# **Anurendra Kumar**

217-819-8065 • Champaign, Illinois 61820 • ak32@illinois.edu • anurendra.github.io

# RESEARCH INTERESTS: Computational Biology, Machine Learning

#### **EDUCATION**

University of Illinois at Urbana-Champaign

M.S., Ph.D. in Computer Science (Concentration in Bioinformatics)

Aug '19 - May '24 GPA: 4/4

Indian Institute of Technology (IIT), Kanpur

M. Tech. in Electrical Engineering

**B. Tech. in Electrical Engineering** (Minors in Artificial Intelligence, Linguistics)

Jul '12 - May '17 GPA: 9.67/10

Dec'19 - Present

GPA: 8.0/10

#### **EXPERIENCE**

#### Graduate RA, Prof. Saurabh Sinha, UIUC

Single cell genomics

• Spatio-temporal Transcritomics: Proposed statistical approaches to understand the spatio-temporal regulation of genes

- Neurogenomics: Proposed an attention-based deep neural network (DNN) to decode combinatorial logic of enhancers
- Gene Regulatory Network (GRN): Developed a parameter estimation for single cell simulator with an underlying GRN

#### Machine Learning Engineer Intern, Service Now

May '20 - Aug '20

• Developed a DNN using BERT for content extraction from document images which yielded ~85% accuracy on SROIE dataset

#### Graduate RA, Prof. Kevin Chang, UIUC

Context-aware Webpage Object Detection [Submitted to CVPR '21]

Aug '19 - May '20 [Code]

- ullet Proposed an attention based DNN which yielded interpretable results and achieved  $\sim\!10\%$  improvement over SOTA
- Created largest public labeled dataset of 7.7k product webpage screenshots

## Lead, Data & Artificial Intelligence, Startup Project

Jan '18 - Mar '19

• Developed algorithms and benchmark metrics for various finance services e.g. credit scoring & risk estimation

#### Research Associate, IIT Kanpur-ISRO Collaboration

Aug '17 - Dec '17

## Research Intern, IBM Research Lab

Hierarchical sparse representation of Knowledge base (KB)

Jun'17 - Aug'17

[Presentation]

• Proposed a tree structured prior for representation learning of KB. Used proximal gradient to deal with non-smoothness

#### Extreme Blue Intern, IBM

Internet of Things (IOT) in Agriculture

May'16 - Jul'16

[Video]

• Crop health monitoring from NIR & RGB images and various sensors. Awarded AEGIS GRAHAM BELL AWARD

#### Research Intern, Samsung

May'15 - Jul'15

#### **PUBLICATIONS**

• A.Kumar, T.Guha, P.Ghosh, Dirichlet Latent Variable Model: A Dynamic Model Based on Dirichlet Prior for Audio Processing, IEEE Transaction on speech and language processing (2019) [Paper]

Extended below model to incorporate multi-order bidirectional dependency and to newer applications

• A. Kumar, T. Guha, P. Ghosh, A Dynamic Latent Variable Model for Source Separation, Int. Conf. on Acoustics, Speech and Signal Processing (ICASSP'18)

[Paper]

Developed a dynamic latent variable model for time-varying non-negative data. Proposed a novel prior distribution which is particularly suitable for dynamic non-negative data and yields elegant update equations. It also lead to connecting our model to the two popular latent basis learning methods - PLCA and NMF

- A.Kumar<sup>+</sup>, L.Pandey<sup>+</sup>, V.Namboodiri, *Monoaural audio source separation using* VAE, **Interspeech** '18 [Paper] Proposed a principled generative approach using VAE for audio source separation. VAE computes efficient Bayesian inference which leads to a continuous latent representation characterizing each source. Our method performed better than best of the relevant methods with 2 dB improvement in the source to distortion ratio
- A. Kumar<sup>+</sup>, K. Morabia<sup>+</sup>, W. Wang, K. Chang, VAMWOD: Visual Attention-based Model for Webpage Object Detection, (Submitted to CVPR '21)

#### **SKILLS**

- Programming: Python, Matlab, C, C++, LaTex, R, JavaScript
- Other Technologies: PyTorch, TensorFlow, Caffe, Scikit-learn, AWS, GIT

#### RELEVANT COURSEWORK

Machine Learning for Computational Biology • Advanced Bioinformatics • Advanced Biochemistry • Computational Bio-engineering • Machine Learning • Computer Vision • Natural Language Processing • Convex Optimization • Algorithms

## **PROJECT HIGHLIGHTS**

## Latent representation based gene regulatory network inference from multi-omic data Prof. Jian Peng, UIUC

Aug' 19 - Present [Report]

- Developed a DNN architecture to characterize a gene with complex 3D structure and epigenomic features.
- Implemented a gene interaction ranking framework from ENCODE epigenomic fetaures and L1000 gene expression

#### Visual grain quality estimation

Aug'16 - Nov'16

## Prof. T. Guha, IITK, (Best project in Image Processing course)

[Report]

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

#### Diverse feature selection in Latent Variable models

Jan' 16 - Apr'16

Prof. P. Rai, IITK

[Project Material]

 Reformulated maximum likelihood objective function of Probabilistic PCA and Matrix factorization as maximum aposteriori estimation. Used determinantal point processes and mutual angular regualizer as priors for diverse selection of latent features.

# Unsupervised speaker diarization

Jan' 16 - Apr'16

Prof. T. Guha, IITK

[Project Material]

• Designed an end-to-end pipeline for speaker diarization. The preprocessing stage included extracting MFCC features followed by speaker activity detection. Each speaker was modeled with a multivariate normal distribution. Hypothesis testing with bayesian information crieria was employed for speaker segmentation. Finally clustering was employed to cluster each segments.

## Multiple Word Vector Embedding for polysemous words

Sep' 15 - Nov' 15 [Project Material]

Prof. A. Mukherjee, IITK

• Extended word vector model to have multiple representations for polysemous words

- Proposed two parametric and two non-parametric solutions that beat state-of-the-art in several specific cases
- Our primary contribution was in developing a non-parametric approach to clustering for optimal number of senses

#### Visual Odometry in Self-Driving Car

Sep' 15 - Nov' 15

Prof. G. Pandey, IITK

[Project Material]

- Developed and implemented visual odometry in self-driving car using opency library in C++
- SIFT and FAST features were extracted in each frames
- KLT tracker with RANSAC for outlier rejection was employed for tracking features

#### Multiple Kernel Learning (MKL)

Sep' 15 - Nov' 15

Prof. H. Karnick, IITK

[Project Material]

 Implemented and performed experiments to show that MKL automatically learns efficient weighted distribution of multiple kernels and have the potential to handle data coming from heterogeneous sources