Charles **MOUSSA**

Research Scientist / Machine Learning Engineer / Software Engineer

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Experience

Pasqal (Quantum Scale-up)
Amsterdam, Netherlands

Lead Software Developer — *June 2024 - Current*

- Architected and maintained open-source and internal Quantum and Machine Learning libraries enabling scalable simulations, integration for research and industry applications, increasing traffic and potential leads for the company by at least 50%.
- Delivered significant performance gains, with runtime improvements ranging from 50% to 1000% faster.
- Applications for customer use cases: Physics-Informed (quantum) Neural Networks for solving Partial Differential Equations, Machine Learning for Chemistry and Optimization problems.
- Open-source Python librairies produced within the Agile Software team:
  - For building digital-analog programs in Pytorch or JAX: Qadence, QoolQit, PyQTorch, Horqrux, Qermod (Quantum error models package), Qadence-protocols (Mitigation and measurement protocols).
  - Machine Learning and optimization: Quantum Evolution Kernel (Quantum feature maps for graph machine learning), Perceptrain (Distributed Machine learning), Maximum independent set.

Stealth Startup
Leiden, Netherlands (Remote)

Machine Learning Engineer — *Sep. 2023 - Feb. 2024*

- Engineered specialized software solutions for next-generation physics-based AI hardware.
- Developed and optimized JAX-based libraries integrating generative AI models and benchmarking frameworks.

Leiden Institute of Advanced Computer Science (University)
Leiden, Netherlands

Ph.D. in (Quantum) Machine Learning — *2019 - 2023*

- Completed industry-sponsored Ph.D. research (TotalEnergies) developing quantum-classical hybrid solutions for real-world optimization and machine learning challenges, bridging academic quantum computing advances with industrial energy sector applications.
- Authored doctoral thesis advancing NISQ algorithm selection and configuration methodologies, establishing frameworks for deploying quantum algorithms in production industrial environments with hardware constraints.
- Designed and implemented multiple quantum machine learning algorithms (QAOA, VQE, Quantum Neural Networks, quantum generative models) with custom variational optimizers, creating research tools adopted by academic and industrial institutions.
- Applied quantum-inspired generative AI models for in-house datasets of small molecules (antioxidants) from TotalEnergies.
- Delivered technical presentations and developed comprehensive tutorials for quantum computing education while mentoring graduate students in quantum algorithm development and implementation.

Los Alamos National Laboratory (US National Laboratory)
New Mexico

Quantum Computing Fellow — *Jun. 2022 - Aug. 2022*

- Selected as a fellow for the highly competitive Quantum Computing Summer School, recognized in quantum technologies.
- Implemented Quantum Machine Learning algorithms on simulators and real quantum hardware to process quantum-native data.

TotalEnergies
Pau, France

Scientific Consultant — *Mar. 2019 - Jun. 2019*

- Scientific advisor for TotalEnergies in their machine learning and quantum computing project.
- Implemented algorithms on high-performance clusters (CPU + GPU).

Oak Ridge National Laboratory (US National Laboratory) - TotalEnergies
Oak Ridge, Tennessee

Researcher — *Aug. 2017 - Jan. 2019*

- Investigated and highlighted quantum computing and applications potential for industrial use cases in the energy sector in Machine Learning, Chemistry, Optimization, and Differential equations.
- This lead to the start of the Quantum Computing project at TotalEnergies with several PhDs and Postdocs projects funded.

Sarenza (Leader in selling shoes online in France)
Paris, France

Data Scientist — *Apr. 2016 - Oct. 2016*

- Designed and implemented daily-updated fact tables using Hive (SQL for Hadoop), significantly reducing data preparation time for Data Science workflows.
- Built a recommendation system using collaborative filtering techniques to enhance user personalization and engagement.
- Applied transfer learning for feature extraction to improve the quality and performance of clustering models.
- Developed scalable sales forecasting solutions using machine learning algorithms (Random Forests, XGBoost, etc.) in Python and Spark, leading to more accurate business planning and inventory management.

Programming & Language Skills

Programming
- **General Languages**: Python, SQL, Java, Bash, C/C++, Fortran, VBA, Julia.
- **(Big) Data, Statistics and Machine Learning**: Scikit-Learn, R, TensorFlow, Keras, Pytorch, JAX, Spark, Hive, MongoDB, HuggingFace.
- **Agentic AI**: LangChain, LangGraph.
- **Quantum Computing**: Qiskit, PennyLane, D-Wave, Cirq, TensorFlow-Quantum, Qadence.
- **Web Programming**: HTML/CSS, PHP, Javascript, jQuery, Ajax, CasperJS, Laravel, Wordpress.

Languages
- **Proficient**: French (Native), English (Advanced).
- **Notions**:: Dutch, Spanish, Japanese.

Education

Leiden Institute of Advanced Computer Science (University) — *Leiden, Netherlands*

Ph.D. in (Quantum) Machine Learning — *2019 - 2023*
- Thesis on Algorithm selection and configuration for Noisy Intermediate Scale Quantum methods for industrial applications.

National Institute of Applied Sciences (School of Engineering) — *Rouen, France*

Master's Degree in Mathematical Engineering — *2011 - 2016*
- Applied Mathematics (Statistics, Optimization, Machine Learning, Partial Differential Equations).
- Computer Science (Programming, Virtual reality, Web Technologies).

University of Rouen — *Rouen, France*

Master's degree in Actuaries and Mathematical Engineering in Insurance and Finance — *2015 - 2016*
- Insurance, Finance, Economy, Management, Banking and Finance Law.
- Mathematics (Pricing, NonParametric Tests, Statistics of extreme values, Survival Analysis, Risk Management).

Hackathons

- Reviewer for code submissions on open-source repositories in UnitaryHack 2025. *2019-2025*
- Second place at the BIG Quantum Hackathon by QuantX, Paris 2021.
  Implemented a Wasserstein quantum GAN with Gradient Penalty and applied to images provided by BMW for car design.
- Participated in QHack 2019, 2022, and 2023, with many prizes won.

Learning & Education/Side Projects

Experimentation of Machine Learning/Data Science algorithms

Data Science Projects
- Experimentation of Machine Learning algorithms on various datasets.
- Automated detection of atmospheric NO2 plumes from satellite data.
- Application on horse races: scrapping data from websites saved into a NoSQL database, and application of Machine Learning for predicting winners.

Secretary/Webmaster of LEO (PhD Association)

Social Projects — *2020-2022*
- Organization of events for PhDs at Leiden University during pandemic.
- In contact with external associations and university entities for raising and tackling PhD-related problems.

Web programming

Website development for family businesses
- Design of an online course membership-based website : rcmedreview.com.

Publications

Journal
- "Evaluation of derivatives using approximate generalized parameter shift rule, 2025.
- "Resource frugal optimizer for quantum machine learning , Quantum Science and Technology (QST), 2023.
- "Hyperparameter importance and optimization of quantum neural networks across small datasets, Machine Learning, 2023.
- "Unsupervised strategies for identifying optimal parameters in Quantum Approximate Optimization Algorithm, EPJ QT, 2022.
- "To quantum or not to quantum: towards algorithm selection in near-term quantum optimization", QST, 2020.
- "Performance comparison of optimization methods on variational quantum algorithms", Physical Review A, 2022.

Conference
- "Application of quantum-inspired generative models to small molecular datasets, QCE IEEE, 2023.
- "Hyperparameter Importance of Quantum Neural Networks Across Small Datasets, Discovery Science, 2022.
- "Tabu-driven Quantum Neighborhood Samplers", EVOCOP, 2021.
- "Function Maximization with Dynamic Quantum Search ", Quantum Technology and Optimization Problems, 2019.