

Riccardo Romanello

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About me

I completed my PhD at University of Udine at the end of 2024 and I successfully defended (cum laude) my thesis entitled *On the role of Graphs in Quantum Computation* in March 17th, 2025. Currently I hold a fellowship from Ca' Foscari University of Venice. My research activity is driven by what theoretical computer science can do to address task related to quantum computing. The main tool I adopt to do so in theoretical graph theory, with a particular emphasis on quantum circuit compilation across all its stages. I have explored various aspects of this process, including CNOT synthesis, qubit mapping, qubit routing, and general unitary synthesis. My investigations in theoretical computer science enhance my capability to tackle diverse challenges in both classical and quantum domains. I am member of the Quantum Computing Lab at the University of Udine.

Contact Information

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Education

University of Udine, Udine, Italy

Ph.D. Student, 11/2021-11/2024

Topic: Investigating the role of graphs in quantum computation. How they can be used in such paradigm and how graph-theoretical techniques can help quantum.

MSc in Computer Science, 2018-2021

Score: 110/110 with honors. *Thesis:* Quantum Automata. How are automata defined in the quantum settings. Introduction of a novel model of quantum automata *a la Heisenberg*.

BSc in Computer Science, 2015-2018

Score: 110/110 with honors. *Thesis:* Models for Quantum Computing. A very first approach to theoretical Quantum models: from Quantum Turing Machines to Grover's algorithm.

Experience

Academic

Technical University of Munich, Munich, Germany

Visiting Scientist, 03/2023-06/2023

Three-month internship at the Technical University of Munich, working in Professor Wille's Quantum laboratory. We investigated techniques for the compilation of Quantum Circuits.

Industrial

Blue Reply, Silea, Italy

Consultant, 10/2018-10/2021

Role: Software developer, Java and Python

Skills

Languages: Italian (native), English (competent).

Software: C/C++, Python, Java, Haskell.

Other: admin of a 200+ people discord server on QC.

Teaching Services

Teaching Assistant: *Elements of Mathematics and Linear Algebra:* Introduction to the basic notions of mathematics, probability and linear algebra, 24 hours. October 2022-February 2023, BSc Computer Science at the University of Udine.

Teaching Assistant: *Foundations of Computer Science:* automata theory, computability theory, complexity theory, 20 hours. March 2024-June 2024, BSc Computer Science at the University of Udine.

Research Activities

Journals Reviewer: Quantum, International Journal of Foundations of Computer Science, IEEE Transactions on Neural Networks and Learning Systems, Intelligenza Artificiale.

Conferences Reviewer:

- IEEE QSW, IEEE International Conference on Quantum Software, 2023.
- AIQxQIA, International Workshop on AI for Quantum and Quantum for AI, 2023 and 2024.
- CILC, Italian Conference on Computational Logic, 2023 and 2024.
- GandALF, Games, Automata, Logics, and Formal Verification, 2023.
- ICTCS, Italian Conference on Theoretical Computer Science, 2023 and 2024.

Program Committee member:

- AIQxQIA, International Workshop on AI for Quantum and Quantum for AI, 2023 and 2024.

Local Committee member:

- EQAI, European Summer School on Quantum AI, from 2022 to 2024.
- AIxIA, International Conference of the Italian Association for Artificial Intelligence, 2023.
- CILC, Italian Conference on Computational Logic, 2023 and 2024.

Thesis Co-Supervisor:

[6] Francesco De Cataldo, MSc Computer Science, University of Udine. *Implementation through ZX calculus of an universal representation for stabilizer codes.*

[5] Jacopo Danielis, BSc Computer Science, University of Udine. *Qubit Allocation Problem: a bisimulation based approach*

[4] Diego Borsoi, MSc Computer Science, University of Udine. *Translating unitaries into the Measurement Based Quantum Computing model.*

[3] Alex Della Schiava, MSc Artificial Intelligence and Cybersecurity, University of Udine. *Graph encoding in Quantum Computing.*

[2] Dusan Sutulovic, MSc Artificial Intelligence and Cybersecurity, University of Udine. *Playing with CNOT: a Reinforcement Learning Approach to Linear Reversible Circuit Synthesis*.

[1] Francesco De Cataldo, BSc Computer Science, University of Udine. *An algorithm for the T-Count of Clifford+T circuits*.

Selected Publications

[7] *CNOT Minimal Circuit Synthesis: A Reinforcement Learning Approach*. Romanello R et al. IEEE QAI (2025).

[6] *Classical computation over quantum architectures: From graph encoding to declarative languages compilation*. Della Schiava A et al. Journal of Logic and Computation (2024).

[5] *Incremental NFA Minimization*. Bianchini C et al. Theoretical Computer Science (2024).

[4] *Quantum Encoding of Dynamic Directed Graphs*. Della Giustina D et al. Journal of Logical and Algebraic Methods in Programming (2024).

[3] *Compressing Neural Networks via Formal Methods*. Ressi D et al. Neural Networks (2024).

[2] *Synthesis of CNOT minimal quantum circuits with topological constraints through ASP*. Piazza C and Romanello R. International Workshop on AI for Quantum and Quantum for AI, AIQxQIA (2023).

[1] *Mirrors and Memory In Quantum Automata*. Piazza C and Romanello R. International Conference on Quantitative Evaluation of Systems, QEST (2022).

Awards

[3] First place at the Hackathon 'Quantum Machine Learning for Smart Cities' organized by University of Cagliari.

[2] *Graph-Theoretical Arguments in Support of a Quantum Declarative Manifesto* presented at CILC23 won the best student paper award.

[1] Best BSc CS student in 2021 by University of Udine.

Publications

Journal papers

[5] *Classical computation over quantum architectures: From graph encoding to declarative languages compilation*. Della Schiava A et al. Journal of Logic and Computation (2024).

[4] *Incremental NFA Minimization*. Bianchini C et al. Theoretical Computer Science (2024).

[3] *Quantum Encoding of Dynamic Directed Graphs*. Della Giustina D et al. Journal of Logical and Algebraic Methods in Programming (2024).

[2] *Compressing Neural Networks via Formal Methods*. Ressi D et al. Neural Networks (2024).

[1] *AI-enhanced blockchain technology: A review of advancements and opportunities*. Ressi D et al. Journal of Network and Computer Applications (2024).

Conference papers

[11] *CNOT Minimal Circuit Synthesis: A Reinforcement Learning Approach*. Romanello R et al. IEEE QAI (2025).

[10] *Periodic Unitary Encoding for Quantum Anomaly Detection of Temporal Series*. Lizzio Bosco D et al. International Conference on Quantum Software (2025).

[9] *Softer is Better: Tweaking Quantum Dropout to Enhance Quantum Neural Network Trainability*. Romanello R et al. International Conference on Quantum Communications, Networking, and Computing, QCNC (2025).

[8] *Speeding up Answer Set Programming by Quantum Computing*. Romanello R et al. ACM Workshop on Quantum Search and Information Retrieval, QUASAR (2024).

[7] *Synthesis of CNOT minimal quantum circuits with topological constraints through ASP*. Piazza C and Romanello R. International Workshop on AI for Quantum and Quantum for AI, AIQxQIA (2023).

[6] *Graph-Theoretical Arguments in Support of a Quantum Declarative Manifesto*. Della Schiava A et al. Italian Conference on Computational Logic, CILC (2023).

[5] *An ASP Approach for the Synthesis of CNOT Minimal Quantum Circuits*. Piazza C et al. Italian Conference on Computational Logic, CILC (2023).

[4] *Neural Networks Reduction Via Lumping*. Ressi D et al. International Conference of the Italian Association for Artificial Intelligence, AIxIA (2022).

[3] *Directed Graph Encoding in Quantum Computing Supporting Edge-Failures*. Della Giustina D et al. International Conference on Reversible Computation, RC (2022).

[2] *Incremental NFA Minimization*. Bianchini C et al. Italian Conference on Theoretical Computer Science, ICTCS (2022).

[1] *Mirrors and Memory In Quantum Automata*. Piazza C and Romanello R. International Conference on Quantitative Evaluation of Systems, QEST (2022).

Talks

[7] **Aarhus University**, October 2025, Aarhus.
Invited talk on the usage of graph theory in quantum compilation.

[6] **QCNC25**, April 2025, Nara.
Softer is Better: Tweaking Quantum Dropout to Enhance Quantum Neural Network Trainability.

[5] **QUASAR24**, June 2024, Pisa.
Speeding up Answer Set Programming by Quantum Computing.

[4] **AIxIA23**, November 2023, Udine.
Synthesis of CNOT minimal quantum circuits with topological constraints through ASP.

[3] **CILC23**, July 2023, Udine.
Graph-Theoretical Arguments in Support of a Quantum Declarative Manifesto.

[2] **QEST22**, September 2022, Warsaw.
Mirrors and Memory in Quantum Automata.

[1] **RC22**, July 2022, Urbino.
Directed Graph Encoding in Quantum Computing Supporting Edge-Failures.

Software

[1] Python Library for the Soft Dropout of VQCs

[2] IBM Quantum Challenge Badge