Abhishek Kajal

Contact

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Education

M.A.Sc. Electrical & Computer Engineering *Sep 2022-Sep 2024*
The University of British Columbia
NSERC CREATE Quantum Computing Scholar
Supervisor - Olivia Di Matteo

B.Sc. (Co-op) Joint Honours Computer Science & Physics *Jan 2016-Dec 2020*
University of Manitoba
Honors project - *Quantum algorithms for the single pair shortest path problem*
Industrial project - *Implementation of the quantum perceptron algorithm*

Research Interests

Quantum circuits and compilation, Quantum machine learning, Quantum tomography and device characterization, Quantum error mitigation

Research Experience

Research Assistant The University of British Columbia, Vancouver, BC *Sep 2022-present*
Quantum Software and Algorithms Research Lab
- Developing attention-based quantum tomography techniques for accurate and efficient characterization of many-body quantum systems.
- Designing resource-efficient compilation methods based on differentiable quantum transforms.

Quantum Machine Learning Researcher TRIUMF, Vancouver, BC *Jan 2021-Apr 2022*
ATLAS at Large Hadron Collider
- Developed hybrid quantum-classical deep generative models to simulate subatomic interactions in a particle physics detector and save billions of simulation CPU hours annually.
- Implemented open-source package to train quantum variational autoencoders based on D-Wave quantum annealers and sample from classically hard-to-sample Boltzmann distributions.

Machine Learning Researcher TRIUMF, Vancouver, BC *May-Dec 2019*
Hyper-Kamiokande Neutrino Observatory
- Developed semi-supervised and unsupervised deep learning models for improved simulation and data analysis of a high precision neutrino experiment.
- Built open-source package and demonstrated improvements over state-of-the-art approaches.

Publications

A. Abhishek et al. *CaloRBM : Simulating High-Energy Particle-Detector Interactions using Hybrid Quantum-Classical Generative Models.* In preparation.

A. Abhishek, E. Drechsler, W. Fedorko and B. Stelzer. *CaloDVAE : Discrete Variational Autoencoders for Fast Calorimeter Shower Simulation.* NeurIPS Workshop on Machine Learning and the Physical Sciences 2021. [arXiV:2210.07430]

A. Abhishek, W. Fedorko, P. de Perio, N. Prouse and J. Z. Ding. *Variational Autoencoders for Generative Modelling of Water Cherenkov Detectors.* NeurIPS Workshop on Machine Learning and the Physical Sciences 2019. [arXiV:1911.02369]

C. K. Leung, **A. Abhishek,** Y. Won and J. M. C. Choi. *Big Data Analytics for Personalized Recommendation Systems.* IEEE International Conference on Cloud and Big Data Computing (CBDCom) 2019.

Skills

Machine Learning	Generative modeling, Quantum-assisted ML, Attention-based models
Programming	Python, C/C++, Java, MATLAB, Mathematica, Ruby, SQL
Libraries	PyTorch, TensorFlow, Ocean SDK, Pennylane, Qiskit, NumPy
Computing	AWS, Docker, Singularity, Slurm, Git
Interpersonal	Leadership, Effective communication, Knowledge sharing, Mentoring
Languages	Hindi (native), English (fluent), French (elementary)

Industry Experience

Associate Machine Learning Developer AltaML *May-Sep 2022*
Applied AI Lab
- Built POC ML application to forecast wind turbine failure based on operational sensor data, and save millions of dollars in replacement costs through early fault-detection and intervention.
- Prepared internal reports and demonstrations for non-technical executive stakeholders.

Research Analyst Online Business Systems *May 2018-Apr 2020*
Innovation Lab
- Designed software tools and workflows for data extraction and analysis from SQL databases.
- Performed case studies to assess feasibility of various ML approaches to solve clients' problems.

Awards

International Tuition Award, UBC, 2022
Graduate Scholarship NSERC CREATE in Quantum Computing, UBC, 2022
Allen Medal in Physics, UManitoba, 2021
Undergraduate Research Award, UManitoba, 2020
International Undergraduate Student Scholarship, UManitoba, 2017-2019
Kenneth Roulston Memorial Scholarship, UManitoba, 2017
Bell MTS Scholarships in Computer Science, UManitoba, 2017

Talks and Posters

ATLAS Canada Collaboration Meeting, TRIUMF, *Talk*, Virtual, Feb 2022
14th Annual Meeting of the Helmholtz Alliance "Physics at the Terascale", *Talk*, Virtual, Nov 2021
Hyper-K Canada Collaboration Meeting, TRIUMF. *Talk*, Virtual, Dec 2019
Data Science and Quantum Computing Workshop, TRIUMF Science Week, *Talk*, Virtual, Aug 2019

Quantum Days Conference, *Poster*, Virtual, Feb 2022
NeurIPS Workshop on Machine Learning and the Physical Sciences, *Poster*, Virtual, Dec 2021
TRIUMF User Group Annual General Meeting, *Poster*, Virtual, July 2022
TRIUMF User Group Annual General Meeting, *Poster*, Vancouver, July 2019

Service

Reviewer, NeurIPS Workshop on Machine Learning and the Physical Sciences 2022
Tutor, Cornerstone Models of Quantum Computing, TRIUMF Summer School, Aug 2021

Extra Curricular

Volunteer, Neural Information Processing Systems (NeurIPS) Conference, 2019, 2021
Volunteer, Canadian Association of Physicists (CAP) Congress, 2021
Volunteer, LabTrek Research Open House, UManitoba, 2018

First place winner, QuantumBC Roadmapping Workshop Pitch Competition, Surrey, 2022
First place winner, BIG quantum hackathon, Montreal, 2022
Participant, QHack Quantum Machine Learning Hackathon, Virtual, 2021
Best technical project, MLH Local Hack Day, UManitoba, 2018

Participant, Cornerstone Models of Quantum Computing, TRIUMF, 2021
Participant, Tri-Institute Summer School on Elementary Particles, TRIUMF, 2019