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DIGITAL LEARNING HUB · QUANTUM COMPUTING ACADEMY

Quantum Computing Academy Curriculum

Detailed overview of the courses, modules and key learning objectives.

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Quantum Computing Academy Curriculum

The Quantum Computing Academy offers a six-month journey, from the fundamentals of quantum information to hybrid quantum–high-performance computing (HPC) workflows. The curriculum also introduces category theory and diagrammatic reasoning as modern mathematical frameworks for describing quantum processes, helping participants develop a deeper understanding of quantum circuits, compositional quantum systems, and the foundations of quantum programming. Participants build a solid theoretical foundation in quantum computing, develop practice on quantum simulators on the MeluXina supercomputer and a unique experience to access real Quantum Computers via the Cloud. Explore applications in key sectors of the Luxembourg economy, and finish with an applied capstone project that brings together the concepts and skills acquired throughout the programme, alongside optional preparation for the IBM Qiskit Developer certification, available upon participant request.

Programme at a glance

Duration	6 months
Next cohort	April 2027 (registrations open in November 2026)
Structure	Six monthly modules, an applied capstone project and a demo day
Certification	Preparation for IBM Qiskit Developer certification
Tools	Qiskit, IBM Quantum Learning courses, simulators, HPC environment, DisCoPy
Prerequisites	Linear Algebra, Python

Programme structure

MONTHS 1 – 2
Build the foundations
Quantum computing and HPC foundations.

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MONTHS 3 – 4
From practice to industry
Hands-on quantum computing and industry use cases.

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MONTH 5
Sector Applications
Luxembourg's key sectors.

›

MONTH 6
Capstone Project
Applied project and Demo Day.

LEARNING OUTCOMES

What you will be able to do

By the end of the programme, participants will be able to:

1. Explain the foundations of quantum information, category theory and diagrammatic quantum reasoning and apply these concepts to understand quantum circuits and quantum algorithms.

2. Model computational and quantum processes using category-theoretic tools and the DisCoPy framework, translating between diagrammatic representations and executable quantum circuits. Submit and manage jobs on an HPC cluster using Slurm, and explain why quantum computing relies on HPC for simulation, optimization and hybrid workflows.

3. Run and compare quantum workloads on quantum simulators on MeluXina and real Quantum Computers via the Cloud, and optimize quantum circuits using both conventional and diagrammatic approaches.

4. Apply quantum approaches to sector use cases, leveraging compositional and diagrammatic methods where appropriate.

5. Frame and lead a quantum project, from a sector need to a working demonstration, integrating mathematical, software and hardware perspectives.

6. Deliver a capstone project and prepare for IBM Qiskit Developer certification.

MONTHS 1 – 2

Build the foundations

The first two modules establish the mathematical, conceptual and technical foundations for the programme.

What you will learn

1 Quantum Computing Foundations

The essential concepts behind quantum computing.

- Context: quantum computing, quantum communication and quantum sensing.
- Introduction to quantum computing, basics of quantum information and fundamentals of quantum algorithms.
- Linear algebra and the mathematical foundations of quantum computing.

2 HPC Foundations and quantum computing

Learn to work in a national supercomputing environment and connect HPC with quantum computing.

- HPC architecture: compute nodes, job scheduling with Slurm and job submission.
- Working in a national supercomputing environment: software modules, storage and access.
- Why quantum computing needs HPC: hybrid workflows and the quantum processor as an accelerator.

MONTHS 3 – 4

From practice to industry

Participants gain practical experience with quantum systems, then connect the learning to industry and Luxembourg's quantum ecosystem.

What you will learn

3 Quantum Computing in Practice

Develop practical understanding of quantum information, hardware access and circuit optimisation.

- General formulation of quantum information.
- Hands-on quantum computing using Qiskit, simulators, and real Quantum Computers via the Cloud with a comparison of their strengths and limits.
- Quantum circuit optimisation and noise.

4 Specialization with focus on Industry

Explore industry use cases through expert keynotes, workshops and a national strategy event.

- Industry use cases, expert keynotes and workshops.
- Qiskit Global Summer School 2027: Work on Advanced Qiskit projects (Participants must register individually by the registration deadline).

KEY EVENT

- Launch event on Luxembourg's national quantum strategy.

MONTH 5

Sector Applications

Apply quantum computing concepts to business and leadership, with a focus on Luxembourg's key sectors.

What you will learn

- Quantum for Business and Leadership.
- Key sectors for quantum technologies in Luxembourg.
- Preparing applied projects by sector; quantum-centric supercomputing; quantum business foundations and leading quantum projects.
- Preparation for IBM Qiskit Developer certification.

MONTH 6

Capstone Project

The capstone project is designed to showcase learners' skills in a real-world application. It can be inspired by their own ideas or proposed during the academy, with mentors guiding them to bring their vision to life.

DELIVERABLES

- Presentation
- Short report
- Demo during defenses

BEYOND THE PROGRAMME

More than an Academy, a whole learning experience

The learning experience goes beyond the hands-on projects. Participants also get opportunities to connect with Luxembourg's quantum computing and technology ecosystem through talks with industry professionals, researchers and companies, organised workshops, hackathons and outdoor events. These activities encourage networking, collaboration, knowledge sharing and community building, giving participants the chance to develop the skills and connections that support a career in quantum computing.

- Talks with professionals
- Workshops
- Hackathons
- Outdoor events
- Networking