Avinandan **Bose**

JUNIOR UNDERGRADUATE · INDIAN INSTITUTE OF TECHNOLOGY KANPUR

Kanpur,Uttar Pradesh,India

(+91) 62-9066-5147 | avibose@iitk.ac.in | avinandan22.github.io | Avinandan22 | avinandan-bose-9114b5176

Education

Indian Institute of Technology Kanpur(IITK) — *Kanpur,Uttar Pradesh*

Bachelor of Technology in Computer Science and Engineering — *July.2018 - PRESENT(Expected Nov.2021)*

- Cumulative Performance Index(CGPA): **9.32/10.0** (After six semesters)

Research Interests

1. Large Scale Multi Agent Reinforcement Learning (Collaborative and Competitive)
2. Game Theory and Behavioural Models
3. Decision Making under Uncertainty
4. Deep Generative Models

Work Experience

Research Assistant, CARE.AI LAB, School of Information Systems — *Singapore Management University*

Prof.Arunesh Sinha, Prof. Pradeep Varakantham, Prof.Mai Ahn Tien — *May.2021 - PRESENT*

- Paper on a hierarchial system of GANs to learn from feedback from other dependent GANs (Submitted AAAI 22).
- Working paper on Distributional Robustness in Stackelberg Games with Quantal Response.
- Working paper on Improving Cooperation in Collaborative Large Scale Multi Agent Systems.

Research Assistant, Dept of Computer Science and Engieering — *IITK*

Prof.Piyush Rai — *Dec.2020 - Mar.2021*

- Paper on non-parametric generative models for images using Second Order Neural ODEs (Submitted, AAAI 22)

Research Assistant, Interdisciplinary Statistical Research Unit — *Indian Statistical Institute, Kolkata*

Prof.Soumendu Sundar Mukherjee — *Dec2019,May.2020- Oct.2020*

- Paper on Change Point Analysis of Topic Proportions in Temporal Text Data (Submitted, JCGS)

Submitted Papers

NeurInt : Learning to Interpolate using Neural ODEs — *Dept of Computer Science and Engineering,IITK*

Avinandan Bose, Aniket Das, Yatin Dandi, Piyush Rai,*Association for Advancement in Artifical Intelligence (AAAI),2022*[Under Review] — *Dec.2020-Mar.2021*

- Developed a generative model for images that learns a distribution of smooth continuous-time interpolation trajectories for a given source-target pair and generates images by subsampling random interpolation curves drawn from the trajectory distribution.
- Parameterised the conditional distribution of interpolation trajectories with Probabilistic Second Order Neural ODEs and formulated the resultant model as a modified Generative Adversarial Network with a nonparametric data-dependent prior for the latent code
- Benchmarked against appropriate GAN and Bidirectional GAN baselines that employ a fixed latent code prior and obtained significant improvements in image generation and interpolation

Multiscale Generative Models: Improving Performance of a Generative Model Using Feedback from Other Dependent Generative Models — *Singapore Management University*

Chen Changyu,**Avinandan Bose**, Shih-Fen Cheng, Arunesh Sinha,*Association for Advancement in Artifical Intelligence (AAAI),2022*[Under Review] — *May.2021-Sept.2021*

- Modelled a system of multiple interacting generative Models (GANs) trained in a hierarchical setup where a higher level GAN is conditioned on the output of several lower level GANs.
- Achieved the goal of training a newly arrived lower level GAN on very limited data through feedback from the pre-trained system of dependent GANs.

Change Point Analysis of Topic Proportions in Temporal Text Data

Interdisciplinary Statistical Research Unit,ISI, Kolkata

Avinandan Bose, Soumendu Sundar Mukherjee,*Journal of Computational and Graphical Statistics(JCGS)*[Under Review]

Dec.2019,May.2020-Oct.2020

- Investigated various online and offline change point estimation algorithms and reviewed topic modelling literature in depth.
- Proposed and developed a novel efficient temporal topic model with provisions for change points to capture offline changes in topic proportions of large corpuses of temporal textual data.
- Our method is extremely fast on very large corpora as well as robust to predicting false positives.
- Change Point Estimation is widely studied but has received very little attention in textual data, hence our work is among the very few available.
- Our method estimated literary era changes in 19th-20th century English Literature Data consisted with linguists works, and scientific trend changes in the field of High Energy Physics in agreement to the beliefs of the scientific community.
- Proposed work facilitates the automated detection of change points in large corpora without any domain knowledge. Our model also serves to explain changes through topic interpretability.

Ongoing Research Projects

Distributional Robusteness in Stackelberg Games with Quantal Response

Singapore Management University

Research Project under Prof. Arunesh Sinha and Prof. Mai Ahn Tien

May.2021-PRESENT

- Developing methodologies for Distributionally Robust Optimization (DRO) in Stackelberg Games with Quantal Response.
- A challenging setting because the objective : $\max_x \min_\theta f(x, \theta)$ where $f()$ is neither concave in x nor convex in θ and the parameter space is also constrained. Prior works have only developed approaches to reach a stationary point in nonconcave-convex max-min relaxed versions or global optimum in a special cases with convex risk functions.
- Reformulated the problem as a Mixed Integer Linear Program which achieves the global optima.
- Derived theoretical bounds on reaching the global optima when using approaches to scale up such as clustering and stratified sampling.
- Currently working towards applications of our method in ML domains.

Improving Cooperation in Large Scale Collaborative Multi Agent Systems

Singapore Management University

Research Project under Prof. Pradeep Varakantham

May.2021-PRESENT

- Working on centralized execution in large scale cooperative multi agent systems.
- Past approaches have used Value Decompositions as a sum of individual agents' values in order to prevent the joint action space from combinatorially blowing up when the number of agents is very large . However this misses out on the benefits of collaboration and knowledge sharing between agents.
- We developed a method based on estimating an expectation of values of neighbouring agents conditioned on an agent's chosen action.
- We are able to significantly improve rewards while keeping the computational complexity at the same level as Value Decomposition Functions as sum of individual agents' values.

Other Projects

Lock-Free Parallelized SGD for Matrix Factorization

Dept of Electrical Engineering,IITK

Course Project for Convex Optimization under Prof.Ketan Rajawat[CODE] [REPORT]

Jan.2020 - Apr.2020

- Reviewed literature on Parallelized Stochastic Gradient Descent with particular focus on Matrix Factorization Tasks.
- Matrix Factorization datasets hardly ever have entries missing completely at random. Proposed a method to permute the rows and columns to identify and separate patches of high density from a seemingly sparse matrix.
- Developed a method to solve matrix factorization problems by combining ideas from HOGWILD and stratified SGD, which highly improved convergence rates on the permuted matrix in synthetic and real datasets.
- Worked on a theoretical analysis of convergence rates of the proposed method, and contrasted with existing methods.

Online Bayesian Tensor Completion for Traffic Estimation

Dept of Electrical Engineering,IITK

Undergraduate Project under Prof.Ketan Rajawat[REPORT]

Aug.2019 - Nov.2019

- Reviewed papers on Variational Bayesian Inference for Robust Streaming Tensor Factorization and Completion with a focus on Traffic Estimation via Online Variational Bayesian Subspace Filtering.
- Studied and understood Tensor Algebra, Low rank Tensor Factorization, Time Series Analysis.
- Proposed a method where Tensor Factorization and Completion follows first order Auto Regressive model for its temporal variation.
- Proposed method applicable in online prediction of estimated time of arrival for cab services.

Honors & Awards

2019,2020	**Academic Excellence Award,** Awarded to top 5 percent students based on annual academic performance	*IIT KANPUR*
2018	**CLASS OF 1990 SCHOLARSHIPS,** awarded to top three rankers of institute	*IIT KANPUR*
2018	**All India Rank 104,** Joint Entrance Examination Advanced 200,000 candidates	*India*
2018	**All India Rank 554,** Joint Entrance Examination Main 1.5 million candidates	*India*
2017	**All India Rank 68,** KVPY Scholarship Indian Institute of Science and Government of India	*Bangalore,India*
2018	**All India Rank 1,** West Bengal Joint Entrance Examination	*West Bengal,India*
2018	**Gold Medal,** Indian National Physics Olympiad	*Mumbai,India*
2015	**Gold Medal,** Indian National Junior Science Olympiad	*Mumbai,India*
2017	**3rd in State, National Top 1 %,** National Standard Examination in Physics	*India*
2017	**3rd in State, National Top 1 %,** National Standard Examination in Chemistry	*India*
2017	**2nd in State, National Top 1 %,** National Standard Examination in Astronomy	*India*
2016	**3rd in State, National Top 1 %,** National Standard Examination in Astronomy	*India*
2016	**State Top 1 %,** National Standard Examination in Physics	*India*
2014	**State Top 1 %,** National Standard Examination in Junior Science	*India*
2016	**Scholar,** National Talent Search Examination	*India*

Skills

Languages	Python, R, C,C++
Deep Learning Frameworks	PyTorch, Tensorflow, Keras, TorchGAN
Data Science Libraries	NumPy,SciPy,Pandas,Scikit-Learn,Gensim
Optimization Softwares	Gurobi, CPLEX
Utilities	Linux Shell Utilities,Git,Vim,LaTeX,MATLAB

Course Work

Graduate Level Courses at IITK

Convex Optimization in Signal Processing and Communication A
Decision Theory and Bayesian Analysis A
Topics in Probabilistic Modelling and Inference[@]
Introduction to Machine Learning A
Stochastic Processes
Quantum Computing A
Game Theory and Mechanism Design [i]
Statistical Simulation and Data Analysis [i]
Algorithmic Game Theory [i]

Other Relevant Courses

Real Analysis and Multivariate Calculus A*
Probability and Statistics A
Fundamentals of Programming A*
Theory of Computation A
Linear Algebra and Ordinary Differential Equations
Data Structures and Algorithms A
Discrete Mathematics for Computer Science A
Advanced Algorithms
Partial Differential Equations A
Mathematical Economics A

A : Grade for exceptional performance(Top 1%)*
@ : audit
i : in progress

Positions of Responsibility

Special Interest Group in Machine Learning(SIGML) IIT KANPUR — *Kanpur, India*

Coordinator — *May. 2020 - PRESENT*

- Responsible for delivering and conducting talks for presenting papers, the speaker's research work, and lectures on specialized subfileds of Machine Learning
- Responsible for conducting sessions aimed at Student and Faculty Researchers in Machine Learning for discussion of their current research problems and cross-pollination of ideas and insights

Association of Computing Activities(ACA) IIT Kanpur — *Kanpur, India*

Project Mentor — *Jan.2020-Apr.2020*

- Mentored a group of twenty freshmen on Probabilistic Machine Learning and its applications
- Conducted lectures, authored weekly assignments and mentored projects on Bayesian Matrix Factorization, Black Box VI and Auto Encoding VB, Stepwise and Incremental EM, Variational Autoencoders

Programming Club IIT KANPUR — *Kanpur, India*

Secretary — *Mar. 2019 - Mar. 2020*

- Responsible for conducting contests and activities for campus community and conducting lectures and workshops on various topics for interested students