Amartya (Marty) Mukherjee

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Education

2022 – 2027   **University of Waterloo** – Waterloo, Ontario
PhD in Applied Mathematics. Supervisor: Jun Liu

2017 – 2022   **University of Waterloo** – Waterloo, Ontario
BMath in Scientific Computation/Applied Mathematics, minor in Statistics

Publications and Preprints

June 2023   Amartya Mukherjee and Jun Liu. 2023. **Actor-Critic Methods using Physics-Informed Neural Networks: Control of a 1D PDE Model for Fluid-Cooled Battery Packs.** ICML Workshop on New Frontiers in Learning, Control, and Dynamical Systems. https://arxiv.org/abs/2305.10952

June 2023   Amartya Mukherjee and Jun Liu. 2023. **Bridging Physics-Informed Neural Networks with Reinforcement Learning: Hamilton-Jacobi-Bellman Proximal Policy Optimization (HJBPPO).** ICML Workshop on New Frontiers in Learning, Control, and Dynamical Systems. https://arxiv.org/abs/2302.00237

April 2022   Amartya Mukherjee, Yusuf Aydogdu, Thambirajah Ravichandran, and Navaratnam Sri Namachchivaya. 2022. **Stochastic Parameterization Using Compressed Sensing: Application to the Lorenz-96 Atmospheric Model.** Tellus A: Dynamic Meteorology and Oceanography, 74(2022), pp.300–317. DOI: http://doi.org/10.16993/tellusa.42

May 2021   Amartya Mukherjee. 2021. **A Comparison of Reward Functions in Q-Learning Applied to a Cart Position Problem.** Preprint arXiv:2105.11617

Patents

November 2021   Sheral Kumar, Amartya Mukherjee, Seel Patel, Rui Xiang Chai, Wentao Liu, Yuanhao Yu, Yang Wang, Jin Tang. **Methods and Devices for Extracting Motion Vector Data from Compressed Video Data.** United States Patent Application 92007962, filed November 26, 2021.

Talks

March 2023   Reinforcement Learning: Zero to ChatGPT [Slides]
Gave a talk for a Machine Learning seminar hosted by the Department of Applied Mathematics, University of Waterloo. This talk gives an introduction to reinforcement learning, proximal policy optimization (PPO), and reinforcement learning with human feedback (RLHF) used to train large language models (LLMs) such as ChatGPT.

Teaching

January 2023 – August 2023

AMATH 242 / CS 371: Introduction to Computational Mathematics

Recorded Matlab tutorials for floating-point numbers. Graded and assisted students with course projects on root-finding methods applied to fluid flow problems. Reviewed students' Matlab, python, C, C++, and Fortran code for the implementation of numerical linear algebra, interpolation, integration, and discrete Fourier methods.

September 2022 – December 2022

MATH 137: Calculus 1 for Honours Mathematics

MATH 117: Calculus 1 for Engineering

Held weekly tutorials teaching students functions, trigonometry, differentiation, and integration.

Research Experience

May 2021 – December 2021

Computer Vision, Noah's Ark Lab at Huawei Technologies Canada

Mentor: Dr. Wentao Liu

Worked on motion vector extraction for accelerated video AI tasks on smartphones. Integrated modified H.264 and HEVC video decoders into the Android Media framework that output motion vector information into the OpenMAX buffer. Reduced the computation times of optical flow and action recognition models by 55% and 34% respectively. Filed a patent, that has been approved by the United States Patent and Trademark Office.

May 2020 – April 2021

Fields CQAM Laboratory for Inference and Prediction

Mentor: Professor Navaratnam Sri Namachchivaya (Department of Applied Mathematics, University of Waterloo)

Worked on data-driven dimensionality reduction methods in two-time-scaled dynamical systems. Replaced regression with a combination of sparse optimization and data assimilation in modelling dynamical systems. Reduced the mean squared prediction error of Rossby waves by 21% using Compressed Sensing and further by 64% using Ensemble Kalman Filter. Lead author of a journal publication.

Other Projects

August 2021 – April 2022

TorchTS [Link to GitHub Repository]

Mentor: Professor Rose Yu (Department of Computer Science, University of California, San Diego)

Contributed to the TorchTS open-source project. Worked on parameter estimations in Ordinary Differential Equations using Optimization for Data Science. Improved the learning methodology of the ODENet model using single-step observations. Developed the ODE-DNN-Net model, which combines ODEs with Deep Neural Networks, to improve the prediction of oscillating data. Reduced the mean squared prediction error of three ODEs by a factor of 10^2.

September 2020 – December 2020

Insider Trading Roles Classification [Link to Report]

Mentor: Professor Ali Ghodsi (Department of Statistics and Actuarial Science, University of Waterloo)

Trained classification models (Support Vector Machine, K-Nearest Neighbors, Neural Network, Decision Tree) on United States conventional stock or non-derivative transactions datasets from over 2000 constituents. Divided role codes of each trader into four levels of hierarchy as the prediction variable. Achieved a 70.2% test accuracy using Bagged Tree.

Honors and scholarships

2023   Reimbursement for full conference registration (International Conference on Machine Learning) - 1,030 USD

2018   President's Scholarship (University of Waterloo) - 2,000 CAD

2017   Founder's Scholarship (K. International School Tokyo) - 300,000 JPY

Technical Skills

Programming languages

Python, Matlab, C++, C, SQL, Java, R

Software

LaTeX, Git, Flask, PyTorch, OpenCV, PySindy, PySpark, ONNX, FEniCS

Languages

English (fluent), Japanese (fluent), Mandarin (basic)