

# CURRICULUM VITAE

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## EDUCATION

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**PhD** | *Universitat Pompeu Fabra - Barcelona Supercomputing Center, Spain*  
**Nov 2024 - ongoing**

- Qualification: Doctoral degree.
- Major: Quantum machine learning for healthcare. Combining quantum computing and classical AI methods to medical data, understanding the potential, scalability, and feasibility of executing algorithms on a quantum computer.
- Collaboration with Barcelona Supercomputing Center (BSC).

**Master** | *Alma Mater Studiorum University of Bologna, Italy*  
**Sep 2021 - Dec 2023**

- Qualification: Master's degree.
- Major: Theoretical Physics.
- Related Coursework: Advanced Physics mandatory courses, programming introduction course.
- Thesis: Quantum Neural Networks for Data-Efficient Image Classification (Quantum Computing). The thesis aimed to apply novel quantum machine learning algorithms, such as QNN, to both simple and real image data to study their generalization ability by varying the number of samples in the training set, while testing on the same test set.

**Bachelor** | *University of Modena and Reggio Emilia, Italy*  
**Sep 2017 - Apr 2021**

- Qualification: Bachelor's degree.
- Major: Physics.
- Related Coursework: Math and Physics mandatory courses, programming introduction course.
- Thesis: Zernike phase plates (Optical Physics). Study the wave function generated by the interference and diffraction phenomena of a set of manufactured semiconductor pillars.

## **EXPERIENCE**

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### **Universitat Pompeu Fabra - Barcelona Supercomputing Center (Barcelona, ESP) 01 Nov 2024 - ongoing**

#### **PhD in quantum machine learning for healthcare**

- Collaboration with Barcelona Supercomputing Center (BSC);
- Research on quantum and classical machine learning algorithms for medical data and imaging (VQAs, non-variational algorithms, kernel methods, GenAI, quantum-classical diffusion models, quantum annealer, image segmentation, medical data and imaging, (XAI) Explainable AI, machine learning for noise-improved quantum computing);
- Tutor assistant (Linear Algebra, Calculus);

### **Università degli Studi di Firenze (Sesto Fiorentino, ITA)**

**Mar 2024 – Oct 2024**

#### **Research Fellow**

- Study and implement quantum machine learning models focusing mainly on unsupervised and supervised learning problems.
- Introduction to classical and quantum diffusion models, and random walks.
- Study and test classical deep learning approaches to image problems.
- Usage of GPU support.
- Usage of Pycharm, VSCode, Anaconda, Tmux, bash, RayTune, PyTorch, Qiskit, Pennylane, JAX, Optax, Overleaf, basic environment creation.

### **CINECA (Casalecchio di Reno, ITA)**

**Apr 2023 – Sep 2023**

#### **Quantum Computing Internship**

- Review and exploration of quantum computing algorithms related to quantum machine learning.
- Development and test of quantum neural network models on the supervised learning problem of image classification.
- Participation in demos and conferences conducted by different companies as ESA, Pasqal.
- Further studies and simulations with HPC - Slurm machine support: basic job run on a cluster machine.

## CONFERENCES

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### Setcases VII 2025 (Setcases, ESP)

25-28 Feb 2025

Pyrenees Winter School in Quantum Information and Quantum Science

- Got Setcases VII Quantum Information ticket for participating in the conference.

### QTECH 2024 (Berlin, GER)

10-12 Sep 2024

Quantum Technology International Conference

- Got QTECH ticket for joining the conference and exposing my work on Quantum Knowledge Distillation as a poster.

## PUBLICATIONS

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### **Publications:**

- (ArXiv - under review) ***Investigating layer-selective transfer learning of QAOA parameters for Max-Cut problem***, authors: Venturelli F. A., Das S., Caruso F.;
- (Ready to be submitted) ***Physics-inspired generative models via real hardware-based noisy quantum diffusion***, authors: Parigi M., Martina S., Venturelli F. A., Caruso F.

## PROJECTS

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GitHub: | *checc1*, | *poporubeus*

Main projects during University and PhD:

- Quantum machine learning using Qiskit and PennyLane for image classification combined with PyTorch.
- Demo uploaded on PennyLane's website, combining the aforementioned framework and JAX for fast model training on the image classification problem.
- Nuclear Physics simulation of Bateman ordinary differential equations with Runge-Kutta and matrix exponentiation.
- Data scraping algorithm to get data from chess tournaments with requests and BeautifulSoup.
- Study relationships between chess players playing different tournaments with Network Theory (using NetworkX, iGraph) to detect communities and perform statistical analysis on selected players.
- BB-84 Quantum Key Distribution simulation algorithm implemented with Qiskit.
- Quantum K-means clustering using PennyLane and Scikit-learn tested on a simple dataset.
- Quantum knowledge distillation using PyTorch to force a lighter quantum model to mimic a larger classical convolutional neural network for image classification.
- Study of critical mass during a nuclear reaction using 1-D integration (using C++) and 2-D integration (using Python).
- Quantum random walks as a forward process in diffusion models combining classical neural networks for backward data reconstruction.
- Transferability of gamma and beta parameters in QAOA algorithm applied to MaxCut problem (published);
- Using and expanding image segmentation using QUBO reformulation problem;
- Feature Selection through quantum annealer and QUBO reformulation;
- Explainable AI (XAI) using support vector machine on extracted convolutional neural network feature maps;
- Feature selection and extraction using quantum annealer on classical convolutional neural network image-extracted representations;

## SKILLS

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**Technical** Maths, Physics, Python (discrete), Julia (learning / tried), C++/ROOT (basic / tried), LaTeX, Linux, Tmux, GPU support, PyCharm, VSCode.

**Language** Fluent English level. Spanish (learning)

**Academic Interests** Classical machine learning, programming, Maths, quantum computing, quantum machine learning, Data Science, data scraping and data handling, Science, Physics, Complex Systems, Physics, technology, Network Theory, Bioinformatics.

**Personal Interests** Chess, relationships, music, football, travelling, finance, wine tasting, reading, technology, skiing, swimming, trekking, movies, acting, sports.