Natansh **Mathur**

Quantum Machine Learning Researcher

Residency: French | Nationality: Indian

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Education

IRIF, CNRS, Université Paris Cité & QC Ware, France — *Paris, France*

Doctorate in Computer Science — *2022 - 2025*

- Industrial PhD (CIFRE) in Quantum Machine Learning
- Topic: Theory and Applications of Hamming-Weight Preserving Quantum Neural Networks
- Supervisor: Prof. Iordanis Kerenidis

Université Paris Cité — *Paris, France*

Parisian Master of Research in Computer Science (MPRI) — *2021 - 2022*

- Honour: Magna Cum Laude

Indian Institute of Technology, Roorkee — *Roorkee, India*

Bachelor of Technology in Computer Science and Engineering — *2017 - 2021*

- CGPA: 9.538/10

Experience

QC Ware Corp. — *Paris, France*

Associate Staff Scientist (Quantum Research) — *August, 2020 - Present*

- Developed subspace-preserving Quantum Neural Networks
- Solve industrial use cases with Quantum Machine Learning solutions
- Clients include top firms across pharmaceuticals, finance, and automotives
- Developed software to run the machine learning solutions on client use case
- Performed several QML hardware experiments on various quantum devices

IRIF, CNRS and Université Paris Cité — *Paris, France*

Master's Research Internship — *April, 2022 - August, 2022*

- Research Internship for M2 of the Masters (MPRI).
- Guided and supervised by Prof. Iordanis Kerenidis.

Quantum Open Source Foundation — *Online*

Mentor — *September, 2021 - January, 2022*

- Mentored a candidate to contribute to the Quantum Protocol Zoo.

Institute for Quantum Computing, University of Waterloo — *Waterloo, Canada (Remote)*

Undergraduate Research Assistant — *April, 2020 - July, 2020*

- Research Assistant under the guidance of Prof. Norbert Lütkenhaus.
- Associated with Optical Quantum Communication Theory Group.

LIP6, CNRS and Sorbonne Université — *Paris, France*

Research Internship — *May, 2019 - July, 2019*

- Summer Research Internship under the guidance of Prof. Elham Kashefi.
- Part of the Quantum Internet Alliance team at CNRS.
- Associated with Paris Centre for Quantum Computing.

Publications

Bayesian Quantum Orthogonal Neural Networks for Anomaly Detection

IEEE QCE 2025

NM, Brian Coyle, Nishant Jain, Snehal Raj, Akshat Tandon, Jasper Simon Krauser, Rainer Stoessel

- https://arxiv.org/abs/2504.18103
- Talk at **QTML, 2025** in Singapore
- Talk at **IEEE Quantum Week, 2025** in Albuquerque, USA
- Poster presented at **QCTiP, 2025** in Berlin, Germany

Training-Efficient Density Quantum Machine Learning

npj Quantum Information

Brian Coyle, El Amine Cherrat, Nishant Jain, **NM**, Snehal Raj, Skander Kazdaghli, Iordanis Kerenidis

- https://www.nature.com/articles/s41534-025-01099-6
- Long Talk at **QTML, 2024** in Melbourne, Australia
- Talk at **QCTiP, 2024** in Edinburgh, UK

Improved Financial Forecasting via Quantum Machine Learning

Quantum Machine Intelligence

Sohum Thakkar, Skander Kazdaghli, **NM**, Iordanis Kerenidis, André J Ferreira-Martins, Samurai Brito

- https://link.springer.com/article/10.1007/s42484-024-00157-0
- Poster presented at **QCTiP, 2024** in Edinburgh, UK

Quantum Fourier Networks for Solving Parametric PDEs

Quantum Science & Technology

Nishant Jain, Jonas Landman, **NM**, Iordanis Kerenidis

- https://iopscience.iop.org/article/10.1088/2058-9565/ad42ce
- Long Talk at **QTML, 2023** in CERN, Geneva, Switzerland
- Poster presented at **QCTiP, 2024** in Edinburgh, UK

Quantum Vision Transformers

Quantum

El Amine Cherrat, Iordanis Kerenidis, **NM**, Jonas Landman, Martin Strahm, Yun Yvonna Li

- https://quantum-journal.org/papers/q-2024-02-22-1265/
- Poster presented at **QTML, 2023** in CERN, Geneva, Switzerland
- Poster presented at **QCTiP, 2023** in Cambridge, UK

Quantum Methods for Neural Networks and Application to Medical Image Classification

Quantum

Jonas Landman, **NM**, Yun Yvonna Li, Martin Strahm, Skander Kazdaghli, Anupam Prakash, Iordanis Kerenidis

- https://quantum-journal.org/papers/q-2022-12-22-881/
- Poster presented at **QIP, 2023** in Ghent, Belgium
- Poster presented at **QTML, 2022** in Naples, Italy

Classical and Quantum Algorithms for Orthogonal Neural Networks

US Patent

Iordanis Kerenidis, Jonas Landman, **NM**

- **US Patent** number: US 11,829,877 B2
- Poster presented at **ECML PKDD, 2022** in Grenoble, France

Towards an Open-source Software Platform for Numerical Key Rate Calculation of General Quantum Key Distribution Protocols

Jie Lin, Ian George, Kai-Hong Li, Kun Fang, Twesh Upadhyaya, **NM**, Max Chemtov, Shlok A Nahar, Shahabeddin M Aslmarand, Thomas Van Himbeeck, Yanbao Zhang, Christopher Boehm, Patrick Coles, Adam Winick, Wenyuan Wang, Norbert Lütkenhaus

- The poster is available at https://2020.qcrypt.net/posters/QCrypt2020Poster139Wang.pdf
- Poster presented at **QCrypt, 2020** in Amsterdam, Netherlands

Towards a Unified Quantum Protocol Framework: Classification, Implementation, and Use Cases

arXiv

Shraddha Singh, Mina Doosti, **NM**, Mahshid Delavar, Atul Mantri, Harold Ollivier, Elham Kashefi

- https://arxiv.org/abs/2310.12780
- Talk at **QTech, 2020** in Barcelona, Spain

Projects

Quantum Machine Learning for Enhancing MRI Screening

Joint work with **Harvard Medical School** and **F. Hoffmann-La Roche AG** *September, 2023 - August, 2024*

- Part of Wellcome Leap: Quantum for Bio Challenge - Phase 1
- Applied various quantum machine learning techniques to improve MRI acquisition

Quantum Bayesian Neural Networks for Anomaly Detection

Joint work with **Airbus** *November, 2023 - August, 2024*

- Applied Bayesian learning to Quantum Orthogonal Neural Networks for segmenting the faults in 3D car parts
- Used FNNs and 3D CNNs along with their different Bayesian versions to find the optimal solution
- Perform real hardware experiments to benchmark performance

Quantum Neural Networks for Credit Risk Assessment

Joint work with **Itaú Unibanco** *September, 2022 - March, 2023*

- Designed Neural Networks for predicting credit risk from the bank's customer data
- Matched classical performance with significantly fewer parameters using hybrid classical-quantum neural networks
- Perform real hardware experiments to benchmark performance

Quantum Autoencoders for Anomaly Detection

Joint work with **Airbus** *September, 2022 - March, 2023*

- Designed autoencoders using quantum orthogonal neural networks to detect anomalies in satellite images of ship routes

Quantum Vision Transformers for Medical Image Classification

Joint work with **F. Hoffmann-La Roche AG** *April, 2022 - August, 2022*

- Developed both a quantum analogue and a quantum native variant of the vision transformer
- Used the developed techniques to classify Medical MNIST images
- Perform real hardware experiments to benchmark performance

Quantum Convolutional Neural Networks for Surface Crack Detection

Joint work with **BMW** *August, 2020 - June, 2021*

- Designed a convolutional neural network based on quantum orthogonal neural networks
- Used the developed techniques to segment cracks on surface images

Quantum Orthogonal Neural Networks for Medical Image Classification

Joint work with **F. Hoffmann-La Roche AG** *August, 2020 - June, 2021*

- Designed an orthogonal neural network architecture using quantum gates
- Designed efficient learning algorithm to train the perfectly orthogonal neural networks
- Extended it further to actual quantum architecture and benchmark its performance
- Used the developed techniques to classify Medical MNIST images

Numerical key rate calculator for QKD Protocols

Part of Research Assistantship at IQC, UWaterloo *April, 2020 - July, 2020*

- Contributed to the development of the software architecture and wrote protocols fitting into it
- Wrote unified algorithms to perform parameter optimisation for various QKD Protocols using numerical methods and optimisation techniques
- Used High-Performance super-computing clusters of ComputeCanada to evaluate various QKD protocols' key rates for different parameters
- Software available in the public domain at *https://openqkdsecurity.wordpress.com/*

Quantum Protocol Zoo

Part of Research Internship at LIP6, Paris *December, 2018 - July, 2019*

- Added various protocols to the online encyclopedia of Quantum Internet Protocols and reviewed many others.
- Analysed and identified the resource requirements for performing each protocol.
- Developed the 'Knowledge Graphs' - a unified, interactive and user-friendly tool for resource visualisation.
- Available online at *wiki.veriqloud.fr*.

Linear Cryptanalysis of Substitution-Permutation Network

Summer Project *May, 2018 - June, 2018*

- Learning project under Prof. Sugata Gangopadhyay, Dept. of CSE, IIT Roorkee.
- Implemented a Substitution-Permutation Network based Block Cipher model.
- Implemented a linear cryptanalytic attack on the developed cryptosystem for retrieval of certain key bits.

Honours & Achievements

2025	**NYUAD Hackathon**, Invited as a Mentor at the UN Quantum Hackathon for Social Good
2024	**NYUAD Hackathon**, Invited as a Mentor at the UN Quantum Hackathon for Social Good
2022	**EUR QuanTech Fellowship**, Fellowship for M2 internship by Université Paris Cité
2021	**BMW Quantum Computing Challenge**, Winner of Automated Quality Analysis Challenge
2021	**USEQIP**, Selected among top 30 individuals from the world by IQC, UWaterloo consecutively twice
2020	**USEQIP & URA**, Selected among top 30 individuals from the world by IQC, UWaterloo
2017	**Aditya Birla Scholarship Programme**, Shortlisted among 30 students from various IITs for 2017-18 Awards
2017	**All India Rank - 348**, JEE Advanced, administered by Indian Institutes of Technology
2017	**All India Rank - 231**, JEE Main, taken by more than a million students.
2017	**All India Rank - 114**, KVPY, administered by Indian Institute of Science.

Skills

Programming Languages	Python, C++, MATLAB, JAVA, C
Packages and Environments	Qiskit, Numpy, PyTorch, IBMQ Experience, JAX
Utilities	Git, LaTeX, MS Office, Linux Shell, Vim, Jupyter
Human Languages	Hindi (Native), Marwari (Native), English (Proficient), Urdu (Advanced), French (Intermediary)