VAIBHAV KUMAR

Research Assistant, IITM ⋄ Associate Data Scientist, UnitedHealth Group
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EDUCATION

Bachelor of Technology in Computer Science 2016 - 2020
Delhi Technological University, Delhi. CGPA: 8.25/10

CBSE, Intermediate /+2 2014 - 2016
KIIT World School, Delhi, 94.8%

CBSE, Matriculation 2014
KIIT World School, Delhi, CGPA: 10/10

SKILLS AND INTERESTS

Natural Language Processing, Reinforcement Learning, Machine Learning, Computer Vision, Parallel Programming, Time Series Analysis, Optimization.

RESEARCH EXPERIENCE

Research Intern – Gender Bias Benchmark Tests August'20 - Present
Indian Institute of Technology, Madras, Guide: Dr. Mitesh and Dr. Pratyush *Madras, India (WFH)*

- Exploring the interpretability and gender-based reasoning ability of language models like BERT.
- Utilizing socially and psychologically grounded templates to expose gender bias in fine tuned natural language inference models with an aim to make them more robust.
- Employing ideas from the latest developments in the intersecting fields of NLP and software engineering to create checklist based test cases to summarize the stereotypes.

Summer School – Eastern European Machine Learning (EEML) 1 July'20 - 9 July'20
EEML (Virtual) *Krakow, Poland*

- Accepted into the **EEML** summer school after shortlisting for the poster presentation of a short paper.
- Poster presentation on **Gender Bias in Hyperbolic Word Embeddings** which extends our earlier work of bias in Euclidean vector space to the hyperbolic space.
- Proposed and presented the idea of black box optimization using Bayesian Deep Reinforcement Learning with an international team of seven students for the EEML unconference session.

Research Assistant – Hyperbolic Word Embedding Specialization Jun'20 - August'20
LCS2 Lab, IIITD, Guide: Dr. Tanmoy Chakraborty *IIITD, Delhi*

- Studied the Gyrovector Space as a Hyperbolic analogue to the Euclidean vector space.
- Proposed a new generalized metric and debiasing objective for bias in Poincaré-GloVe.
- Currently improving upon the research paper recently rejected at EMNLP 2020.

Research Assistant – Mitigating gender bias in Word Embeddings Sep'19 - Jun'20
LCS2 Lab, IIITD, Guide: Dr. Tanmoy Chakraborty *IIITD, Delhi*

- Created a new metric (Gender Based Illicit Proximity Estimate, GIPE) to quantify gender bias in word embeddings while considering the effect of words in a certain proximity of the target word.
- Devised and optimized a custom objective function in pyTorch with heavy use of the autograd engine.
- Achieved state-of-the-art results in minimizing gender bias while introducing minimal semantic offset.
- Contributed as the first author of a full paper accepted at the prestigious **TACL journal** and open-sourced all the related code and data with reproducibility guidelines on GitHub.

Research Intern – Predictably Securing Network Systems Through Sequence Modelling and Reinforcement Learning Jun'19 - Nov'19
Guide: Dr. Arun Balaji Buduru *IIITD, Delhi*

- Developed a novel attention based network called "AnomalyNet" to predict attacks in network systems.
- Trained the network over a class-imbalanced data using an Imbalanced classification Markov decision process (ICMDP) based approach and attained competitive results over the CTU-13 dataset.
- Related paper currently under review at the Asia-CCS 2020 Conference.

WORK EXPERIENCE

Associate Data Scientist August'20 - Present
Optum (UnitedHealthGroup) *Bangalore, India (WFH)*

- Working with the natural language processing team for intent mining and test-case generation.
- Utilized graph-based natural language processing techniques to generate new test cases for software testing.
- Creating interpretable NLP based models and techniques for real-time intent classification and prediction over the UnitedHealthcare customer care chat.

PUBLICATIONS

Nurse is Closer to Woman than Surgeon? Mitigating Gender-Biased Proximities in Word Embeddings
Vaibhav Kumar, Tenzin Singhay Bhotia, Vaibhav Kumar, Tanmoy Chakraborty - Published in Transactions of the Association for Computational Linguistics (**TACL**), Volume 8, 2020 p.486-503.

Fair Embedding Engine: A Library for Analyzing and Mitigating Gender Bias in Word Embeddings
Vaibhav Kumar, Tenzin Singhay Bhotia, Vaibhav Kumar - Accepted at 2nd Workshop for Natural Language Processing Open Source Software at Empirical Methods in Natural Language Processing (**NLP-OSS, EMNLP**), 2020.

Multiple Resource Management and Burst Time Prediction using Deep Reinforcement Learning
Vaibhav Kumar, Siddhant Bhambri, Prashant Giridhar Shambhakar - International Journal of Advanced Computer Science and Applications (**IJACSA**), January, 2019.

AnomalyNet: A Context Sensitive Early-Warning Technique to Predicting Security Threats in Stochastic Environments
Vaibhav Kumar, Tenzin Singhay Bhotia, Aarindam Roy, Avinash Tulasi, Arun Balaji Buduru - **Under Review** at ACM Asia Conference on Computer and Communications Security (**AsiaCCS**), 2020.

PROJECTS AND OPEN SOURCE CODE

Fair Embedding Engine

- Fair Embedding Engine: A Library for Analyzing and Mitigating Gender Bias in Word Embeddings.
- FEE will facilitate the development and testing of debiasing methods for word embeddings models and also make it easier visualize the bias present in word vectors, demonstrating their possible impact.

Food Waste Prevention

- Multi-Agent RL for dynamic pricing of food to save wastage while maximizing profit.
- Carefully crafted an OpenAI gym compatible environment for food waste prevention by considering various economic theories and implications.

Fair-GAN

- A generative adversarial network based approach to mitigate gender bias in word embeddings.
- The generator generates 300 dimension word embeddings using the existing ones and learns on the basis of how often the discriminator fails to identify the gender of the corresponding word correctly.

- Fair-GAN was able to drastically reduce the direct bias in the GloVe 300D embedding while introducing minimal semantic offset.

yTermPlayer

- A minimal, terminal based YouTube playlist streaming program written in python.
- Published on PyPI with more than 10,000 total downloads (pip install ytermplayer).

Turing Machine Simulator

- Implemented a Turing machine simulator in the Python programming language.
- Used Matplotlib's pyplot to create real-time animation for the running tape of the Deterministic Turing Machine.

ACHIEVEMENTS

Generative Dog Images Aug'19
Silver Medal *Kaggle*

- Won a second silver medal and became a kaggle competitions expert by implementing C-GAN architecture with the Wasserstein GAN loss function for dog image generation.
- Achieved a public MiFID score of 47.02.

Santander Customer Transaction Prediction Apr'19
Silver Medal *Kaggle*

- Won my first silver medal on Kaggle by doing a predictive analysis of transcations by the Santander customers.
- Achieved a public AUC-ROC score of 0.91

TECHNICAL SKILLS

Programming Languages: Fluent in Python, C++; Familiar with JavaScript, Bash and Prolog.
Libraries: pyTorch, Jax, Haiku, Fastai, OpenAI Gym, Pandas, Scikit-Learn, Numpy.
Software Skills: Git, LaTeX.
Development: Docker, Kubernetes, Flask, SQLite, jQuery, HTML, CSS.

POSITIONS OF RESPONSIBILITY

Graphic Designer Sept'18 - Feb'19
Coding Blocks *Delhi*

- Edited more than 200 online lectures for Coding Blocks India in Adobe After Effects and Premiere Pro.
- Created graphics for the Coding Blocks YouTube channel and managed their online video lecture portal.

Graphic Designing Head Sept'16 - Sep'18
Team Engifest *DTU, Delhi*

- Managed the online presence of the biggest fest in north India – Engifest, Delhi Technological University (DTU).
- Created various advertisements, sponsor posters and promotional videos for the fest.

EXTRACURRICULARS

Technical Blogging

- Mathematical Analysis of Reinforcement Learning — Bellman Optimality Equation
- PyTorch 1.3 — What's new?
- Reinforcement learning: Temporal-Difference, SARSA, Q-Learning Expected SARSA in python
- PyTorch Autograd
- Random forests and decision trees from scratch in python
- Deploy Machine Learning Models for Free