Quantum Computing: from Mathematical and Physical Basics to Coding (12h)

This course introduces quantum theory starting from the mathematical and physical foundations of quantum mechanics to progressively moves toward quantum programming and quantum-inspired computational models.

The course is designed for PhD students in Computer Science and aims to provide a rigorous understanding of the Hilbert space formalism, quantum states and operators, and their computational interpretation in terms of qubits and quantum circuits. The final part of the course discusses both basic quantum algorithms and quantum-like approaches for modeling non-quantum problems.

The covered topics are the following:

1. **Mathematical and physical foundations**: historical, mathematical and physical introduction to quantum mechanics;
2. **Quantum coding:** implementation of code to simulate quantum mechanical model;
3. **Quantum programming and quantum algorithm**: introduction to the main features of quantum computation and to the main quantum algorithms;
4. **Quantum-like models**: discussion on possible applications of the quantum formalism to solve classical problem.