ARYAMAN BANSAL

aryaman.bansal@mail.utoronto.ca | github.com/aryaman1802 | aryaman1802.github.io/ | linkedin.com/in/aryaman1802

EDUCATION

Bachelor of Science (Honors), University of Toronto 2022 - 2026

• Double Major in Statistics and Physics

• Relevant coursework: Calculus with Proofs, Linear Algebra I, Multivariable Calculus, Introduction to Ordinary Differential Equations, Probability, Statistics and Data Analysis I, Probability, Statistics and Data Analysis II, Methods of Data Analysis I, Applied Bayesian Statistics, Statistical Computation, Time Series Analysis, Research Opportunity Program (Machine Learning for Mechanical Ventilation), Software Design, Supervised Study in Physics (Geometric and Scientific Machine Learning), Statistical Methods for Machine Learning I, Data Visualization, University College Independent Studies (Machine Learning for Cancer Cell Evolution), Undergraduate Research Project (Multi-Objective Reinforcement Learning for Geological Carbon Storage), Statistical Methods for Machine Learning II.

EXPERIENCE

ML Researcher, Dr. Andrei Swidinsky's Lab, University of Toronto September 2025 - Present

- Working on multi-objective reinforcement learning (MORL) for geological carbon storage (GCS).
- Built an environment for simulating GCS based on CO_2 buoyancy, including time-lapse gravity and borehole gravity measurements. Packaged the environment as a Gymnasium class.

ML Researcher, Dr. Gregory Schwartz's Lab, University Health Network August 2025 - Present

- Developing deep generative models for virtual staining of H&E images to multi-tissue images for improving the performance of cell and nucleus segmentation algorithms.
- Model development is carried out on Digital Research Alliance of Canada (DRAC) clusters.

ML Researcher, Dr. Divya Sharma's Lab, York University May 2025 - Present

- Developed two new preference-conditioned offline MORL algorithms inspired by Pareto Q-Learning and Pareto Efficient Decision Agent (PEDA), utilizing neural networks for function approximation.
- Modified PEDA Decision Transformer architecture to work with offline evaluation.
- Benchmarked single-objective RL algorithms against MORL algorithms. Leveraged DRAC clusters for model training and evaluation, resulting in my first first-author preprint.

ML Researcher, Dr. Haibo Zhang's Lab, Unity Health Toronto July 2024 - August 2025

- Applied machine learning models to test the efficacy of EIT (electrical impedance tomography) over CT (computed tomography) as a radiation-free, non-invasive bedside continuous monitoring technology. Further tested the use of randomized vs. constant ventilation strategies for developing robust machine learning models.
- Built a physics-informed variational autoencoder for synthetic data generation of mechanical ventilation data.
- This resulted in 2 research reports and 1 poster presentation.

ML Intern, Vacmet India Limited (Remote) September 2024 - December 2024

- Used a time-series model for predicting machine failures to reduce machine downtime and repair costs.
- Used a YOLO series model for defect detection in the company's production lines to reduce material wastage and operational costs.

RESEARCH PAPERS

Benchmarking Offline Multi-Objective Reinforcement Learning in Critical Care (arXiv:2512.08012)

RESEARCH REPORTS

EIT for ARDS lung injury prediction: comparable to CT and enhanced by randomized ventilation data

Outperforming Classical Machine Learning Models With Physics-Informed Machine Learning for Mechanical Ventilation

PRESENTATION

Integration of Machine Learning with bioimaging-based feature ranking for predicting ventilator-induced lung injury

- Poster Presentation at ROP Poster Fair 2025, hosted by UofT's Faculty of Arts & Science on March 12, 2025.

KAGGLE COMPETITIONS (SOLO)

Regression with a Crab Age Dataset Rank: 165/1429

SELECTED PROJECTS

Model Implementations (github.com/aryaman1802/model-implementations)

- Implemented a variety of reinforcement learning algorithms from scratch using Numpy and PyTorch with extensive theoretical explanation in a blog-like style. For example: Variants of MC & TD, Deep Q-Network & variants, Policy Gradient algorithms (like REINFORCE, A2C, etc.)
- Implemented a variety of deep generative learning models from scratch using PyTorch with extensive theoretical explanation in a blog-like style. For example: VAE, GAN & variants (like WGAN, Conditional GAN, etc.), DDPM, etc.
- Implemented miscellaneous deep learning models (eg: Transformer, U-Net, etc.) from scratch using PyTorch.

Diffusion model for Image Super-Resolution (github.com/aryaman1802/dgm_img_super_resolution)

- Used SRDiff and Stable Diffusion models to enhance lower resolution images.
- Created an interactive dashboard using Streamlit to use the models.

Age Estimation (github.com/aryaman1802/Pet-Projects/age-estimation)

- Used the pretrained VGG-16 as the backbone model with a linear classifier as the head, and trained the overall model on the FairFace dataset.
- Created an interactive dashboard using Streamlit to use the model.

Brain Tumor Segmentation (github.com/aryaman1802/Pet-Projects/brain-tumor-segmentation)

- Implemented a U-Net model from scratch in PyTorch on the brain tumor segmentation dataset, consisting of 3064 images.
- The model achieved 0.02417 validation loss on the "Binary Cross Entropy" metric.
- Created an interactive dashboard using Streamlit to use the model.

EXTRACURRICULAR ACTIVITIES

UofT's Computer Vision Club

- Co-led a talk on the paper "Attention is all you need - Vaswani, et al".
- Co-led a talk on the paper "Semi-Supervised Classification with Graph Convolutional Networks - Kipf, et al".

CERTIFICATES

- IBM Certified Associate Developer - Quantum Computation using Qiskit v0.2X
- Natural Language Processing Specialization
- Deep Learning Specialization
- Machine Learning Specialization
- AI for Medical Prognosis
- AI for Medical Diagnosis
- HackerRank Python (Basic) Certificate