Francesco **Scala**

PhD Student in Quantum Machine Learning

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Summary

I'm an eager **third-year PhD student in Quantum Machine Learning** (QML) at University of Pavia, focusing on both classical and quantum machine learning. I bring **strong foundations** in state-of-the-art **theoretical aspects of QML** as well as **proficiency in numerical simulations** of quantum computing systems and QML algorithms. Thanks to my collegiate and representative of PhD students experience, I am used to interdisciplinary and challenging environments. Apart from the academic side, I'm an outgoing and active person enjoying sports, gardening and travelling.

Work Experience

Full-time

Mar - May 2024 | **Reserach intern** IBM Research — *Zurich - Switzerland*

Research internship focused on Quantum Machine Learning. My supervisors are Dr. **Ivano Tavernelli** and Dr. **Francesco Tacchino**, I closely work also with Dr. **Christa Zoufal**.

2021 - present | **PhD in Quantum Machine Learning** Università degli Studi di Pavia — *Pavia – Italy*

My research deals with **QML algorithms**, with special focus on **overparametrization** and **regularization** properties of **Quantum Neural Networks**. Part of my studies are also devoted to simulations of quantum computing platforms. My supervisor is Prof. **Dario Gerace**.

Part-time

Oct 2022-present | **Teaching assistant** Università degli Studi di Pavia — *Pavia - Italy*

- **Lectures on General Physics** at the degree program in Chemistry and Pharmaceutical Technologies

Jul - Dec 2022 | **Intern** Quantum Computing Lab - CINECA — *Casalecchio di Reno (BO) - Italy*

- Benchmarking of **HPC infrastructures** for quantum computing and **QML applications** (Python)

Education

2019 - 2021 | **Master degree in Physics of Quantum Technologies** Università degli Studi di Pavia — *Pavia – Italy*

Graduation date: 23-09-2021, Thesis: "Witnessing Entanglement by Quantum Neural Networks".

2016 - 2019 | **Bachelor degree in Physics** Università degli Studi di Pavia — *Pavia – Italy*

Graduation date: 24-09-2019 , Thesis: "Machine learning techniques applied to the quantum many-body problem".

Contributions: conferences, schools

Nov 2023 | **Quantum Techniques in Machine Learning (QTML) 2023** CERN — *Geneve - Switzerland*

Talk: A General Approach to Dropout in Quantum Neural Networks

Oct 2023 | **Quantum Computing and Simulation Workshop** Istituto Veneto — *Venezia - Italy*

Poster: A General Approach to Dropout in Quantum Neural Networks

Aug 2023 | **Superconducting Qubits and Algorithms (SQA) Conference** IQM Quantum Computers — *Munich - Germany*

Poster: Symmetrizing Quantum Machine Learning for Quantum Field Theory

Jun 2023 | **International Conference on Optics of Excitons in Confined Systems** Università del Salento — *Lecce - Italy*

Talk: Quantum computing platform with polariton integrated circuits

Nov 2022 | **Quantum Techniques in Machine Learning (QTML) 2022** University Federico II *Napoli - Italy*

Poster: Quantum variational learning for entanglement witnessing

Ago - Sept 2022 | **VCQ & AppQInfo SummerSchool 2022** Universität Wien *Wien - Austria*

Student Talk: Quantum variational learning for entanglement witnessing

Jul 2022 | **World Congress On Computational Intelligence 2022** IEEE *Padova – Italy*

Talk: Quantum variational learning for entanglement witnessing

Jun 2022 | **Quantum Computing Hard- and Software Summer School 2022** EPFL, ETH zürich *Lausanne - Switzerland*

Poster: Quantum variational learning for entanglement witnessing

Extracurricular Activities

Feb 2024 | **2nd Place** QHack 2024 - Xanadu *Online*

- Topic: Spectral Gap estimation
- Spectral Gap Superposition States **[paper] [Github]**

Apr 2023 - present | **Technical-scientific Committee Member** BeQuantum *Online - Italy*

- Production of technical posts. General posts review.

May 2023 | **1st Place** ETH Quantum Hackathon 2023 - IQM Challenge *Zurich - Switzerland*

- Topic: Exploiting symmetries in Quantum Machine Learning
- Tasks: TicTacToe (given), Schwinger model (our proposal) **[Github]**

Apr 2022 - Jul 2022 | **Mentee** Quantum Open Source Foundation (QOSF) *Online*

- Implementation of Krylov module within `tequila` Python package **[Github]**
- Mentor: Prof. **Jakob Kottmann**

2022 - 2023 | **Phd Student representative** Università degli Studi di Pavia *Pavia - Italy*

Jan 2022 | **2nd Place** MIT iQuHACK 2022 - Micrsoft/IonQ division *Online*

- Topic: Quantum game with educational purposes
- Blackjack-inspired quantum game named QuHackJack **[Github]**

Skills

- Programming: Python, C++(basic)
- Quantum programming: `Pennylane` (in combination with `JAX`), `Qiskit`, `tequila`, `AWS Braket`
- Soft skills: predisposition to interpersonal relationships, teamwork, quick learner, proactive, time management

Languages

Italian: Native **English**: Level C1 **French**: Level A1

Publications

F. Scala et al. | **arXiv:2402.17668** Spectral Gap Superposition States *2024 (Preprint)*

F. Scala et al. | **Adv. Quantum Tech. 2300220** A General Approach to Dropout in Quantum Neural Networks *2023*

F. Scala et al. | **arXiv:2306.05072** Deterministic entangling gates with nonlinear quantum photonic interferometers *2023 (In review)*

J. Kottmann, F. Scala | **arXiv:2302.10660** Compact Effective Basis Generation: Insights from Interpretable Circuit Design *2023 (Acc. by JCTC)*

F. Scala et al. | **IEEE - IJCNN 2022 Proceedings** Quantum variational learning for entanglement witnessing *2022*