Avinandan **Bose**

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Education

Indian Institute of Technology Kanpur — *Kanpur,Uttar Pradesh*

Bachelor of Technology in Computer Science and Engineering — *July. 2018 - PRESENT*

- Cumulative Performance Index(CGPA): **9.40/10.0** (After five semesters)

Research Interests

Online Learning and Real-time Inference, Sequential Decision Making, Temporal Data Analysis, Neural ODEs, Multi Agent Reinforcement Learning, Change Point Estimation, Topic Models, Deep Generative Models

Work Experience

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

Prof.Soumendu Sundar Mukherjee — *Dec 2020 - PRESENT*

- Working on developing scalable models for multi-agent systems for the purpose of sequential decision making.
- Particular focus on online learning when number of agents grow large in number.

Submitted Papers

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

Research Project under Prof.Piyush Rai — *Aug.2020-PRESENT*

- Proposed a novel approach to train Generative Adversarial Networks by learning a flexible prior over interpolations conditioned over a source and a target image.
- Instead of relying on deterministic interpolation approaches, devised a framework that models the interpolation trajectories between images by Neural Ordinary Differential Equations and a deep generative model is learned by learning to interpolate between pairs of images.
- Proposed framework was effective in producing images of improved quality as well as learning a distribution over smooth and reversible interpolation trajectories between images.
- Our trajectories exhibit great amount of diversity in class labels of interpolation images, which is lacking in standard interpolation techniques.
- This joint training framework learns a latent space, which highly favours interpolation, whilst preserving image quality.
- Work currently under peer review at ICML 2021.

Change Point Analysis of Topic Proportions in Temporal Text Data — *Interdisciplinary Statistical Research Unit,ISI, Kolkata*

Research Project under Prof.Soumendu Sundar Mukherjee — *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.
- Work is currently under peer review at ACL-IJNLP 2021.

Ongoing Research Projects

Sequential Decision Making and Online Learning in Multi-Agent Systems — *Interdisciplinary Statistical Research Unit,ISI, Kolkata*

Research Project under Prof.Soumendu Sundar Mukherjee — *Dec.2020-PRESENT*

- Reviewed literature on Reinforcement Learning, Interacting Particle Systems and Game Theory.
- Exploring stability in systems having a large number of agents, by conditioning policies on a dynamic set of competitors per agent.

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	Proficient : C,C++, Python Familiar : Javascript
Deep Learning Frameworks	PyTorch, TorchGAN
Data Science Libraries	NumPy,SciPy,Pandas,Scikit-Learn,Gensim
Utilities	Linux Shell Utilities,Git,Vim,LaTeX,MATLAB

Course Work

Real Analysis and Multivariate Calculus A*
Linear Algebra and Ordinary Differential Equations
Discrete Mathematics for Computer Science A
Convex Optimization in Signal Processing and Communication A
Introduction to Machine Learning A
Advanced Algorithms
Stochastic Processes[i]
Quantum Computing[i]
Fundamentals of Programming A*
Data Structures and Algorithms A
Topics in Probabilistic Modelling and Inference[@]
Bayesian Analysis A
Theory of Computation A
Partial Differential Equations A
Mathematical Economics[i]
Probability and Statistics[i]

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