

The course aims at providing students and researchers a foundation in inference and estimation using graphical models. Instead of exhaustive coverage of this rather broad area, the course aims at in depth coverage of a small number of topics, aiming for a level of understanding where members can actually incorporate (some of) the models in their own research applications in addition to appreciating their fundamental origins and similarities and differences.

The course will be planned and offered as per the norms set by IIT Allahabad for the GIAN program

- Course Start Date: 25/12/2017; Course End Date:05/01/2018
- Number of Participants (maximum): 50 (Preference will be given to the participants registering against 2 Credits)

Modules:

- Introduction to Graphical Models (1 lecture- module 1)
- Review of Probability (1 lecture- module 1)
- Inference and Estimation: MAP and ML rules (1 lecture- module 2)
- MAP/ML Estimation for IID and Markov Processes (1 lecture- module 2)
- MAP Estimation for Binomial and Gaussian Distributions (Tutorial- module 2)
- Latent Variable Models and The EM Algorithm(1 lecture- module 3)
- EM Algorithm Application Example(1 lecture- module 3)
- EM Gaussian Mixture Model Segmentation(Tutorial- module 3)
- Hidden Markov Models I(1 lecture- module 4)
- Hidden Markov Models II(1 lecture- module 4)
- HMM Application Example I(1 lecture- module 5)
- HMM Application Example II(1 lecture- module 5)

- Dynamic programming and String Edit Distance (Tutorial- module 5)
- Stochastic Context Free Grammars I(1 lecture- module 6)
- Stochastic Context Free Grammars II(1 lecture- module 6)
- SCFG Application Example(1 lecture- module 7)
- Markov Random Fields I(1 lecture- module 7)
- Markov Random Fields II(1 lecture- module 8)
- Conditional Random Fields I(1 lecture- module 8)
- SCFGs for Parsing (Tutorial)(1 lecture- module 8)
- Conditional Random Fields II(1 lecture- module 9)
- Conditional Random Fields Example(1 lecture- module 9)
- Markov Chain Monte Carlo(1 lecture- module 10)
- Summary and Emerging Directions(1 lecture- module 10)
- Conditional Random Fields (Tutorial –module 10)

Who Can Attend?

- Faculty interested in initiating a program of research in this exciting and important field.
- Industry researchers, engineers, and executives working with machine learning applications that are interested in an overview of the field and a better understanding of the tools they use.
- Students in computer science, electrical and computer engineering, and software engineering interested in learning the basics of graphical models as a gateway to research and development in this field. The course will be appropriate for graduate students in these disciplines although undergraduates in their final year can also take the course.
- Number of participants for the course will be limited to fifty. Preference will be given to the participants opting against credits.

Participation Fee:

The participation fee for taking the course is as follows:

- Participants from abroad : US \$500
- Industry/Research Organizations: INR 10,000 (all modules) OR INR 2,000 (any 2 modules)
- Faculty from Academic Institutions: INR 5,000
- Students: INR 2,000 (SC/ST students eligible for 50% fee waiver).

The above fee include all instructional materials, computer use for tutorials and assignments, laboratory equipment usage charges, 24 hours free internet facility. The participants will be provided with the suitable accommodation on payment basis.

The Faculty

Prof. Gaurav Sharma is a Professor at the University of Rochester, in Rochester, NY in the departments of Electrical and Computer Engineering, Computer Science, Biostatistics and Computational Biology. 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). Dr. Sharma's research interests span the fields of signal and image processing with applications to computer vision, medical and bio informatics, communications, color imaging, and media security. He has authored/co-authored over 190 technical journal and conference papers in these areas. Dr. Sharma is a fellow of the IEEE, a fellow of SPIE -- the international society for optics and photonics, and a fellow of the Society for Imaging Science and Technology (IS&T). He is also an elected member of Sigma Xi, the scientific research society and the Phi Kappa Phi and Pi Mu Epsilon honor societies. Dr. Sharma served as the Editor-in-Chief for the Journal of Electronic Imaging. He was the Chair and Co-Chair, respectively, for the 2013 and 2012 IS&T/SPIE Electronic Imaging (EI) Symposia and Technical Program Co-Chair for the 2012 IEEE International Conference on Image Processing (ICIP). Dr. Sharma serves on the IEEE Publication Services Product Board (PSPB) as a member-at-large and as the Treasurer, on the IEEE PSPB Strategic Planning Committee, and on the Multimedia-Signal Processing Technical Committee of the IEEE SPS. He has previously served on the IEEE Signal Processing Society's Conference Board and its Executive subcommittee. He was also a Technical Program Co-Chair for the 2016 and 2012 editions of the IEEE International Conference on Image Processing (ICIP).



Dr. Satish Kumar Singh obtained his B.Tech in Electronics Engg. followed by an M.Tech and Ph.D from Jaypee University. He joined Indian Institute of Information Technology, Allahabad as an Assistant Professor in 2013 after working as an Assistant Professor in Jaypee University, Guna. Currently, he is associated with the IEEE Signal Processing Society (SPS) and is the Secretary for the IEEE SPS UP Chapter. He has also served as an Executive



Committee member for the IEEE Computer India Council from 2015-17 and is serving as the Member Secretary, STSC, IIT Allahabad. His interests include Digital Image Processing, Computer and Machine Vision, Data Compression, Pattern Recognition, Biometrics Systems and Image Indexing and Retrieval.

Course Coordinator

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