

Raihan Seraj

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🌐 [raihan-seraj.github.io](https://github.com/raihan-seraj) 🔄 Raihan-Seraj 🎓 google scholar 🏠 Toronto, ON Canada

EDUCATION

Mila - Quebec AI Institute and McGill University , Montreal, Canada PhD, Electrical and Computer Engineering	Jan 2019 – Apr 2025
Mila - Quebec AI Institute and McGill University , Montreal, Canada MEng, Electrical and Computer Engineering	Jan 2017 – Jan 2019
Islamic University of Technology , Dhaka, Bangladesh BSc, Electrical and Electronic Engineering	Dec 2011 – Dec 2015

Affiliation: *ILLS* (International Laboratory on Learning Systems).

RESEARCH EXPERIENCE

Foundation-scale time-series modeling for high-dimensional dynamical systems.
Multi-agent reinforcement learning and emergent decentralized intelligence.
Human-in-the-loop AI, shared autonomy, and adaptive control.
Large-scale deep learning, diffusion models, and generative frontier architectures.

PROFESSIONAL EXPERIENCE

GenAI Researcher- Capital Markets KX , Toronto, Canada	May 2026 – Present
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- Designed and developed machine learning and optimization frameworks for capital markets, integrating portfolio optimization and time-series forecasting to support asset allocation and investment decisions.
- Built memory-trace and observability infrastructure for LLM agents, establishing metrics and evaluation workflows to assess reasoning quality, tool use, and performance on long-horizon tasks.
- Bridged research and engineering to develop scalable financial applications using generative AI, time-series modeling, and quantitative machine learning.
- Developed and trained a reinforcement learning-based foundation model for portfolio rebalancing, using learned policies to guide dynamic asset allocation.

Machine Learning Scientist Bagel Labs , San Francisco, USA	May 2025 – May 2026
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- Implemented a frontier-scale video generation model using a decentralized diffusion framework, enabling training and inference without centralized data or parameter sharing.
- Designed and implemented text-to-image diffusion models trained entirely via decentralized computation, demonstrating scalable generative modeling under fully distributed, communication-free settings.
- Designed and implemented distributed reinforcement learning algorithm for fine-tuning large language models (LLMs) across globally distributed compute nodes, enabling scalable, high-throughput training and reducing convergence time by leveraging worldwide parallelism.
- Designed and built a robust reinforcement learning library for fine-tuning large language models (LLMs) on tool-use tasks.

Senior ML Engineer

Oct 2024 – April 2025

Braxted Inc, Toronto, Canada

- Led a multidisciplinary team of engineers and researchers in the successful design, development, and deployment of agentic Retrieval-Augmented Generation (RAG) systems tailored for Canadian immigration processes, enhancing retrieval accuracy and response reliability.
- Designed and implemented a robust long-term memory framework for conversational agents utilizing (LLM-OS) capabilities. The framework focused on enabling conversational agents to store, organize, and retrieve relevant information across extended interactions, significantly improving their ability to provide context-aware and personalized responses.

Global Research Associate

Aug 2023 – Feb 2024

Borealis AI, Royal Bank of Canada, Montreal, Canada

Mentors: Tristan Sylvain, Layla El Asri, Greg Mori

- Designed AI model for event forecasting from large-scale text corpora via AutoCast++ using zero-shot ranking and transformer-based context retrieval.
- Developed entropy-based human feedback algorithms for contextual bandits, enhancing decision accuracy and model performance for real-time recommendation systems.

Machine Learning Researcher (Scientist in Residence Program)

June 2021–Sept 2021

Valence Drug Discovery, Montreal, Canada

Mentor: Daniel Cohen

- Designed fibrous autoencoder architectures to learn latent molecular spaces that enable the generation of structurally diverse compounds while maintaining consistent bio-activity profiles.
- Formulated a reinforcement learning framework for scaffold hopping using latent molecular representations, collaborating with the R&D team to efficiently explore large chemical spaces and accelerate de novo drug discovery.

AI Research Scientist Intern

March 2020 – Oct 2020

Paladin AI, Montreal, Canada

Mentor: Mikhail Klassen

- Improved pilot performance evaluation by 25% through feature-based segmentation of flight simulator data.
- Analyzed time series data from aircraft simulators to segment pilot reactions during faults, leading to the development of a proficiency metric for pilot performance evaluation.

Research Scientist Intern

March 2018 – May 2019

Aerial Technologies, Montreal, Canada

Mentors: Negar Ghourchian, Michel Allegue

- Designed feature extraction algorithms for WiFi Channel State Information (CSI) data, which improved model generalization by addressing concept drift in real-time indoor localization systems.
- Analyzed time series data and trained deep learning models to classify fall detection using WiFi Channel State Information (CSI).

- Designed learning algorithms to automatically classify QRS complexes, enabling the detection of acceptable ECG traces.
- Developed PC-based telemedicine system with integrated diagnostics, enabling 500 rural families to access real-time medical services online.
- Worked on software development for automatic frequency domain analysis to identify neurological disorders from evoked EMG responses.
- Engineered software interfacing for a 12-lead computerized ECG machine on Android, facilitating near real-time data transmission to and from remote areas.

SELECTED PUBLICATIONS (A full list is available on Google Scholar.)

1. Zhiying Jiang, **Raihan Seraj**, Marcos Villagra, Bidhan Roy “Heterogeneous Decentralized Diffusion Models.” Proceedings of the **IEEE/CVF Conference on Computer Vision and Pattern Recognition. (CVPR) 2026.**
2. **Raihan Seraj**, Aditya Mahajan, Jerome Le Ny. “Fatigue and task load dependent decision referrals for joint binary classification in human-automation teams” **IEEE Control Systems Letters, 2025**
3. **Raihan Seraj**, Aditya Mahajan, Jerome Le Ny. “Dynamic Estimation of Mental Workload and Operator Accuracy in Human Automation Teams” **IEEE Transactions on Human Machine Systems, 2025**
4. Qi Yan, **Raihan Seraj**, Jiawei He, Lili Meng, Tristan Sylvain. “Autocast ++: Enhancing world event prediction with zero-shot ranking based context retrieval”. **International Conference on Learning Representation (ICLR), 2024.**
5. Anurag Koul, Shivakanth Sujit, Shaoru Chen, Ben Evans, Lili Wu, Byron Xu, Rajan Chari, Riashat Islam, **Raihan Seraj**, Yonathan Efroni, Lekan P Molu, Miroslav Dudík, John Langford, Alex Lamb. “PcLast: Discovering Plannable Continuous Latent States”. **International Conference on Machine Learning (ICML), 2024.**
6. **Raihan Seraj**, Jivitesh Sharma, Ole-Christoffer Granmo. “Tsetlin Machine for solving contextual bandit problems”. **35th Conference on Neural Information Processing System (NeurIPS), 2022**
7. **Raihan Seraj**, Jerome Le Ny, Aditya Mahajan. “Mean field approximation for large population beauty contest games”. **IEEE Conference on Decision and Control (CDC) 2021.**
8. Jayakumar Subramanian, Amit Sinha, **Raihan Seraj**, Aditya Mahajan. “Approximate information state for approximate planning and reinforcement learning in partially observed environments”. **Journal of Machine Learning Research (JMLR), 2020.**
9. Riashat Islam, **Raihan Seraj**, Pierre-Luc Bacon, Doina Precup. “Entropy Regularization with Discounted Future State Distribution in Policy Gradient Methods”. **NeurIPS Workshop on Optimization Foundations for Reinforcement Learning, 2019.**

TECHNICAL SKILLS

Programming languages – Python, SQL, Matlab, Java, C, Julia.

Frameworks – PyTorch, LangChain, HuggingFace Transformers, Scikit-Learn.

ML Domains – GenAI, NLP, Time-series Forecasting, Reinforcement Learning.

Systems – Linux, OSX.

POSITIONS OF RESPONSIBILITY

- **Consultancy:** Delivered expert consultancy and managed machine learning research interns at *Dreeven Technologies* and the *International Air Transport Association*, guiding them through complex projects and accelerating their professional growth.
- **Reviewer:** Reviewed for prestigious conferences such as NeurIPS 2021, ICML 2022, and ACC 2024, driving the advancement of research in the field.
- **Teaching Assistant:** Conducted tutorials and provided extensive support in graduate courses on computer organization, intelligent robotics, and algorithm design, enriching students' learning experiences and driving their academic success.