

# ANURENDRA KUMAR

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## RESEARCH INTEREST

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Machine Learning; Explainable Artificial Intelligence

## EDUCATION

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**University of Illinois at Urbana-Champaign** Aug '19 - May '21  
M.S., *Computer Science*, Concentration in *Bioinformatics*  
**Indian Institute of Technology, Kanpur** Jul '12 - May '17  
B.Tech-M.Tech, *Electrical Engineering*  
Minors in *Artificial Intelligence*, *Linguistics*

## WORK EXPERIENCE

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**Graduate Research Assistant** Aug'19 - Present  
*FORWARD Lab mentored by Prof. Kevin Chang, Funded by NSF and UIUC-IBM collaboration*

Developed a large dataset and a novel scalable Deep learning architecture for web information extraction. Inspired by the recent advances in NLP, we propose a self attention based architecture for optimal contextual learning. The proposed model is promising because it is optimized to exploit semi-structured data such as a webpage.

**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 Intern** [\[Presentation\]](#) Jun'17 - Aug'17  
*IBM Research Bangalore, India (Cognitive Computing Platform & Infrastructure Division)*

Hierarchical sparse representation of Knowledge base(KB) – Developed an algorithm to learn the vector representation of entity and relations in KB. The proposed model could exploit the existing tree structured hierarchy in latent dimensions.

**Intern (Extreme Blue Internship Programme)** [\[Video\]](#) May'16 - Jul'16  
*IBM Bangalore, India*

Internet of Things (IOT) in Agriculture – Developed the prototype for precision agriculture in India. Our foundational work later developed into full fledged system and won the prestigious **AEGIS GRAHAM BELL AWARD**.

**Research Associate** [\[Presentation\]](#) Aug'17 - Dec'17  
*Indian Institute of Technology Kanpur, India (Funding Agency; Indian Space and Research Organisation)*

Image quality evaluation aimed to develop a no reference metric for quantifying the remote sensing image dynamics.

**Research Intern** May'15 - Jul'15  
*Samsung Research Institute, Delhi, India*  
Latent variable models for object classification and annotation.

## JOURNAL PUBLICATIONS

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**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

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

## RELEVANT COURSEWORK

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**Machine Learning and Algorithms:** Bayesian Machine Learning; Natural Language Processing\*; Machine Learning for Computational Biology; Learning theory; Computer Vision; Machine Learning; Data Structures and Algorithm; Principles of Computing

**Signal Processing and Bioinformatics:** Advanced Bioinformatics, 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)

## MASTER'S THESIS

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**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*

Developed a dynamic latent variable model to exploit temporal dependence. Proposed a dynamic Dirichlet distribution as a prior distribution which is particularly suitable for non-negative data and leads to elegant update equations.

## TEACHING EXPERIENCE

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- Teaching Assistant, Convex Optimization, IIT Kanpur
- Teaching Assistant, Electronic Circuit Lab

## TECHNICAL SKILLS

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Python, C, C++, R, Matlab, Javascript, Tensorflow, Pytorch, Caffe, Latex

## PROJECTS

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**Latent representation based gene regulatory network inference** [\[Presentation\]](#) *Aug'19 - Dec'19*  
*Project with Prof. Jian Peng, UIUC*

Developed an efficient deep learning framework which characterizes a gene with complex 3D structure and epigenomic features in informative latent dimensions to infer gene regulatory network.

**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. Our primary contribution was in developing a non-parametric approach to clustering for optimal number of senses.

**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 novel segmentation algorithm followed by classification.

**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.

**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.

**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.

**Multiple Kernel Learning (MKL)** [\[Project Material\]](#) *Sep'15 - Nov'15*  
*Learning with Kernel course project under Prof. H. Karnick, IIT Kanpur*

• 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*

• To objective was to develop latent variable models to capture diverse topics/latent features. 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*  
*Undergradaduate 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.

**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.