

ANURENDRA KUMAR

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RESEARCH INTERESTS

Machine Learning; Signal Processing; Computational Biology

EDUCATION

Indian Institute of Technology, Kanpur

M.Tech, *Electrical Engineering*

B.Tech, *Electrical Engineering*

Minors in *Artificial Intelligence, Linguistics*

Jul '12 - May '17

GPA: 9.67/10

GPA: 8.0/10

PAPER

A Dynamic Latent Variable Model for Source Separation (Submitted in ICASSP'18). [\[Link\]](#)

Dynamic Dirichlet Latent Variable Model (To be submitted in IEEE Transactions on signal processing). [\[Link\]](#)

Monoaural audio source separation using variational autoencoders (Submitted in ICASSP'18). [\[Link\]](#)

RESEARCH EXPERIENCE

Dynamic Probabilistic Non-negative Matrix Factorization (DPNMF) [\[Thesis\]](#)

Jun'16 - May'17

Master's Thesis- Advisor: Prof. T. Guha, IIT Kanpur

The objective is to extend the existing NMF and *Probabilistic Latent Component Analysis* (PLCA) models used in acoustic modeling to exploit temporal dependence. Proposed a dynamic Dirichlet distribution as prior distribution which is particularly suitable for non-negative data with mixture multinomial as likelihood. Developed the solution with intuitive updates which automatically reduces to the PLCA and NMF algorithms when there is no temporal dependency. Proved the blockwise convexity of expected log-likelihood. Also proposed the algorithm for source separation using the proposed DPNMF.

RELEVANT COURSEWORK

Machine Learning and Algorithms: Natural Language Processing*; Probabilistic Machine Learning; Learning with Kernel; Computer Vision; Machine Learning; Data Structures and Algorithm; Principles of Computing

Signal Processing: Detection and Estimation Theory*; Mathematical Methods in Signal Processing*; Image Processing*; Information Theory and Communication Systems; Topics in Signal and Image Processing; Digital Signal Processing

Mathematics: Convex Optimization*; Probability and Statistics*; Linear Algebra* ¹

INDUSTRIAL EXPERIENCE

Hierarchical sparse representaion of Knowledge base(KB)

Jun'17 - Aug'17

IBM research Bangalore, India

Developed an extension of TransE model to learn the vector representation of entity and relations in KB. The proposed model could exploit the existing hierarchy in KB by imposing tree structured hierarchy in latent dimensions. Proposed an iterative proximal gradient method which gave results similar to state of the art on 1 million entities from wikidata.

Internet of Things (IOT) in Agriculture

May'16 - Jul'16

Extreme Blue Internship Programme, IBM Bangalore, India

Worked in team to develop the prototype for precision agriculture in India. I took the charge of crop health monitoring from the *near infra red* (NIR) and RGB crop images and deployment of real sensors.

Latent variable models for object classification and annotation

May'15 - Jul'15

Samsung Research and Development Center, Noida, India

Achievement: Formulated the probabilistic framework for object classification and annotation using SIFT features taking the inspiration from PLCA model. Modeled the objects as sources. Learnt latent bases for each object as distribution of SIFT features. Used entropy as prior to impose sparsity. Implemented and achieved accuracy above 90% in classification.

TEACHING EXPERIENCE

Teaching Assistant, Convex Optimization, Instructor : Prof. K. Rajawat

Jan'16 - Apr'16 & Jan'17 - Apr'17

Conducted problem solving sessions for junior year students.

Teaching Assistant, Electronic Circuit Lab, Instructor : Prof. B. Mazhari

Aug'16 - Nov'16

Assisted a group of junior year students in conducting experiments related to analog circuits.

¹* denotes A grade

PROJECTS

Multiple Word Vector Embedding for polysemous words [\[Project Material\]](#)

Sep'15 - Nov'15

Natural Language Processing course project under Prof. A. Mukherjee, IIT Kanpur

- Extended word vector model to have multiple representations for polysemous words.
- Proposed two parametric and two non-parametric solutions. The solutions were evaluated on four evaluation metrics.
- Proposed solutions beat state-of-the-art in several specific cases.

Automatic wheat grain quality estimation [\[Report\]](#)

Aug'16 - Nov'16

Image Processing course project under Prof. T. Guha, IIT Kanpur

- Developed proof-of-concept for quality estimation of grain from the image of a grain sample.
- Created a labeled data-set with the help of traders and farmers.
- Proposed two-level segmentation method to segment overlapped grains which were further classified as grains/ impurities demonstrating the performance of proposed technique.

Visual Odometry in Self-Driving Car [\[Project Material\]](#)

Sep'15 - Nov'15

Undergraduate project mentored by Prof. G. Pandey, IIT Kanpur

Developed and implemented visual odometry in self-driving car using opencv library in C++.

Multiple Kernel Learning (MKL) [\[Project Material\]](#)

Sep'15 - Nov'15

Learning with Kernel course project under Prof. H. Karnick, IIT Kanpur

- Studied the theory behind multiple kernel learning and semi-infinite linear programming.
- Implemented and performed experiments to show that MKL automatically learns the efficient weighted distribution of multiple kernels and have the potential to handle data coming from heterogeneous sources.

Diverse feature selection in Latent Variable models [\[Report\]](#)

Jan'16 - Apr'16

Probabilistic Machine Learning course project under Prof. P. Rai, IIT Kanpur

- Objective: To improve latent variable models to capture diverse topics/latent features.
- Reformulated maximum likelihood objective function of Probabilistic PCA and Matrix factorization as maximum a posteriori estimation. Used *determinantal point processes* and *mutual angular regularizer* as priors to incorporate diverse selection of latent features.

Capacity maximization in Wideband Cognitive Radio Networks (CRN)

May'14 - Dec'14

Undergraduate project under Prof. K. Rajawat, IIT Kanpur

- Mathematically formulated the optimization problem for capacity maximization of *wideband* CRN inspired by the concept of *multiple input multiple output* (MIMO) beamforming. Majority of literature was dedicated to *narrowband* signals.
- Reformulated the non-convex problem as convex problem using convex optimization techniques and solved it.

Video segmentation [\[Project Material\]](#)

Jan'16 - Apr'16

Computer Vision course project under Prof. V. Nambodiri, IIT Kanpur

- Improved graph-based hierarchical segmentation in videos for both the online and offline segmentation.
- Proposed a preprocessing step which segments videos using shot transition detection. The proposed method performed better than state-of-the-art on all (four) evaluation metrics, for instance, *3D Undersegmentation Error*.

Unsupervised speaker diarization [\[Report\]](#)

Jan'16 - Apr'16

Selected Methods in Signal Processing course project under Prof. T. Guha, IIT Kanpur

- Implemented speaker diarization which solves the problem of speaker identification using speech data.

Multi-objective Optimization and Pareto optimality [\[Report\]](#)

Sep'14 - Nov'14

Convex Optimization course project under Prof. K. Rajawat, IIT Kanpur

- Surveyed and implemented techniques to solve multi-objective optimization problems namely, *Method of Global Criterion* and *Normal Boundary Intersection*. Applied to cognitive radio networks in MIMO scenario.

SCHOLASTIC ACHIEVEMENTS

Best Project award in image processing course.

Ranked among the top 0.4% among 0.5 million candidates in IIT-JEE 2012.

Received merit-cum means scholarship for three consecutive years at IIT Kanpur.

Ranked first in district and among top 1% in country in class XII CBSE exam.

TECHNICAL STRENGTHS

Programming Languages

C, C++, Python, MATLAB

Software & Utilities

Tensorflow, Git, scikit-learn, cvx, opencv, GNURadio, L^AT_EX