

Alessandro Ruzza

EUMaster4HPC student

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🇮🇹 Italian 🔄 AlessandroRuzza

🌐 Alessandro Ruzza

🌐 LANGUAGES

English

C1

Italian

Native

French

📜 CERTIFICATES

ETH Quantum Hackathon Winner 📄

Won QuEra's challenge on quantum compilation for neutral atoms

EuroHPC Summit Winning Team 📄

Won Rudolfovo's challenge on graph coloring using VEGA supercomputer

EPFL Quantum Hackathon 3° place 📄

Alice&Bob's challenge on Quantum Error Correction (QEC) for cat-qubits

Quantum Ideas Factory 2° place 📄

Challenge on Toric codes for QEC, including a custom asymmetric code

🎓 EDUCATION

Master in Computational Science

Università della Svizzera Italiana (USI)

09/2024 – Present | Lugano, Switzerland

Second year of EUMaster4HPC double-degree program.

Master in High Performance Computing

Politecnico di Milano

09/2024 – Present | Milan, Italy

First year of EUMaster4HPC double-degree program.

Bachelor in Engineering of Computing Systems

Politecnico di Milano 📄

09/2021 – 07/2024 | Milan, Italy

High School Diploma (IT specialisation)

I.I.S. Cesaris 📄

09/2016 – 07/2021 | Casalpusterlengo, Italy

📁 PROJECTS

Quantum Error Correction for Quantum Networks

Master's Thesis @ SWSYSTEMS lab (USI)

03/2026 – 09/2026

Developed a compact, network-oriented representation of stabilizer states to describe memoryless quantum networks. Using this representation, we generalized results in the literature about graph fusions and applied them to all-photonic quantum repeaters.

Gained expertise on:

- Quantum Error Correction (redundancy for loss-tolerance)
- Memory-based and memoryless quantum networks
- Formal abstraction of stabilizer states for classical simulation of arbitrary quantum stabilizer circuits.

Open-source 📄 and available online as a web-based tool 📄.

Distributed Quantum Networks Simulation 📄

Preparation for Master's thesis @ USI

10/2025 – 12/2025

Discrete-event simulation of quantum network protocols developed using NetSquid 📄.

- Protocol Implementation: modeled entanglement distillation (DEJMPS) and swapping to tackle exponential photon loss in fiber channels.
- Performance Analysis: Quantified trade-offs between Fidelity and Secret Key Rate (BB84), showing that "Distill-first" architectures are robust in high-noise regimes.
- Validation of simulation results against analytical models for varying distances and coherence times (T_1 , T_2).

Toric Code for Biased Quantum Error Correction

5-people team, Quantum Ideas Factory @ CESQ

03/2026

Designed an asymmetric Toric code that allows for a rectangular lattice for efficiency under highly biased noise models. An interactive demo is available here 📄.

We applied Biased Syndrome Matching using Anisotropic edge weights.

Fault-tolerant Quantum Compilation

3-people team - Gaussian-potential mapping heuristic

09/2025 – Present

Given a logical circuit and a physical architecture as a graph of qubits (nodes) and pairings (edges), we optimize the Qubit Mapping and Routing problem to produce the physical circuit. We developed a Gaussian-potential heuristic using to provide the initial qubit mapping.

Quantum Knapsack 📄

2-people team

02/2025

MATLAB Live Script for solving the Knapsack problem using Quantum Approximate Optimization Algorithm:

- Standard Knapsack formulation
- QUBO 📄 formulation
- Ising Model representation
- Quantum Ansatz circuit and optimization



EXPERIENCE

Università della Svizzera Italiana

Student assistant

05/2026 – 09/2026 | Lugano, CH



PROGRAMMING SKILLS

Imperative

C, C++, C#

Java

Python

Microsoft VBA

Matlab

Assembly

HPC & Quantum

Slurm (deployment on clusters)

CUDA (for NVIDIA GPUs)

LLVM/MLIR [↗](#) (compilers)

Qiskit [↗](#), Cirq [↗](#)

Stim [↗](#)

Web Development

HTML

CSS

Javascript (React)

PHP

Database

SQL

FaunaDB

Others

VHDL (Hardware Description)

Git (Version control)

RAPID (ABB robotics)

Multi-dimensional Finite Element Method [↗](#)

3-person team

08/2025

C++ implementation from scratch of a FEM solver for diffusion-transport-reaction parabolic PDEs in 1D, 2D, 3D. Focus on modular design, flexibility and expandability. Libraries used: Eigen, OpenMP, TOML [↗](#), exptk [↗](#).

Fisher-Kolmogorov Equation for neurodegenerative diseases [↗](#)

4-people team

07/2025 – 08/2025

Collaborated with *Professor Emeritus Alfio Maria Quarteroni* from PoliMi and *Professor Johannes Weickenmeier* from Oxford University in a project on the theoretical study of the Fisher-Kolmogorov equation.

Developed a numerical solver using C++, deal.II [↗](#) and MPI. We simulated a realistic diffusion-reaction model on multiple detailed brain meshes, using information on axons and white/gray matter.

See our [report](#) [↗](#) and [simulation videos](#) [↗](#).

Chasing the Perfect Hue [↗](#)

A High-Performance Dive into Graph Coloring

02/2025

A parallel branch-and-bound solver for determining the chromatic number of a graph.

- Uses heuristic-based bounding strategies
- Uses MPI for distributed computation
- Project proposed by Rudolfovo [↗](#) for the EuroHPC Summit Student Challenge 2025
- Benchmarked on Slovenian supercomputer VEGA [↗](#)

"Codex Naturalis" [↗](#)

4-people team, Bachelor final examination @ PoliMi

03/2024 – 06/2024

Digital recreation of the tabletop game "Codex Naturalis" [↗](#)

- Developed in Java using Maven and Swing
- Client / Server structure for multiple players

Digital Logic Design (VHDL)

Bachelor final examination @ PoliMi

02/2024 – 03/2024

Development of a hardware component that reads and processes data from memory. Tested in behavioural and post-synthesis simulation on Artix-7 FPGA.



RELEVANT COURSES

Information Technology

- Distributed Systems
- Distributed Algorithms
- Code Transformation and Optimisation
- Advanced Computer Architectures
- Advanced Methods for Scientific Computing
- Parallel Computing

Quantum

- Quantum Physics
- Quantum Computing
- Quantum Information Processing 101
- Quantum Circuits and Devices
- Quantum Communications