

# Tathagat Verma

Final Year Computer Science Undergraduate, IIT Bombay

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## EDUCATION

Indian Institute of Technology Bombay, Mumbai, India

July 2018 - May 2022

BTech. in Computer Science and Engineering with Honors

CPI - **9.64/10**

**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** [\[paper\]](#)  
Authors: **Tathagat Verma**, Abir De, Yateesh Agrawal, Vishwa Vinay, Soumen Chakrabarti  
Conference: International Conference on Machine Learning 2022

## 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

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### 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,  $L_\infty$  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 **Fasttext** 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

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### 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

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<b>Programming</b>	C++, Python, C, Java, Bash, Solidity, Racket, Prolog, VHDL, SQL, MATLAB
<b>Packages</b>	PyTorch, TensorFlow, Keras, NLTK, SciPy, Pandas, Statsmodels, NumPy, PyQt, NS3
<b>Software</b>	Git, L <sup>A</sup> T <sub>E</sub> X, AutoCAD, SOLIDWORKS, Android Studio, Wireshark
<b>Web Development</b>	HTML, CSS, JavaScript, Django, Bootstrap

## RELEVANT COURSES

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**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

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<b>Institute Student Mentor</b> <i>Student Mentorship Program</i>	<i>Jun 2021 - Present</i> <i>IIT Bombay</i>
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- 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

<b>Senior Department Academic Mentor</b> <i>Computer Science and Engineering Department</i>	<i>Jun 2020 - May 2022</i> <i>IIT Bombay</i>
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- 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

<b>Teaching Assistant</b>	<i>IIT Bombay</i>
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- **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

<b>Organiser in Corporate Relations</b> <i>Entrepreneurship Cell</i>	<i>Nov 2018 - Mar 2019</i> <i>IIT Bombay</i>
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- 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

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- Won **gold** medal in Route Optimization Competition at the **Inter IIT Technical Meet, IIT Roorkee** *2019*
- Represented IIT Bombay at the **34<sup>th</sup> 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*