

# Abhinav Muraleedharan

Graduate Student, University of Toronto, Toronto, Canada

Abhinav.Muraleedharan@mail.utoronto.ca—abhi98m@cs.toronto.edu — +1 (437) 430-2622 — LinkedIn —  
abhinavmuraleedharan.com

## RESEARCH INTERESTS

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Quantum Algorithms, Machine Learning, Quantum Dynamics, Reinforcement Learning, Autoregressive Generative Models, Alignment of Large Language Models.

## EDUCATION

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**University of Toronto**, Toronto, Canada May 2024 —  
PhD in Computer Science  
Advisors: Prof. Roger Grosse and Prof. Nathan Wiebe

**University of Toronto**, Toronto, Canada Jan 2022 — June 2024  
Master of Engineering, (AI/Quantum Specialization) Cumulative GPA: 4.00/4.00  
Thesis: Retention based Autoregressive Models for modelling neural dynamics

**National Institute of Technology**, Karnataka, India June 2015 — May 2019  
Bachelor of Technology: Major in Mechanical Engineering and Minor in Computer Science

## ACADEMIC EXPERIENCE

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**Nathan Wiebe Research Group** Toronto, Canada  
*Research Assistant* June 2023 — Present

- Development of novel Quantum Algorithms for simulating non-unitary quantum dynamics.
- Development of novel Quantum Algorithms for solving nonlinear ordinary differential equations.
- Conducted comprehensive analyses of query complexity and computational complexity for quantum algorithms, providing insights into algorithmic efficiency and performance.
- Conducted perturbation analysis to derive precise error bounds for quantum simulation algorithms, ensuring accuracy and reliability in quantum computational simulations.

**Computational Modeling and Design Optimization Under Uncertainty Group** Toronto, Canada  
*Research Assistant* September 2023 — December 2023

- Developed novel autoregressive generative models for modeling stochastic dynamics of neural spiking patterns.
- Introduced 'Retention' Mechanism for equipping Autoregressive models with long-context memory.
- Conducted a rigorous evaluation of the model against Transformer-based Autoregressive Models, demonstrating its superiority in scalability and efficiency.
- Thesis Link: Retention based Autoregressive Models for modelling neural dynamics

## PROJECTS

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**Cogniframe Inc** Toronto, Canada  
*Research Scientist* September 2023 — February 2024

- Quantum Algorithms for solving Navier Stokes Equation.
- Quantum Machine Learning Algorithms for Supervised Machine Learning Tasks.
- Implemented efficient GPU-based simulation of medium-scale Quantum Circuits.

## PUBLICATIONS

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### Journal paper

# In-Review

- Muraleedharan, A. (2023). Beyond dynamic programming. arXiv preprint arXiv:2306.15029

## SELECTED COURSES

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### Master's Courses

- Introduction to Quantum Algorithms
- Special Reading Course in Computer Science (Quantum Simulation Methods)
- Foundations of Data Analysis and Machine Learning
- AI Applications in Robotics
- Perception Algorithms (Computer Vision)
- MEng project (Thesis)

## AWARDS AND ACHIEVEMENTS

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### Joint Entrance Examination (JEE) Main, 2015

Ranked in the top 0.5% of participants nationwide

India  
May 2019

### Indian Innovation Challenge, 2017

Selected as one of the top 20 finalists out of 20,000 students across universities in India

Recognized for innovative ideas and problem-solving skills in a national-level innovation competition.

India  
Year 2017

## OTHER EXPERIENCES

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### Raytheon Technologies

*Associate Engineer*

Bangalore, India  
June 2019 — Sep 2021

- Filed 1 Trade Secret.
- Developed Machine Learning Algorithms for Computational Design Of Aircraft Components.
- Computational Design and Development of Aircraft Components.
- Developed Motion Planning Algorithms for generating Dynamically Stable Chaotic Motion Trajectories for UAVs/missiles.

### Minds and Machines, Springer Journals

*Reviewer*

Toronto, Canada

## SKILLS

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- **Programming Languages:** Proficient in C++, Python (including libraries such as NumPy, SciPy, Pandas), experience with parallel programming and GPU computing.
- **Quantum Computing:** Familiarity with quantum algorithms, quantum circuit simulation, quantum error correction, and quantum machine learning concepts.
- **Computational Physics:** Experience in numerical methods, computational fluid dynamics (CFD), finite element analysis (FEA), and other computational techniques relevant to physics simulations.
- **Machine Learning:** Understanding of machine learning algorithms, deep learning frameworks (e.g., PyTorch), and experience in applying them to solve real-world problems.
- **Software Development:** Proficient in software development methodologies, version control systems (e.g., Git), and software engineering best practices.
- **Data Analysis:** Strong data analysis skills including data preprocessing, statistical analysis, and data visualization techniques.
- **Problem Solving:** Ability to quickly grasp complex concepts, identify problems, and propose effective solutions.
- **Communication Skills:** Excellent written and verbal communication skills, including the ability to convey technical information effectively to diverse audiences.
- **Collaboration:** Experience working collaboratively in multidisciplinary teams, fostering a positive team environment, and effectively managing project tasks and deadlines.

## REFERENCES

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### Prof. Nathan Wiebe

*Professor, Department of Computer Science, University of Toronto, Toronto, Canada*

E-mail: nathan.wiebe@cs.toronto.edu

Scholar Profiles: University of Toronto - Personal Page — Google Scholar

**Prof. Alan Aspuru Guzik**

*Professor, Department of Computer Science, University of Toronto, Toronto, Canada*

E-mail: [aspuru.assistant@utoronto.ca](mailto:aspuru.assistant@utoronto.ca)

Scholar Profiles: [University of Toronto - Personal Page](#) — [Google Scholar](#)

**Prof. Prasanth Nair**

*Professor, Institute for Aerospace Studies, University of Toronto, Toronto, Canada*

E-mail: [pbn@utias.utoronto.ca](mailto:pbn@utias.utoronto.ca)

Scholar Profiles: [University of Toronto - Personal Page](#) — [Google Scholar](#) —