

ANURENDRA KUMAR

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RESEARCH INTEREST

Machine Learning; Statistical Modeling; Explainable Artificial Intelligence; Bioinformatics

EDUCATION

Indian Institute of Technology, Kanpur

Jul '12 - May '17

M.Tech, *Electrical Engineering*

GPA: 9.67/10

B.Tech, *Electrical Engineering*

GPA: 8.0/10

Minors in *Artificial Intelligence, Linguistics*

JOURNAL PUBLICATIONS

A.Kumar, T.Guha, P.Ghosh, 'Dirichlet Latent Variable Model: A Dynamic Model Based on Dirichlet Prior for Audio Processing', IEEE Trans. on speech and language processing (2019) . [\[Link\]](#)

CONFERENCE PUBLICATIONS

A. Kumar, T. Guha, P. Ghosh, 'A Dynamic Latent Variable Model for Source Separation', Int. Conf. on Acoustics, Speech and Signal Processing (ICASSP), Calgary, Apr 2018 . [\[Link\]](#)

L.Pandey⁺, **A.Kumar**⁺, V.Namboodiri, 'Monoaural audio source separation using variational autoencoders', Interspeech'18, Hyderabad, India . [\[Link\]](#) (+ denotes equal contribution)

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* (* denotes A grade)

WORK EXPERIENCE

Research Intern, Data Science

Apr'19 - Jul'19

Rivigo

Developed and validated novel machine learning algorithm for modeling prices in freight marketplace. Proposed model yielded competitive performance in comparison to other models developed at the company.

Lead, Data & Artificial intelligence

Jan'18 - Mar'19

Start up Project (Confidential)

Developed and validated machine learning algorithms for futuristic finance services. My work included-i) Designing statistical framework for risk assessment and mitigation in our platform, ii) Modeling and prediction of time-series data when very less training data is available, iii) Explainability of Artificial intelligence techniques.

Research Associate [\[Presentation\]](#)

Aug'17 - Dec'17

Indian Institute of Technology Kanpur, India (Funding Agency; Indian Space and Research Organisation)

Application-aware image quality evaluation aimed to develop a no reference metric for quantifying the remote sensing image dynamics. Learned an over-complete dictionary with sparsity constraints from natural images. A subspace for a test image was also learnt in a similar manner. Finally, a metric for alignment between two subspaces were used as a measure for the change in remote sensing images.

Research Intern [\[Presentation\]](#)

Jun'17 - Aug'17

IBM research Bangalore, India (Cognitive Computing Platform & Infrastructure Division)

Hierarchical sparse representation of Knowledge base(KB) – Developed an extension of translational embedding (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 a 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.

Intern (Extreme Blue Internship Programme) [\[Video\]](#)

May'16 - Jul'16

IBM Bangalore, India

Internet of Things (IOT) in Agriculture – Worked in a 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. I was also involved in deployment of soil sensors using Arduino. Our foundational work later developed into full fledged system and won the prestigious AEGIS GRAHAM BELL AWARD .

Research Intern

May'15 - Jul'15

Samsung Research Institute, Delhi, India

Latent variable models for object classification and annotation – Formulated the probabilistic framework for object classification and annotation. Learnt latent bases for each object as distribution of sparse SIFT features. Implemented the algorithm and achieved accuracy above 90% in classification.

MASTER'S THESIS

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

Jun'16 - May'17

Master's Thesis mentored by Prof. T. Guha, IIT Kanpur and Prof. P. Ghosh, IISc Bangalore

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

TEACHING EXPERIENCE

Teaching Assistant, Convex Optimization, IIT Kanpur

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

Instructor: Prof. K. Rajawat

Teaching Assistant, Electronic Circuit Lab

Aug'16 - Nov'16

Instructor : Prof. B. Mazhari

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. We constructed context vectors which was clustered to give the local word vector for each senses. Proposed two parametric and two non-parametric solutions. Our primary contribution was in developing a non-parametric approach to clustering for optimal number of senses. 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

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

- Developed a 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 a two-level segmentation method to segment overlapped grains which were further classified as grains/ impurities demonstrating the performance of proposed technique.

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

Jan'16 - Apr'16

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

- Designed an end-to-end pipeline for speaker diarization. The preprocessing stage included extracting MFCC features which was later followed by speaker activity detection. Each speaker was modeled with a multivariate normal distribution. Hypothesis testing with bayesian information criteria as a metric was employed for speaker segmentation. We used a pretrained model followed by low dimensional representation with i vector to represent each segments. Finally Integer Linear Programming clustering was employed to cluster each segments.

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++. SIFT and FAST features were extracted in each frames. KLT tracker with RANSAC for outlier rejection was employed for tracking features.

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

Jan'16 - Apr'16

Computer Vision course project under Prof. V. Namboodiri, 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*.

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 [\[Report\]](#)
Probabilistic Machine Learning course project under Prof. P. Rai, IIT Kanpur

Jan'16 - Apr'16

- To objective was to develop 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)
Undergradaduate project under Prof. K. Rajawat, IIT Kanpur

May'14 - Dec'14

- 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.

Multi-objective Optimization and Pareto optimality [\[Report\]](#)
Convex Optimization course project under Prof. K. Rajawat, IIT Kanpur

Sep'14 - Nov'14

- 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 course project award in Image Processing.

Ranked in top 0.4% among 0.5 million candidates in IIT-Joint Entrance Exam 2012.

Received undergraduate scholarship (awarded on merit-cum-means basis) for three consecutive years at IIT Kanpur.

District rank 1, and among top 1% nationwide in Class XII (higher secondary) CBSE exam.