Charles **MOUSSA**

Research Scientist

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Experience

Pasqal
Amsterdam, Netherlands

Lead Software Developer — *June 2024 - Current*

- Development and maintenance of several librairies for quantum computing simulations and and machine learning applications.
- Open-source librairies: Qadence, PyQTorch, Horqrux, Qadence-protocols.

Stealth Startup
Leiden, Netherlands (Remote)

Research Scientist — *Sep. 2023 - Feb. 2024*

- Designing software and research code for unconventional physics-based hardware for AI workloads.
- Application of generative models, benchmarking algorithms, and software engineering for future open-source Jax libraries.

Leiden Institute of Advanced Computer Science
Leiden, Netherlands

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

- Ph.D. sponsored by TotalEnergies, combining Quantum Computing, Optimization, and Machine Learning for industrial problems.
- Thesis on Algorithm selection and configuration for Noisy Intermediate Scale Quantum methods for industrial applications.
- Development of hybrid quantum-classical algorithms for research and education:
  QAOA, Quantum Neural Networks, quantum GAN, and optimizers for variational algorithms.
- Participation in teaching activities as guest presenter and developing tutorials. Supervision of students.

Los Alamos National Laboratory
New Mexico

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

- Selected fellow for the Quantum Computing Summer school.
- Implementation of QML algorithms on simulators and hardware for quantum data.

Modis - TotalEnergies
Pau, France

Quantum Computing Scientist — *Mar. 2019 - Jun. 2019*

- Supporting TotalEnergies in their quantum computing project.
- Implementation of quantum algorithms on a high-performance cluster.
- Supervising interns in their research projects.

Oak Ridge National Laboratory - TotalEnergies
Oak Ridge, Tennessee

Quantum Computing Researcher — *Aug. 2017 - Jan. 2019*

- Investigating quantum computing and applications for the energy sector in Machine Learning, Chemistry, Optimization, and Differential equations.
- Implementation of classical and quantum algorithms:
  Genetic Algorithms, Restricted Boltzmann Machines, Grover Search, TotalQBoost...
- Coding algorithms with different quantum simulation software:
  Qiskit, D-Wave API, PennyLane, Strawberry Fields, Atos Quantum Learning Machine.
- Production of reports for documentation on quantum algorithms potential for industry use cases.

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

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

- Created fact tables with Hive (SQL for Hadoop) that are updated daily to save time in Data preparation for Data Science use cases.
- Recommendation system using collaborative filtering.
- Using Transfer Learning to extract features for clustering.
- Sales forecasting with Machine Learning algorithms (Random forests, XGBoost, Extreme Gradient Boosting...) using Python and Spark.

Programming & Language Skills

Programming

Quantum Computing : Qiskit, PennyLane, D-Wave API, myQLM, Cirq, TensorFlow-Quantum.
Statistics and Machine Learning : Scikit-Learn, R, TensorFlow, Keras, Pytorch, Equinox.
General Languages : Python, SQL, Java, Bash, C/C++, Fortran, VBA, Julia, Jax.
Big Data : Spark, Hive (SQL for Hadoop), MongoDB.
Web Programming : HTML/CSS, PHP, Javascript, jQuery, Ajax, CasperJS, Laravel, Wordpress.

Languages

Proficient : French (Native), English (Advanced).

Notions : Dutch, Spanish, Japanese.

Education

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

Hackathons *2019-2022*

- 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.
- Participation in QHack 2019, 2022, and 2023, with many prizes won.

Learning & Education/Side Projects

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.

Experimentation of Data Science algorithms

Data Science Projects

- Experimentation of Machine Learning algorithms on various datasets.
- Application on horse races: scrapping data from websites saved into a NoSQL database, and application of Machine Learning for predicting winners.

Web programming

Website development for family businesses

- Designing an online course membership-based website : rcmedreview.com.

Publications

Conference

- C. Moussa, H. Wang, M. Araya-Polo, T. Bäck, V. Dunjko: "Application of quantum-inspired generative models to small molecular datasets, QCE IEEE, 2023.
- C. Moussa, J. N. van Rijn, T. Bäck, V. Dunjko: "Hyperparameter Importance of Quantum Neural Networks Across Small Datasets, Discovery Science, 2022.
- C. Moussa, H. Wang, H. Calandra, T. Bäck, V. Dunjko: "Tabu-driven Quantum Neighborhood Samplers", EVOCOP, 2021.

Journal

- C. Moussa, M. Hunter Gordon, M. Baczyk, M. Cerezo, L. Cincio, P. J. Coles: "Resource frugal optimizer for quantum machine learning , Quantum Science and Technology, 2023.
- C. Moussa, Y. Patel, J. N. van Rijn, T. Bäck, V. Dunjko: "Hyperparameter importance and optimization of quantum neural networks across small datasets, Machine Learning, 2023.
- C. Moussa, H. Wang, T. Bäck, V. Dunjko: "Unsupervised strategies for identifying optimal parameters in Quantum Approximate Optimization Algorithm, EPJ Quantum Technology, 2022.
- C. Moussa, H. Calandra, V. Dunjko: "To quantum or not to quantum: towards algorithm selection in near-term quantum optimization", Quantum Science and Technology, 2020.
- X. Bonet-Monroig, H. Wang, D. Vermetten, B. Senjean, C. Moussa, T. Bäck, V. Dunjko, T. E O'Brien: "Performance comparison of optimization methods on variational quantum algorithms", Arxiv, 2021.

Workshop

- C. Moussa, H. Calandra, T. Humble: "Function Maximization with Dynamic Quantum Search ", Quantum Technology and Optimization Problems, 2019.