

PRATEEK GARG

✉ prateekg@iitb.ac.in | 🌐 prateekgargx | in prateekgg

EDUCATION

Indian Institute of Technology Bombay

B.Tech in Electrical Engineering and M.Tech in Artificial Intelligence (**Cumulative GPA: 8.68/10.0**)

Minor in Computer Science & Engineering

• **Key Coursework:** Algorithms, Optimization, Probability, Graphical Models, Graph Learning

Mumbai, India

Nov'20 – Present

RESEARCH INTERESTS

Statistical ML, Representation Learning, Causality, Explainable and Fair AI

PUBLICATIONS

- Sahar Nasser, **Prateek Garg**, Shashwat Pathak, Keshav Singhal, Mohit Meena, Nihar Gupte and Amit Sethi, "**Utilizing Radiomic Feature Analysis for Automated MRI Keypoint Detection: Enhancing Graph Applications**" accepted at [11th International Conference on Bioimaging \(BIOIMAGING 2024\)](#); [arXiv:2311.18281]🔗
- Vishak Prasad C, Colin White, Sibasis Nayak, Paarth Jain, Aziz Shameem, **Prateek Garg**, Ganesh Ramakrishnan, "**Speeding up NAS with Adaptive Subset Selection**", under review at [AutoML Conference 2024](#)

RESEARCH EXPERIENCE

Counterfactual Inference and Application to Algorithmic Recourse

Aug'23 – Present

Bachelor's Thesis, Guide: [Prof. Sunita Sarawagi](#)

CSE, IIT Bombay

- ◇ **Introduction:** A fast adoption of algorithmic methods across industries poses significant challenges. Algorithmic Recourse provides recommendations to individuals adversely affected by an automated system.
- Analysed the problem from the lens of Counterfactual Inference, where recommended actions have downstream effects
- Formulated a recourse optimization problem on **temporal processes** where current actions affect future data points
- Developed **synthetic datasets** and conducted extensive experiments to validate the proposed methods

Image Registration using Graph Neural Networks

Jan'23 – Nov'23

Guide: [Prof. Amit Sethi](#)

EE, IIT Bombay

- ◇ **Introduction:** Image registration involves alignment of different images of the same object, crucial for medical imaging. Classical methods which rely on techniques such as feature matching, do not perform well under non-linear deformations.
- Explored Graphs Neural Networks to model image data at **multiple scales** to perform registration at different resolutions
- Created a novel dataset [Medal-Retina](#) consisting of **retinal scans** to evaluate models and algorithms for image registration
- Experimented with different techniques to **Laplacian node embeddings** to enhance performance on downstream task

PROFESSIONAL EXPERIENCE

Modem Firmware Intern | Qualcomm Technologies Inc. | WLAN Firmware team

May'23 – Jul'23

WLAN Firmware team develops the low-level software with stringent latency requirements for Wi-Fi chips

Hyderabad, India

- Improved the existing testing platform written using **System-C** library, developed for **hardware-software co-design**
- Utilised **GDB** to scout bugs and generalised a part of code, resulting progression of **30 testcases** on **end-to-end testing**
- Developed firmware for Wi-Fi ranging feature adhering to **IEEE 802.11az** standard to support **many-to-one ranging**

SCHOLASTIC ACHIEVEMENTS

- Accepted into Inter-Disciplinary Dual Degree Programme at **Center for Machine Intelligence and Data Science** (2023)
- Secured an **All India Rank of 762** in JEE Advanced among 200K candidates (2020)
- Secured an **All India Rank of 2388** in JEE Mains (Engineering) among 1.3 million candidates (2020)
- Secured an **All India Rank of 200** in **Kishore Vaigyanik Protsahan Yojana(KVPY)** Examination (2020)
- Recipient of the **KVPY Fellowship** by Department of Science and Technology, Government of India (2020)
- Ranked in the **national top 1%** in NSEC and selected to appear for Indian National Chemistry Olympiad (2019)

KEY TECHNICAL PROJECTS

Local Augmentation for Graph Neural Networks

Aug'23 – Nov'23

Guide: [Prof. Abir De](#) (CS768: Learning with Graphs)

IIT Bombay

- Reproduced the results in the assigned paper and performed experiments to validate the method on other graph tasks
- Implemented a **normalizing-flow** based generative model to replace conditional VAE which had superior results
- Proposed a **probabilistic message-passing** scheme –based on the paper– to overcome over-smoothing observed in GNNs

Exploring Neural Ordinary Differential Equations

Aug'23 – Nov'23

Guide: [Prof. Amit Sethi](#) (EE762: Advanced Topics in Machine Learning)

IIT Bombay

- Explored whether Neural ODEs as **continuous depth models** have advantage for various applications in machine learning
- Devised a custom pytorch autograd function implementing **adjoint method** to differentiate through Neural ODEs
- Demonstrated the effectiveness of Neural ODEs on synthetic as well as real-world datasets like CIFAR-10 and MNIST

Structured Sparsity inducing Adaptive Optimizers

Jan'23 – May'23

Guide: [Prof. Ganesh Ramakrishnan](#) (CS769: Optimization in ML)

IIT Bombay

- Studied the notion of **structured sparsity** in context of neural networks and regularisation techniques to prune them
- Explored various regularisers utilising structured sparsity such as **mixed ℓ_1/ℓ_2 norm** and **min-max concave penalty**
- Implemented an optimization routine via **proximal descent algorithm** along with Newton-Raphson method

Variational Thompson Sampling

Jan'23 – May'23

Guide: [Prof. Jayakrishnan Nair](#) (EE6106: Online Learning and Optimisation)

IIT Bombay

- Explored the application of **variational inference** for approximate posterior in **Multi-Armed Contextual Bandit problem**
- Studied a **Gaussian mixture model** to model distribution of parameters over arms which have no closed form posteriors
- Studied the trade-offs between the variational approach and inference based on Gibbs sampling for this model

OTHER PROJECTS

- Developed a **reverse auto-grad engine** and a neural network library using native python with a Pytorch-like API (2023)
- Contributed to the open-source project [xtensor-stack/xsimd](#), a **SIMD intrinsics** wrapper library written in C++ (2022)
- Implemented **Automatic Repeat Request protocol** over udp sockets in C, utilising Stop and Wait algorithm (2022)
- Designed a custom 4D vector class in C++20, utilising **XSIMD** library for a **Ray-Tracing Engine** [Rendera](#) (2022)

TECHNICAL SKILLS

Programming Languages: C/C++, Python, Julia, Java, Bash, Assembly{8051,8086}

Libraries: Pytorch, PyTorch-Geometric, Tensorflow, Numpy, Pandas, SciPy, Seaborn, SymPy, Scikit-Learn, OpenCV

Software: Git, \LaTeX , MATLAB, OpenCV, Octave, GNU Radio, SSH, WSL

TEACHING EXPERIENCE

Graduate Teaching Assistant

TA for the course **CS726: Advanced Machine Learning** under [Prof. Sunita Sarawagi](#), Department of Computer Sci. & Engg Spring'24

- Part of a team of 8 TAs, facilitating smooth course organization for a **class of 100+ students** from diverse backgrounds
- Assisting the instructor by grading papers, proctoring exams, mentoring students, conducting tutorials and help sessions

Undergraduate Teaching Assistant

TA for the course **MA106: Linear Algebra** under [Prof. Dipendra Prasad](#), Department of Mathematics

Spring'23

- Conducting weekly tutorial sessions for a batch of 30+ freshmen and discussing problem sets; underwent TA training
- Assisting the instructor in the course by conducting tutorials, proctoring exams and periodic assessments

EXTRA-CURRICULAR ACTIVITIES AND OTHER ACHIEVEMENTS

Achievements	<ul style="list-style-type: none">• Secured 1st position for Hostel-5 in Technical Inter-Hostel General Championship organised by ERC, IITB• Contributed to Open-Source projects during Hacktoberfest 2021 organised by Digital Ocean
Volunteering	<ul style="list-style-type: none">• Devoted 80+ hours of volunteering work under the National Service Scheme, IIT Bombay to promote sustainability, contributing articles to Parivartan-NSS, IITB Wordpress blog with 100K+ hits• Participated in Abhyuday's —social body of IITB— campaign to clean Versova Beach, Mumbai
Sports	<ul style="list-style-type: none">• Completed a 4-days trek to Bhrigu Lake, Manali, Himachal Pradesh 14000 feet above the sea level• Completed trek to Anjaneri Hill Fort, Nashik, Maharashtra 4263 feet above the sea level
Mentorship	<ul style="list-style-type: none">• Mentored 4 teams of 10+ freshmen for programming contest, introduced Python3 and version control• Guided 15+ students on their summer reading project on Deep Learning and Neural Networks