Quantum programming and algorithms

online course 2026-2027

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The **Quantum programming and algorithms** course (4 ECTS) is offered online by the University of Orléans. Lectures are scheduled on

Tuesdays, 14:00 – 16:00, from September 22 (5 sessions spread over 11 weeks).

Exercises will be provided, and assistance in solving them will be available if necessary.

Assessment is based on practical work (Python notebooks for implementing quantum programs in Qiskit) and an oral or written examination at the end of the course. ECTS will be awarded upon completion of the assessment. Students can also attend the course for their personal interest, without ECTS credits.

Content. This course offers an introduction to quantum computing through the programming of quantum circuits. Students are invited to build circuits and simulate their execution to understand what current quantum technology offers and how it differs from classical Boolean computing models. This experimental approach will then allow for a more detailed presentation of the algorithmic promises and current challenges of this technology.

We will cover:

- Qubits: from classic (Boolean) gates to quantum gates
- Particularities of quantum computing: superposition, interference, entanglement
- A first, simple algorithm with a quantum advantage: the Bernstein-Vazirani problem
- Grover's algorithm: searching for a particular element among N in time $O(\sqrt{N})$
- Discussions on other potential applications (factorisation, cryptography, simulations, etc.) and the current limits of quantum computing

All algorithms will be implemented as quantum circuits and simulated in Qiskit.

Learning outcomes. Discover quantum computing through quantum circuit programming. Understand the specific features of quantum processors. Master a circuit design and simulation environment.

Prerequisites. This course uses and reviews concepts from algebra (matrices), elementary probability and Boolean circuit calculation. Prior knowledge in one or more of these areas is an advantage. However, the quantum programming module should be accessible to students with a bachelor's degree in computer science, mathematics or physics.

To register, please complete this following form by **September 10, 2026**.