

AZAL AHMAD KHAN

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Research Interests

Primary: Improving performance and scalability of Foundation Models (e.g., GPT, DALL-E)

Secondary: Distributed Machine Learning in Heterogenous Networks, Reinforcement Learning

Education

Indian Institute of Technology Guwahati

2020 – 2024(Expected)

Bachelor of Technology in Chemical Science and Technology

Guwahati, Assam

Thesis Advisor: Dr. Debanga Raj Neog, School of Data Science and Artificial Intelligence

Thesis Title: Direct Preference Optimization in prompt engineering for text-to-image synthesis [Report] [PPT]

Computer-Science Courses: Deep Learning, Introduction to Reinforcement Learning, Computer-Aided Applied Optimization, Introduction to Computing, Computing Lab **Mathematics Courses:** Linear Algebra & Differential Equations, Real Analysis & Multivariable Calculus, Complex Analysis & Partial Differential Equations

Publications & Pre-prints

[6] **FLOAT: Federated Learning Optimizations with Automated Tunnings**

Ahmad Faraz Khan, Azal Ahmad Khan, Samuel Fountain, Ahmed M. Abdelmoniem, Ali Butt, Ali Anwar
Under review at ACM EuroSys 2024

[5] **A quantum-inspired predator-prey algorithm for discrete optimization**

Azal Ahmad Khan, Salman Hussain, Rohitash Chandra
Under review at Recent Advances in Algorithms for Swarm Systems 2024

[4] **Delhi air quality prediction using LSTM deep learning models with a focus on COVID-19 lockdown**

Animesh Tiwari, Azal Ahmad Khan, Tvisha Malik, Rishabh Gupta, Rohitash Chandra
Under review at Environmental Modelling & Software 2024

[3] **PI-FL: Personalized and Incentivized Federated Learning** [arXiv]

Ahmad Faraz Khan, Xinran Wang, Qi Le, Azal Ahmad Khan, Haider Ali, Jie Ding, Ali Anwar, Ali Butt
Under review at Advancement of Artificial Intelligence (AAAI) 2024

[2] **Personalized Federated Learning Techniques: Empirical Analysis**

Azal Ahmad Khan, Ahmad Faraz Khan, Ali Anwar
Soon to be available on ArXiv

[1] **A review of ensemble learning and data augmentation models for class imbalanced problems: combination, implementation and evaluation.** [arXiv]

Azal Ahmad Khan, Omkar Chaudhari, Rohitash Chandra
Under review at Expert Systems With Applications 2023

Experience

Research Intern, University of Minnesota

January 2022 – Present

Advisor: Dr. Ali Anwar, Computer Science and Engineering, University of Minnesota

Remote

- Conducted empirical analysis on 10 personalized PFL across heterogeneous settings, providing valuable insights.
- Developed an incentivization approach in PFL, outperforming other algorithms in performance in non-IID settings.
- Improved federated learning efficiency by employing reinforcement learning to minimize staleness for non-IID clients.
- Leading research project at the intersection of parallelization and LLM to enhance inference speed and scalability.

Research Intern, University of New South Wales

January 2022 – Present

Advisor: [Dr. Rohitash Chandra](#), School of Mathematics and Statistics, University of New South Wales

Remote

- Co-authored 3 research papers and worked on quantum chemistry, computer optimization, and deep learning
- Developed a metaheuristic optimization algorithm, that outperformed 8 SOTA methods in best solution and speed.
- Conducted computational analysis of data augmentation and ensemble learning to address class imbalance challenges.

Research Intern, Yale University

June 2022 – August 2022

Advisor: [Dr. David Van Dijk](#), Computer Science, Yale University

Remote

- Used Deep Learning to model brain dynamics in mesoscopic calcium imaging data highlighting cognitive processes.
- Used Vision Transformers, Neural Ordinary Differential Equations, and Continuous Transformers on mice brain data.

Course Projects

QCMBO: Quantum Cat and Mouse Based Optimization Algorithm

Aug 2022 – Nov 2022

Advisor: [Dr. Prakash Kotecha](#), Department of Chemical Engineering

[GitHub](#) | [Report](#)

- Developed a novel optimization algorithm inspired by quantum chemistry and natural laws.
- Evaluated the algorithm on 14 objective functions and applied it to production planning problems.
- QCMBO outperformed famous pre-developed algorithms like PSO, s-TLBO, and real-coded GA.
- Performed statistical analysis(t-test) and sensitivity analysis to show algorithms performance.

Probabilistic Deep Learning for Robust 3D VSLAM in Dynamic Environments

Aug 2023 – Present

Advisor: [Dr. Arijit Sur](#), Department of Computer Science and Engineering

- Developing probabilistic deep learning methods for Visual SLAM to improve accuracy in 3D and dynamic environments.
- Enabling end-to-end learning, incorporating probabilistic dependencies between VSLAM components for navigation.
- Extending uncertainty-aware techniques from 2D to 3D and dynamic settings, advancing autonomy in complex scenarios.

Positions and Volunteer Works

Coordinator, Coding Club IITG: Participated in conducting various events, courses, and projects. June 2021-April 2022

Associate, Consulting and Analytics Club: Contributed to organizing various club events. June 2021-April 2022

Volunteer, NSS(National Service Scheme): Participated in campaigns for student awareness. Aug 2022-Nov 2022

City Representative, Technothon: Represented Technothon IIT G in multiple schools of the city. June 2021-Aug 2021

Technical Skills

Programming: Python, C/C++

ML Tools: Pandas, Numpy, Scipy, Matplotlib, Seaborn, Scikit-learn, Keras, Tensorflow, Pytorch, OpenCV, Hugging Face

Miscellaneous: Jupyter Notebook, Google Colab, Git, GitHub, SQL, L^AT_EX

Web Technologies: HTML, CSS, Bootstrap, Django

Operating Systems: MacOS, Windows

References

[Dr. Ali Anwar](#)

Assistant Professor, Computer Science and Engineering
University of Minnesota – Twin Cities

[Dr. Debanga Raj Neog](#)

Assistant Professor, School of Data Science and Artificial Intelligence
Indian Institute of Technology Guwahati

[Dr. Rohitash Chandra](#)

Senior Lecturer, School of Mathematics and Statistics
University of New South Wales