

Francesco Scala

RESEARCH FELLOW IN QUANTUM MACHINE LEARNING

Pavia, Italy

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Summary

I'm an eager **researcher** 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.

Work Experience

FULL-TIME

- Oct - Dec 2024 | **Research fellow** UNIVERSITY OF PAVIA Pavia - Italy
Research fellowship focused on overparametrization in Quantum Machine Learning in collaboration with the research group led by **Dario Gerace**.
- 2021 - 2024 | **PhD in Quantum Machine Learning** UNIVERSITY OF PAVIA Pavia - Italy
My research dealt 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 controlling **integrated quantum photonics**. Supervisor: Prof. **Dario Gerace**.
- Mar - May 2024 | **Visiting PhD** IBM RESEARCH Zurich - Switzerland
Research internship focused on Quantum Machine Learning. Supervisors: Dr. **Ivano Tavernelli**, Dr. **Francesco Tacchino**. and Dr. **Christa Zoufal**.

PART-TIME

- 2022-24 | **Teaching assistant** UNIVERSITY OF PAVIA Pavia - Italy
 - **General Physics**: preparation for the exam at the degree program in Chemistry and Pharmaceutical Technologies (2022-24)
 - **Computational methods** (bash, C++): preparation for the exam at the degree program in Physics (2023-24)
- Jul - Dec 2022 | **Intern** QUANTUM COMPUTING LAB - CINECA Casalecchio di Reno (BO) - Italy
Benchmarking of **HPC infrastructures** for quantum computing and **QML applications** (Python). Supervisor: Dr. **Riccardo Mengoni**

Education

- 2019 - 2021 | **Master degree in Physics of Quantum Technologies** UNIVERSITY OF PAVIA Pavia - Italy
Graduation date: 23-09-2021, Thesis: "Witnessing Entanglement by Quantum Neural Networks".
- 2016 - 2019 | **Bachelor degree in Physics** UNIVERSITY OF 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 & AppQlinfo 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

2021-present		Reviewer	JOURNALS-CONFERENCES	Online
<ul style="list-style-type: none"> Reviewer for Scientific Journals: Quantum Science and Technology, Quantum Machine Intelligence, Quantum Information Processing, International Journal of Theoretical Physics Reviewer for Scientific Conferences: Quantum Techniques in Machine Learning (QTML), IEEE Quantum Week 				
2022-present		Winner	QUANTUM HACKATHONS	Online/In-presence
<ul style="list-style-type: none"> 2nd Place - QHack 2024 (Xanadu): Spectral Gap estimation [paper] [Github] 1st Place - ETH Quantum Hackathon 2023 (IQM Challenge): Exploiting symmetries in Quantum Machine Learning [Github] 2nd Place - MIT iQuHACK 2022 (Microsoft/IonQ division): Quantum game with educational purposes [Github] 				
Apr 2023 - present		Technical-scientific Committee Member	BEQUANTUM	Online - Italy
<ul style="list-style-type: none"> Production of technical posts. General posts review. 				
Apr 2022 - Jul 2022		Mentee	QUANTUM OPEN SOURCE FOUNDATION (QOSF)	Online
<ul style="list-style-type: none"> 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

Skills

- Programming: Python, familiarity with C++, familiarity with high-performance computing (MPI, OpenMP)
- Quantum programming: **PennyLane** (in combination with **JAX**), **Qiskit**, **tequila**, **AWS Braket**
- Mark-up: ~~TeX~~, familiarity with **html**, CSS
- Soft skills: predisposition to interpersonal relationships, teamwork, quick learner, proactive, time management

Languages

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

Publications

F. Scala <i>et al.</i> , In preparation , Quantum Neural Networks Diagnostics with Neural Tangent Kernels	2024
F. Ghisoni, F. Scala <i>et al.</i> , arXiv:2409.08929 , Shadow Quantum Linear Solver	2024
J. Kottmann, F. Scala, JCTC 20 (9), 3514-3523 , Quantum Algorithmic Approach to Multiconfigurational Valence Bond Theory	2024
F. Scala <i>et al.</i> , Commun Phys 7, 118 , Deterministic entangling gates with nonlinear quantum photonic interferometers	2024
F. Scala <i>et al.</i> , arXiv:2402.17668 , Spectral Gap Superposition States	2024
F. Scala <i>et al.</i> , Adv. Quantum Technol. 2300220 , A General Approach to Dropout in Quantum Neural Networks	2023
F. Scala <i>et al.</i> , IEEE - IJCNN 2022 Proceedings , Quantum variational learning for entanglement witnessing	2022