KUSHAGRA GUPTA

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EDUCATION

IIT Kanpur
B.Sc in Mathematics and Scientific Computing, GPA: 9.1/10 *Expected Graduation: June 2021*
Delhi Public School, Jaipur
Science and Mathematics, 95.6% *CBSE AISSCE 2017*

RELEVANT COURSEWORK

Numerical Analysis and Scientific Computing
Markov Chain Monte Carlo*
Probability Theory*
Probability and Statistics
Data Structures and Algorithms
Bayesian Inference* Linear Algebra
Bayesian Econometrics*
Stochastic Processes Real Analysis
∗: In progress

PROJECTS

Multi-Agent Reinforcement Learning using latent code *Research Project*
- Working on multi-agent self-play in atari games in collaborative and competetive settings
- Currently working on using variational autoencoders to disentangle multiple near optimal policies extracted using latent code.
- Initial results on the model gave win probability of 72%, which is close to 80% SOTA values, and much better than human score of 40% in multi-agent CTF.
- Developing a generative model for InfoRL to maintain unsupervised setting for latent code generation to allow all standard MARL algorithms to be used with InfoRL.

Multi-Class Image Segmentation on extremely small datasets *ML Competition*
Inter IIT Tech Meet, IIT Bombay
- Designed and implemented a U-Net architecture for image segmentation of high quality satellite images by using context-based representations.
- Improved existing accuracy from 84% to 91% on just 25 images by developing new algorithm based on 9 U-Nets using 'one vs all' classification approach.
- Won the silver medal in the competition. Currently working on designing custom U-Nets for each class in the multi-class classification.
- Used localized optimization of parameters with high frequency to break bottleneck of small dataset.

Fully Homomorphic Encryption Library *Research Project*
- Programming Club, IIT Kanpur
- Implemented a C++ FHE library based on GSW encryption system using libtorch with CUDA to enable parallel computation with Automatic Differentiation.
- The only University in India to develop a fully homomorphic encryption crpytography; one of only 2 homomorphic schemes to make multiplication homomorphic without re-linearization or bootstrapping.
- Extended current implementation of approximate eigenvector method for encryption to reach close to asymptotic fastest encryption based on learning with errors.

Interval Regression using Bayesian Inference *Undergraduate Project*
- Developing a new paradigm for Bayesian Inference by extending set arithmetic for interval-valued variables.
- Implemented SOTA approaches covering convex optimization, swarm minimization, linear programming and Information Theory for Interval Regression.
- Extending existing Bayesian Quantile Regression to cover problems involving continuous and partially observed variables.

Bayesian Inference on 3 parameter Weibull Distribution *KVPY project*

- Prof Debasis Kundu, IIT Kanpur

- Developed algorithm for parameter estimation of 3-Weibull distribution using bayesian inference, achieving MSE of 0.007 as compared to 0.015 for general Bayesian methods for 25 data points.
- Improved performance of existing bayesian based algorithm for parameter estimation of both 2-Weibull and 3-Weibull distribution using numerical optimization techniques, reducing running time to less than 30 seconds from more than 5 minutes.
- Implemented MCMC sampling methods using Metropolis-Hasting and Gibbs-Sampling methods.

WORK EXPERIENCE

SOTA Online Recommendation Engine based on Implicit Feedback *May 2018 - November 2018*

Machine Learning Intern in New York Office, IIT Kanpur

- Implemented state of the art algorithm for online collaborative filtering based on Fast Matrix Factorization for Online Recommendation with Implicit Feedback, achieving NDCG close to 0.8 after only 2 online iterations.
- Integrated element-wise Alternating Least Squares (eALS) based incremental update strategy for online learning to tackle cold-start problem, reducing time from 21 minutes to 72 seconds and achieving hit ratio of more than 0.5 after only 1 user interaction.
- Developed online collaborative filtering based deep learning algorithm recommender based on AutoEncoder using tensorflow.

Toxic Comments Detection *June 2018 – July 2018*

Machine Learning Intern in New York Office, IIT Kanpur

- Implemented Bidirectional LSTM based model for flagging hate-speech on comments based on six metrics.
- Further improved the performance by using ELMO word representation to introduce contextualized word-embedding, increasing performance of baseline model by 6.8%.

ACHIEVEMENTS AND ACCOLADES

- **Coordinator Programming Club**- Conducted lecture series, projects, reading-groups, hackathons and winter-camps on machine learning and mathematics topics.
- **Coordinator, Stamatics** - Head of the student body, dept of Mathematics and Statistics. Responsible for conducting colloquium and lectures.
- Part of the **Probabilistic Machine Learning and Inference group, IIT Kanpur**, headed by Prof. Piyush Rai.
- **Kishore Vigyan Protsahan Yojana(KVPY)** fellow in 2016 and 2017, **National Talent Search Examination(NTSE)** scholar 2015
- Awarded **A* (for exceptional academic performance)** in Econometrics, Real Analysis, General Relativity and Mechanics and Introduction to Literature.
- Cleared level 1 of Physics and Chemistry International olympiads in **National Physics (NSEP) and Chemistry Olympiads (NSEC)**,
- **Student's representative to Departmental UG Committee, Mathematics** - Responsible for representing mathematics UG students in the university academic committee.
- **Mentored more than 150 students** for projects on Language Models, Optimization Techniques, cryptoML and reinforcement learning under Programming Club and Stamatics, IIT Kanpur.
- 2nd prize in Inter IIT Tech Meet in Machine Learning.
- JEE mains rank 157 among 15 lakh candidates and JEE advanced rank 768 among 1.72 lakh candidates

TECHNICAL SKILLS

Interests - Applied Mathematics | Deep Learning | Bayesian Inference | Reinforcement Learning
Languages - C++ | C | Python | Matlab | R | Golang |Julia
Frameworks used - Pytorch | Keras | Libtorch | Tensorflow | Scikit-learn
Softwares/Libraries used - OpenAI gym | Gensim | NLTK | Pandas | Scipy | Kafka | BeautifulSoup | Couchbase | Docker | Locust | Numpy