Tathagat Verma

Final Year Computer Science Undergraduate, IIT Bombay

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Education

Indian Institute of Technology Bombay, Mumbai, India — *July 2018 - July 2022(expected)*
BTech. in *Computer Science and Engineering* with *Honors* — CPI - **9.65/10**

Research Interests: Deep Generative Models, Graph Neural Networks, Medical Image Processing, Natural Language Processing

Scholastic achievements

- Secured **All India Rank 53** in **JEE Advanced** out of 200,000 candidates *2018*
- Secured **All India Rank 34** in **JEE Main** out of 1.2 million candidates *2018*
- Recipient of the **Quadeye Excellence Scholarship**, awarded on the basis of academic achievements *2021*
- Amongst top **30** in India selected for the **International Astronomy Olympiad** Selection Camp *2018*
- Amongst top **35** in India selected for the **International Mathematical Olympiad** Training Camp *2017*
- Awarded **Advanced Performer (AP)** grade in **3** courses for exceptional performance *2018-21*
- Amongst top 300 students selected for the **Indian National Physics** and **Chemistry Olympiads** *2018*
- Recipient of the **Kishore Vaigyanik Protsahan Yojana** (KVPY) fellowship by **Govt. of India** *2017*

Publications

1. Title: **VarScene: A Deep Generative Model for Realistic Scene Graph Synthesis**
   Authors: ***Tathagat Verma***, *Abir De, Yateesh Agrawal, Vishwa Vinay, Soumen Chakrabarti*
   Conference: IEEE/CVF Conference on Computer Vision and Pattern Recognition 2022
   Status: Under review

Research experience

VarScene: A Deep Generative Model for Realistic Scene Graph Synthesis — *Autumn 2021*
Guides: Prof. Soumen Chakrabarti, Prof. Abir De | *R&D Project* — *InfoLab, IIT Bombay*

- Developed a deep generative model for novel scene graph synthesis using **VAE** and **Graph Neural Networks**
- Designed a goal oriented decoder for minimizing the maximum mean discrepancy between graph distributions
- Developed code in **PyTorch** and used the Visual Genome and Visual Relationship Detection datasets
- Significantly outperformed baselines on the Fréchet Inception Distances (**FID**), Inception Scores (**IS**) and achieved better results on the Shortest Path, Weisfeller Lehman and Neighborhood Subgraph Pairwise Distance kernels

Deep Learning for Medical Image Quality Enhancement — *Spring 2021, Autumn 2021*
Guide: Prof. Suyash Awate | *R&D Project, Bachelor's Thesis Project* — *IIT Bombay*

- Enhanced the quality of MRI images with sub-sampling and Gaussian noise in the frequency domain and PET images with Poisson noise in the sinogram domain under the weakly-supervised regime
- Trained models using the **RED-CNN** and **UNet** architectures with Bayesian learning in **PyTorch**
- Utilized intermediate VGG-16 layers for **style based losses** and Fourier and Wavelet transform loss functions

Internships

Image functionality in the Whiteboard Android Application — *Summer 2021*
Microsoft India (R&D) Pvt. Ltd. | *Software Engineer Intern* — *Noida, India*

- Integrated **Microsoft Lens SDK** into Whiteboard Android, to support image and OCR tools provided by Lens
- Worked in **Java Android** backend, building the bridge to send images from native Android to the web application
- Developed code in **React** for the web application, making the UI component for triggering image workflow

Attribute Value Extraction from Product Descriptions — *Summer 2020*
Coupa Software India Pvt. Ltd. | *Data Science Intern* — *Pune, India*

- Developed unsupervised and semi-supervised methods for extracting attribute values from product descriptions
- Implemented an **RNN** model for sequence tagging using **CRF**, **BiLSTM** and attention mechanisms
- Optimized hyper parameters using **Bayesian Optimization**, reducing time required for tuning the model
- Automated taxonomy creation by clustering on co-occurrence graphs using the **Chinese Whispers Algorithm**

Business Monitoring and Alerting Systems *Summer 2019*
Delta Exchange | *Software Engineer Intern* *Mumbai, India*

- Made real time predictions for prices of multiple Crypto Derivative contracts by implementing ARIMA model
- Developed a dashboard using **Django** to monitor Business Performances, now being used on a daily basis
- Used **MySQL** database along with APIs and **WebSockets** of various exchanges for obtaining real time data

Key technical projects

Blockchain Simulation and Applications *Autumn 2021*
Guide: Prof. Vinay Ribeiro | *Blockchains, Cryptocurrencies and Smart Contracts* *Course Project*

- Implemented a peer-to-peer cryptocurrency network simulation in **C++** following the **Bitcoin** protocols
- Simulated selfish and stubborn mining attacks, analyzing the effects of hash power and network connectivity
- Developed a decentralized payment application on top of **Ethereum** in Solidity, utilizing smart contracts

Adversarial Attacks and Robust Deep Learning Models *Spring 2021*
Guide: Prof. Sunita Sarawagi | *Advanced Machine Learning* *Course Project*

- Implemented the L_2 attack, L_∞ attack with first and second order norms and the L_0 Pointwise attack
- Trained 3 robust models using the methods; Analysis by Synthesis, Stability training and Adversarial training
- Developed code in **Keras**, doing a comparative study using the MNIST dataset on all models & across all attacks

Foreshadow Attack and its Variants *Spring 2021*
Guide: Prof. Bernard Menezes | *Advanced Network Security and Cryptography* *Course Project*

- Studied the **Foreshadow** attack and its impact on **Intel SGX** and **VM** systems due to speculative execution
- Simulated the proof-of-concept attack on **Linux** kernel with **x86** processor in the absence of Intel TSX

Topical Poetry Generation *Autumn 2020*
Guide: Prof. Pushpak Bhattacharyya | *Speech and Natural Language Processing* *Course Project*

- Developed a program to generate any number of poems on a user supplied topic and rhyme scheme
- Used the CMU Pronunciation Dictionary and **Fastext** word embeddings to obtain topical rhyming words
- Created **Finite State Acceptors** to accept word sequences following the iambic pentameter stress pattern
- Extracted fluent poems from the FSA with **RNN** language models trained on the Gutenberg Poetry Corpus

Route Optimization Algorithm *Winter 2019*
Inter IIT Technical Meet *IIT Roorkee*

- Proposed solution for the Vehicle Scheduling Problem in the setting of buses, winning **gold** medal among 20 teams
- Reduced the problem to multiple instances of the Travelling Salesman Problem(**TSP**) using k-means clustering
- Generated routes while taking real time traffic into account using **Google Maps APIs** in Python

Other projects

E-Commerce Recommender System *Spring 2021*
Guide: Prof. Umesh Bellur | *Database Management* *Course Project*

- Built an E-Commerce recommendation website using **Neo4j** graph database and **Node.js** runtime environment
- Included the features of user history, trending products and text similarity metrics to generate recommendations

Compiler for C-like Language *Spring 2021*
Guide: Prof. Uday Khedker | *Implementation of Programming Languages* *Course Project*

- Built compiler for a C-like language, constructing Three Address Code and Register Transfer Language incrementally
- Implemented the scanner in **lex**, parser in **yacc** and conversion of abstract syntax tree to TAC and RTL in C++

Medical Image Segmentation using Deep Learning models *Spring 2020*
Guide: Prof. Suyash Awate | *Medical Image Computing* *Course Project*

- Performed segmentation of neuronal structures from electron microscopy images on the ISBI 2012 dataset
- Implemented and trained the **Deep Multilevel Contextual Network** and **U-Net** models with variations
- Performed ablation studies for U-Nets, achieving results comparable to state of the art models
- Developed code in Keras and implemented weight maps to learn border pixels in cases of touching cells

Portal for Selecting and Evaluating Teaching Assistants *Autumn 2019*
Undergraduate Academic Council *IIT Bombay*

- Revamped the selection portal for Teaching Assistants being used in the Institute by faculty and students
- Developed a **full-stack** application with backend in Django, MySQL DB and frontend with HTML and JavaScript

Splitwise Clone Web Application *Autumn 2019*
Guide: Prof. Amitabha Sanyal | Software Systems Lab *Course Project*
- Built a **Django** web app to automate addition and splitting of bills among stakeholders, similar to **Splitwise App**
- Designed a database in **MySQL** for efficiently implementing features like settling up expenses from all groups
- Provided statistical insights on the type of expenditures made by users, using **JavaScript** and **Highcharts**

Slime Volleyball *Spring 2019*
Guide: Prof. Amitabha Sanyal | Abstractions and Paradigms for Programming *Course Project*
- Developed the Volleyball game, simulating collisions and gravity using functional programming in **Racket**
- Utilized Racket's networking package (**TCP**) for playing the two-player game on separate systems
- Designed an algorithm using heuristic approaches to determine best possible shots for the one player game

Technical Skills

Programming	C++, Python, C, Java, Bash, Solidity, Racket, Prolog, VHDL, SQL, MATLAB
Packages	PyTorch, TensorFlow, Keras, NLTK, SciPy, Pandas, Statsmodels, NumPy, PyQt, NS3
Software	Git, LaTeX, AutoCAD, SOLIDWORKS, Android Studio, Wireshark
Web Development	HTML, CSS, JavaScript, Django, Bootstrap

Relevant Courses

Artificial Intelligence: Foundations of Intelligent and Learning Agents; Machine Learning Theory and Methods; Medical Image Computing; Advanced Machine Learning; Speech and Natural Language Processing; Artificial Intelligence and Machine Learning; Data Analysis and Interpretation

Security: Introduction to Blockchains, Cryptocurrencies and Smart Contracts; Advanced Network Security and Cryptography; An Introduction to Number Theory and Cryptography

Computer Science: Automata Theory; Implementation of Programming Languages; Computer Architecture; Operating Systems; Database and Information Systems; Computer Networks; Data Structures and Algorithms; Digital Logic Design

Mathematics: Calculus; Linear Algebra; Differential Equations; Introduction to Numerical Analysis

Leadership Positions

Institute Student Mentor *Jun 2021 - Present*
Student Mentorship Program *IIT Bombay*
- Mentoring **12 freshmen**, helping them adjust to the institute environment, focusing on their holistic development
- Amongst 130 out of over 300 applicants selected through a rigorous procedure of interviews and peer reviews

Senior Department Academic Mentor *Jun 2020 - Present*
Computer Science and Engineering Department *IIT Bombay*
- Mentoring **6 sophomores** of CSE department to assist them in navigating department specific curriculum
- Working in a supportive, facilitative and developmental role for the student community in general as a mentor

Teaching Assistant *IIT Bombay*
- **Artificial Intelligence and Machine Learning** | *Prof. Ganesh Ramakrishnan* *Jul 2021 - Nov 2021*
- **Data Structures and Algorithms** | *Prof. Sharat Chandran* *Jan 2021 - May 2021*
- **Logic for Computer Science** | *Prof. Krishna S* *Jul 2020 - Nov 2020*

Responsible for conducting doubt sessions, preparing problem sets, programming labs and grading examinations

Organiser in Corporate Relations *Nov 2018 - Mar 2019*
Entrepreneurship Cell *IIT Bombay*
- Responsible for speaker handling and handling overall logistics in multiple events
- Part of the execution team for **The Panel Discussion** at Entrepreneurship Summit, 2019

Extracurricular

- Won **gold** medal in Route Optimization Competition at the **Inter IIT Technical Meet, IIT Roorkee** *2019*
- Represented IIT Bombay at the **34th Inter IIT Aquatics Meet, IIT Guwahati** *2018*
- Awarded **second** position in **CoDecode** (coding competition) organized by Techfest, IIT Bombay *2020*
- Covered a distance of **23.2 km** swimming continuously for **12 hours** at Swimathon, IIT Bombay *2019*
- Awarded Certificate of Merit for **winning** the Inter Department Football Tournament IIT Bombay *2019*
- Awarded Diploma Certificate for competing in the **Gothia Football Cup, Gothenburg, Sweden** *2011*
- Completed 2 levels of graded examination in communication skills from **Trinity College London** *2013*
- Phonathon: Pitched to 50 alumni the events conducted by Student Alumni Relations Cell, IIT Bombay *2019*