KUSHAGRA GUPTA

SENIOR UNDERGRADUATE, IIT KANPUR

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EDUCATION

- **Bachelor of Science** — **Indian Institute of Technology, Kanpur**
  Major: Mathematics and Scientific Computing, GPA: ***9.2/10*** — *(expected) April 2021*
  Minor: English Literature
- **CBSE AISSCE (standardized 12th grade)** — **Delhi Public School, Jaipur**
  Science and Mathematics, ***95.6*** % — *May 2017*

PUBLICATIONS

- **Estimating Monte Carlo variance from multiple Markov chains** **[arXiv]**
  Kushagra Gupta, Dootika Vats — *July 2020*
  Under Review: *Journal of Machine Learning Research* (JMLR)
  - Proposed a multivariate replicated batch means (RBM) estimator of the limiting covariance of ergodic averages from parallel Markov chains and demonstrated its superior convergence and finite sample properties.
  - Proved strong consistency and obtained bias and variance of the estimator under weak mixing conditions.
  - Obtained the closed form asymptotic covariance matrix expression for bivariate normal Gibbs sampler.
- **Bayesian equation selection on sparse data for discovery of stochastic dynamical systems** **[arXiv]**
  Kushagra Gupta, Dootika Vats, Snigdhansu Chatterjee — *Jan 2021*
  Under Review: *Technometrics*
  - Developed a Bayesian variable selection technique for identification and elicitation of dynamic systems.
  - Proposed computational strategies that are critical in teasing out the important details about the dynamical system and algorithmic innovations to solve for acute parameter interdependence in the absence of rich data.
  - Discussed the sources of unreliability and instability in inferring dynamical systems from observed data.

RESEARCH PROJECTS

- **Bayesian Inference on 3 Parameter Weibull Distribution** **[details]**
  - Prof. Debasis Kundu (IIT Kanpur)
  - Statistically motivated the approximation of the log-concave posterior by a Gamma density based on moment conditions and explained the inconsistency and inefficiency in MLE estimation for certain cases.
  - Dramatically improved efficiency of the supervisor's posterior decomposition based inference algorithm.
- **Interval Regression using Bayesian Inference** **[details]**
  - Prof. Mohammad A. Rahman (IIT Kanpur), Prof. Dootika Vats
  - Explored interval regression paradigms covering quantile regression (QR), meta-heuristic algorithms, information theory, convex analysis, and set arithmetic linear models.
  - Extended Bayesian QR to continuous and partially observed variables by modifying the quantile loss function.

PROGRAMMING PROJECTS

- **Multi-Class Image Segmentation on Extremely Small Datasets** **[details]**
  - Inter IIT Tech Meet, IIT Bombay (Silver Medal)
  - Designed and implemented a U-Net architecture for image segmentation of high quality satellite images by using context-based representations and localized optimization of parameters with high frequency.
  - Developed a 'one vs all' algorithm with 9 U-Nets to improve accuracy on just 25 images.
- **Multi-Agent Reinforcement Learning using Latent Code** **[details]**
  - Dept. of Computer Science and Engineering, IIT Kanpur
  - Created self-play algorithm for multi-agent atari games. Used variational autoencoders to disentangle multiple near optimal policies extracted with the help of latent code.
  - Achieved close to state of the art win probabilities in multi-agent CTF in collaborative and competitive settings.

Fully Homomorphic Encryption Library **[details]**
- Programming Club, IIT Kanpur

- Implemented a `C++` Fully Homomorphic Encryption library with `libtorch` based on the generation scheme of Gentry, Sahai, and Waters, capable of parallel computation and Automatic Differentiation.
- Extended current implementation of approximate eigenvector method for encryption to reach close to asymptotic fastest encryption based on learning with errors.

WORK EXPERIENCE

Proprietary Trading Strategies **April 2020 - June 2020**
Quantitative Researcher, Kivi Capital, Gurgaon

- Designed trading strategies combining technical indicators from diverse time-frames to capture market trends.
- Conducted a comprehensive study of candlestick trading patterns for medium frequency trading of futures.

Online Recommendation Engine based on Implicit Feedback **[details]**
Machine Learning Intern, New York Office, IIT Kanpur

- Implemented state-of-the-art algorithm for online collaborative filtering based on Fast Matrix Factorization.
- Implemented Bidirectional LSTM based model for flagging hate-speech on comments with ELMO embedding.

RELEVANT COURSEWORK

Statistics	Bayesian Inference, MCMC, Machine Learning*, Econometrics*, Probability Theory, Inference**, Statistical Simulations and Data Analysis*, Time Series, Stochastic Processes
Mathematics	Advanced Linear Algebra, Several Variable Calculus, Real Analysis*, ODE, PDE
Programming	Data Structures and Algorithms, Scientific Computing, Fundamentals of Computing

: (A) exceptional performance **: in progress

TECHNICAL SKILLS

Languages	R, Python, C/C++, Matlab, Stan, Golang
Frameworks	Pytorch, Keras, Libtorch, Tensorflow, Scikit-learn
Softwares/Libraries	rstan, mcmcse, sgmcmc, Scipy, OpenAI gym, Gensim, NLTK

ACHIEVEMENTS AND ACCOLADES

- Department rank in **top 5**.
- **Silver medals** in Inter IIT Technical Meet in Machine Learning and Data Science competitions.
- **All India Rank 157** among 1,500,000 in IIT Joint Entrance Examination (JEE) Mains.
- **National top 1%** in National Standard Examination in Physics, level 1 of IPhO.
- **Statewise top 1%** in National Standard Examination in Chemistry, level 1 of IChO.
- **Kishore Vigyan Protsahan Yojana(KVPY)** fellow in 2016 and 2017,
- **National Talent Search Examination(NTSE)** scholar 2015, awarded by Govt. of India.
- **State topper of Mathematics** in IAIS, organized by UNSW Australia.
- **Mentored more than 150 students** for projects on statistics and machine learning.

EXTRACURRICULARS

Leadership	*Coordinator*, Programming Club, IIT Kanpur
	Coordinator, Mathematics and Statistics Society, IIT Kanpur
Positions	*Member*, Probabilistic Machine Learning and Inference Group, Dept. of CSE, IIT Kanpur
	Student Nominee, Department Undergraduate Committee, IIT Kanpur
Talks	Markov chain Monte Carlo, Special Interest Group in Machine Learning, IIT Kanpur [slides]
	Machine Learning Winter Camp, Programming Club, IIT Kanpur [slides]
Debating	*Honourable Mention* in Parliamentary Debate, Hindu College
	Chair of the Asian Parliamentary Debate, Cultural Festival IIT Kanpur
Other	*Core group member* of journalism cell, IIT Kanpur and Debating society, IIT Kanpur