

MIHIR AGARWAL

Probabilistic Machine Learning • Computer Vision • Graph Neural Networks

+91 8851142209

@ agarwalmihir@iitgn.ac.in

Ahmedabad, Gujarat, India

mihir agarwal

agarwal-mihir

EDUCATION

Indian Institute of Technology Gandhinagar (IITGN) [Transcript]

B.Tech in Electrical Engineering with minors in Computer Science & Engineering and Mathematics

CPI: 8.98/10

2021-2025

Delhi Public School, R.K. Puram [Transcript]

Class XII, Central Board for Secondary Education

Percentage: 98.2

2020-2021

Delhi Public School, R.K. Puram [Transcript]

Class X, Central Board for Secondary Education

Percentage: 96.6

2020-2021

ACCEPTED PUBLICATIONS

Mihir Agarwal*, Progyan Das*, Udit Bhatia

Spatially Regularized Graph Attention Autoencoder Framework for Detecting Rainfall Extremes - Accepted at Tackling Climate Change with Machine Learning at NeurIPS 2023

Progyan Das*, Mihir Agarwal*

Less But Better, Towards better AQ Monitoring by learning Inducing Points for Multi-Task Gaussian Processes - accepted in the NeurIPS 2023 Workshop on Adaptive Experimental Design and Active Learning in the Real World (RealML-2023)

Progyan Das*, Mihir Agarwal*

Focus on What's Important! Inspecting Variational Distributions for Gaussian Processes for better AQ Station Deployment - accepted at 2023 NeurIPS Workshop on Computational Sustainability: Pitfalls and Promises from Theory to Deployment (CompSust)

Mihir Agarwal*, Lalit Chandra Routhu*, Zeel B Patel, Nipun Batra

Conformal Prediction: A Visual Introduction - accepted at the 6th Workshop on Visualization for AI Explainability

WORK EXPERIENCE

Air Quality Prediction in Delhi using Graph Neural Networks

Research Internship | Prof. Nipun Batra | Sustainability Lab, IIT Gandhinagar

May'23-Jul'23

- Conducted research at IIT Gandhinagar's Sustainability Lab, collaborating with Prof. Nipun Batra and Prof. Udit Bhatia, to enhance air quality predictions in Beijing and Delhi through the application of Graph Neural Networks and Spatio-Temporal Graph Neural Networks such as EvolveGCN, ConvGRU etc.
- Leveraged real-world datasets and cutting-edge techniques to construct graph representations, model spatiotemporal relationships, and fine-tune models, resulting in more accurate air quality forecasts; gained insights into advanced machine learning applications in environmental sustainability.

Uncertainty Bounds for Anomalous Geomagnetic Storm Forecasting – A Deep Learning Approach

Research Internship | Prof. Dibyendu Chakrabarty and Prof. Soumyabrata Chakrabarty | Physical Research Laboratory, ISRO

| Poster

Jan'23-June'23

- Worked with Prof. Soumyabrata Chakrabarty, chief engineer at ISRO, and Prof. Dibyendu Chakrabarty, principal investigator of the Aditya-L1 mission, to develop insights and simulations that would assist ISRO in deploying the spacecraft.
- Used deep neural networks such multi-output multivariate transformers, LSTMs, RNNs etc for forecasting geomagnetic storms at Lagrange points through time-series analysis of parameters at the earth's magnetosphere.
- We were able to predict the storms within reasonable error upto 96 hours before the storm. We submitted the results at **Advances in Space Research Journal, 2023**

6D Pose Estimation using Deep Learning for Robotics

Machine Learning Research Internship | Mr. Rajesh Sinha and Mr. Prakash Ambwani | Smart Machines Automation Lab, TCS Research

Oct'22-April'23

- Worked on 6D pose estimation for various robotics applications. Furthermore, working on a semi-supervised architecture for calculating the 6D pose of the object.
- Created a tool for making BOP Datasets from object models. The tool allowed the user to generate RGBD images with the 6D pose ground truth with great flexibility to change background, textures, etc.

AI-Enhanced Network Threat Detection Platform for Optimized Security Protocol Testing

Software Internship | Mr. Sanjeev Kumar, DELL and Mr. Prasad Malempati, Accenture | Efcens Systems

July'22-Oct'23

- Developed a Python-based network threat detection platform, incorporating research on network security concepts to enhance the testing of new security protocols and applications.

- Analyzed network configurations across various devices to identify and mitigate potential security risks.

SELECTED PROJECTS

Conformalized Quantile Regression for Energy Disaggregation

Research Project | Prof. Nipun Batra | Sustainability Lab, IIT Gandhinagar

Aug'23 - Nov'23

- Developed a novel, distribution-free approach to uncertainty quantification in Non-intrusive Load Monitoring (NILM) through conformalized quantile regression, enhancing model reliability without assuming a Gaussian data distribution.
- Implemented conformal prediction techniques to provide mathematical guarantees for expected coverage, improving the calibration of predictive uncertainty in energy disaggregation.
- Demonstrated through empirical analysis that our conformal prediction method outperforms traditional uncertainty quantification techniques in NILM, offering computational efficiency and superior calibration metrics.

Streak Removal from High-Intensity Focused Ultrasound Images for Therapeutic Ultrasound

Research Project | Prof. Himanshu Shekhar | MUSE Lab, IIT Gandhinagar

Ongoing

- Using state-of-the-art deep learning techniques for streak removal from ultrasound images for better diagnosis for therapeutic ultrasound.
- We also explored heuristic methods such as image filtering and thresholding techniques to complement our utilization of Deep Image Prior and Segmentation models in effectively removing streak artifacts from ultrasound images.

Extreme Rainfall Events analysis using Event Synchronisation and Graph Neural Networks

Research Project | Prof. Udit Bhatia | MIR Lab, IIT Gandhinagar | Poster

Jan'23-July'23

- Applied complex network principles, particularly network evolution, to study Extreme Rainfall Events (EREs) and drought patterns across the Indian subcontinent. Investigating short and long-range correlations within EREs and their synchronization.
- Incorporated Spatio-Temporal Graph Neural Networks to enhance predictive capabilities. By combining GNNs with complex network analysis, we aim to provide more accurate predictions for extreme rainfall events and their interconnected impacts.

De novo creation of organic emitters via graph neural network approach

Research Project | Prof. Anirban Mondal | IITGN

Ongoing

- Working on predicting several properties of organic molecules, such as absorbed and radiated emission wavelengths using state-of-the-art graph neural network approaches. Further work includes molecule generation using the generative graph neural networks for specific properties.

PhenoNERF – End-to-end Phenotypic classification for Botanical Trees from single-images via Neural Radiance Fields

Research Project | Prof. Shanmuganathan Raman | CVIG Lab, IIT Gandhinagar

Ongoing

- Implemented Neural Radiance Fields (NeRFs) to reconstruct the volumetric scene function from 2D images, enabling detailed 3D reconstructions of trees and plants.
- Augmented the NeRFs approach with Graph Neural Networks (GNNs) to capture intricate structures and relationships in the botanical subjects, ensuring highly accurate and realistic 3D modeling.
- Designed a comprehensive dataset tailored for 3D model reconstruction by leveraging the capabilities of Unity and BlenderProc.

CodeMixed Data Analysis: Semi-Automated Dataset Creation and Evaluation of State-of-the-Art Language Models

Research Project | Prof. Mayank Singh | IIT Gandhinagar

Jan'22-July'22

- Developed an extensive Hindi question-answer dataset, circumventing the impracticality of manual annotation by leveraging pre-existing datasets such as Xsquad, MLQA, and CHaii.
- Fine-tuned multiple state-of-the-art language models, including mbret, mt5, and xlm-Roberta, to adapt to the nuances of the Hindi language and optimize dataset quality
- Conducted comprehensive evaluations to assess and benchmark the performance of each language model in generating high-quality Hindi QA pairs.

Non Local Means Filtering

Project | Prof. Shanmuganathan Raman | IITGN

Aug'23

- Studied, optimized, and implemented the Non-Local Means Denoising algorithm from scratch in Python.
- Compared and analyzed its performance with Gaussian Filtering for Salt & Pepper noise and Gaussian noise.
- Optimized the Non-Local Means Algorithm to minimize Mean Squared Error and time taken for denoising.

AWARDS AND ACHIEVEMENTS

- **Awarded with the Dean's list** for academic excellence in semester 3 and 4.
- **Inter IIT representative** for IITGN in Machine Learning and Product Development Problem Statement.
- **Runners up** 26th Annual International Space Settlement Design Competition, 2019, NASA Kennedy Space Center, Florida, USA.
- **Secured 2nd position** in the web development category and were **1st among first years** in the Machine Learning challenge in the Annual College Hackathon - **HackRush**.

TEACHING EXPERIENCE

Instructor

SC 336: Mathematics of Machine Learning

October '23

- Instructed IIT Gandhinagar's first student-led, fully-accredited short course, with record registrations of 170 students across undergraduate and graduate years. Taught 1 lecture based on Convolutions, Fourier analysis, Linear Regression, Polynomial Regression, and Regularisation.

Academic Discussion Hours, Mentor

Ordinary Differential Equations • Introduction to Electrical Systems • Calculus of Single Variable and Linear Algebra • Numerical Methods

Jan '23 - Nov '23

- Mentored a diverse group of first and second-year undergraduate students.
- Designed and delivered supplementary learning materials, including study guides and practice exercises to enhance students' comprehension of complex technical concepts.
- Collaborated with professors to align mentoring efforts with course objectives and ensure consistency in teaching methodologies.

Teaching Assistant

World of Engineering

Jun '23 - July '23

- Mentored several project groups having the potential to become startups. Several projects have received funding from various grants. I was the **only undergraduate TA** for the course.

Workshops

Gujarat Urja Vikas Nigam Ltd (GUVNL) Workshop

Oct'23

- Conducted a workshop on Introduction to Python as part of the AI/ML Applications in Power Sector for the officers of the Gujarat Urja Vikas Nigam Ltd (GUVNL) and its subsidiary companies.

TECHNICAL SKILLS

Languages: Python Verilog C++

Tools: Xilinx Vivado VS Code \LaTeX Git Anaconda Autodesk Inventor LTSpice

Frameworks and Libraries: PyTorch OpenCV Matplotlib Pandas Tensorflow Streamlit FastAi

RELEVANT COURSES

Digital Image Processing • Probability and Random Processes • Networks and Complex Systems • Space Science and Satellite Technology • Machine Learning • Analog Circuits • Data Structures and Algorithms-I • Electronic Devices • Signals Systems and Networks • Electromagnetic Waves.

POSITIONS OF RESPONSIBILITY & EXTRA CURRICULAR

- **Class Representative** of first year Electrical Engineering, IITGN 2021 - 2021
- Secretary of **Machine Learning Hobby group**, IITGN 2023 - 2024
- Overall Coordinator of **G20-Ignite**, a Sci-Tech Fair, IITGN 2023
- **Peer Assisted Learning (PAL)** mentor providing valuable support to first-year students with limited English proficiency, fostering a positive learning environment and facilitating their academic success. Jan '23 - April '23
- **Sponsorship Head for IIT Gandhinagar's cultural fest**, where I coordinated collaborations with 40 companies, securing sponsorship worth 12 lakhs, marking a remarkable two-fold increase from the previous year. July '22 - Feb '23
- **Technical Coordinator** of the Technical Council and the **Deputy Contingent Leader** for the Inter IIT Tech Meet Contingent of IIT Gandhinagar. Apr '23 - March '24