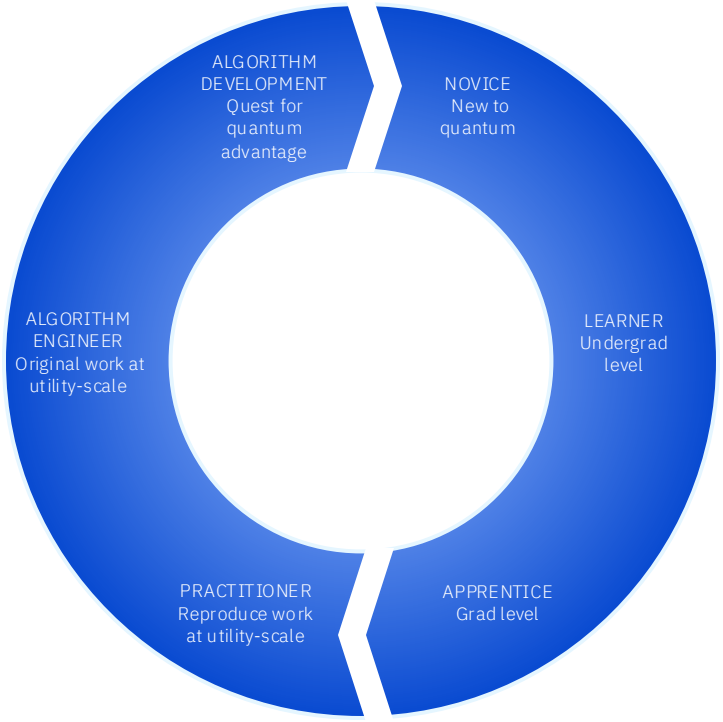
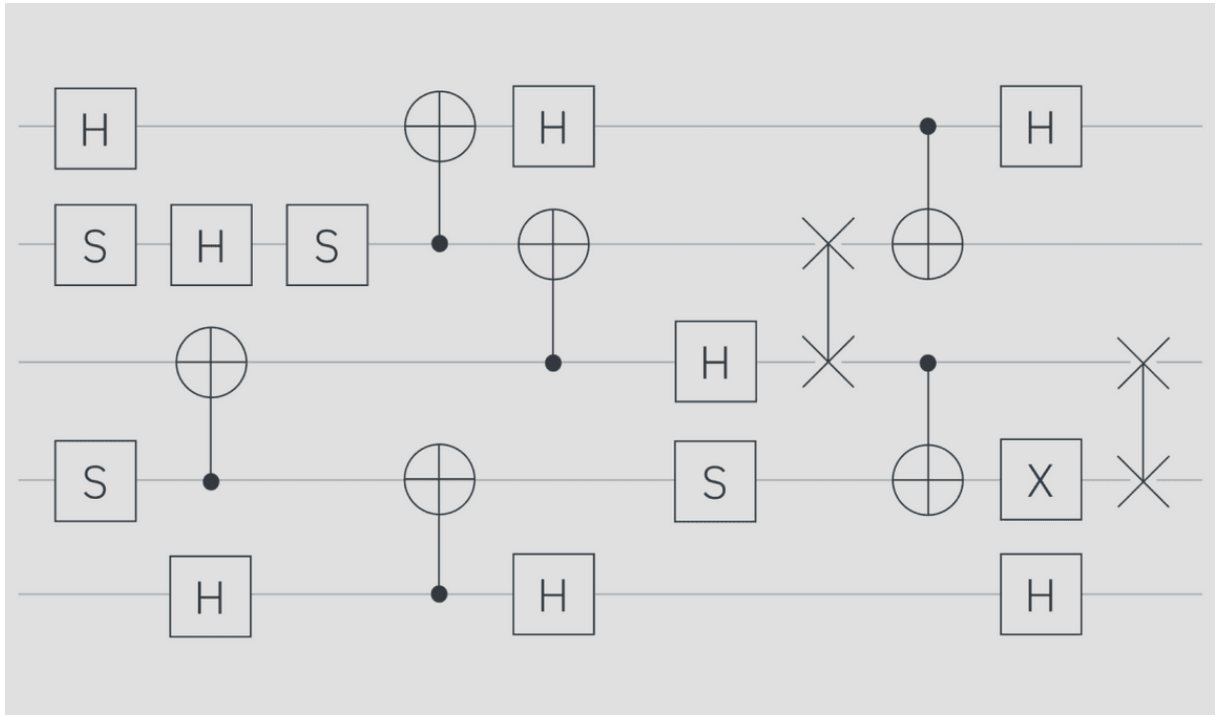
Road to Practitioner (R2P) Program

A curated learning journey from novice to practitioner





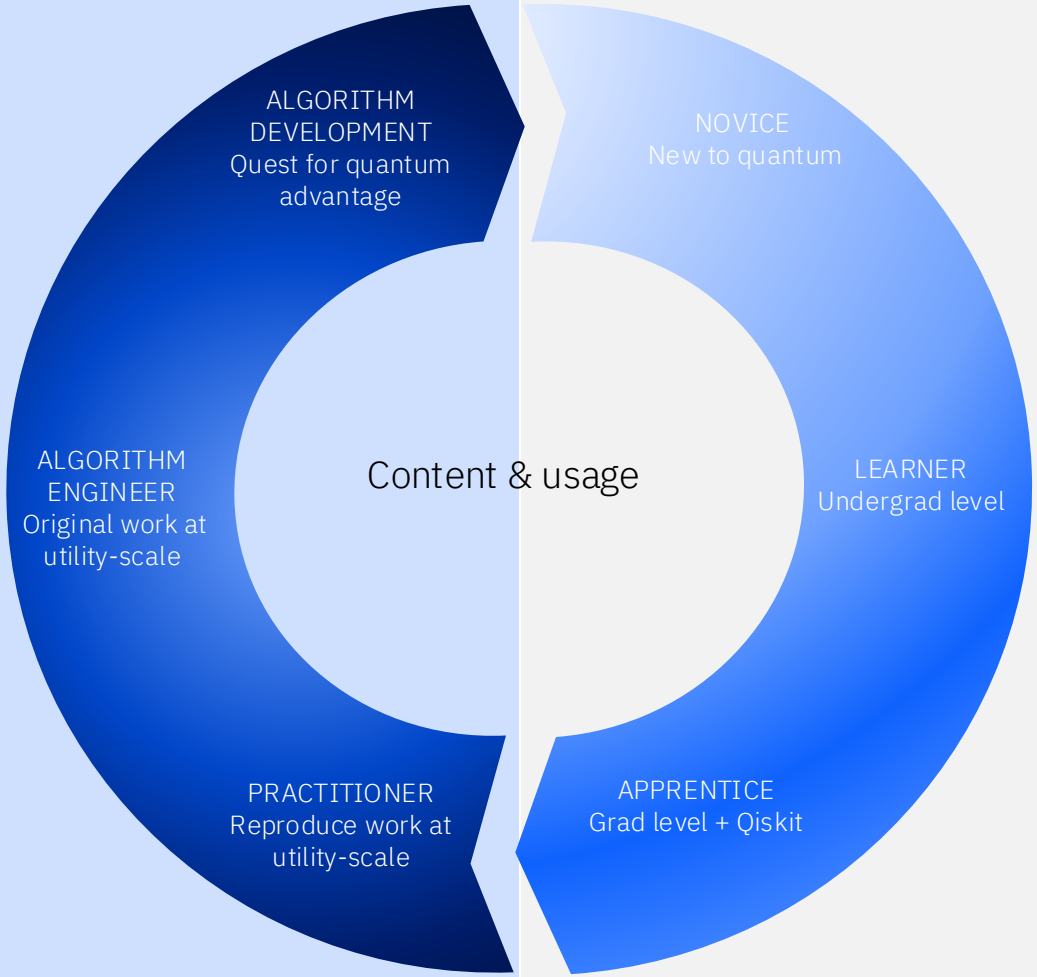
BasQ Basque Quantum

IBM **Quantum**

QIC adoption stages

RESEARCH PHASE

Algorithm Engineering



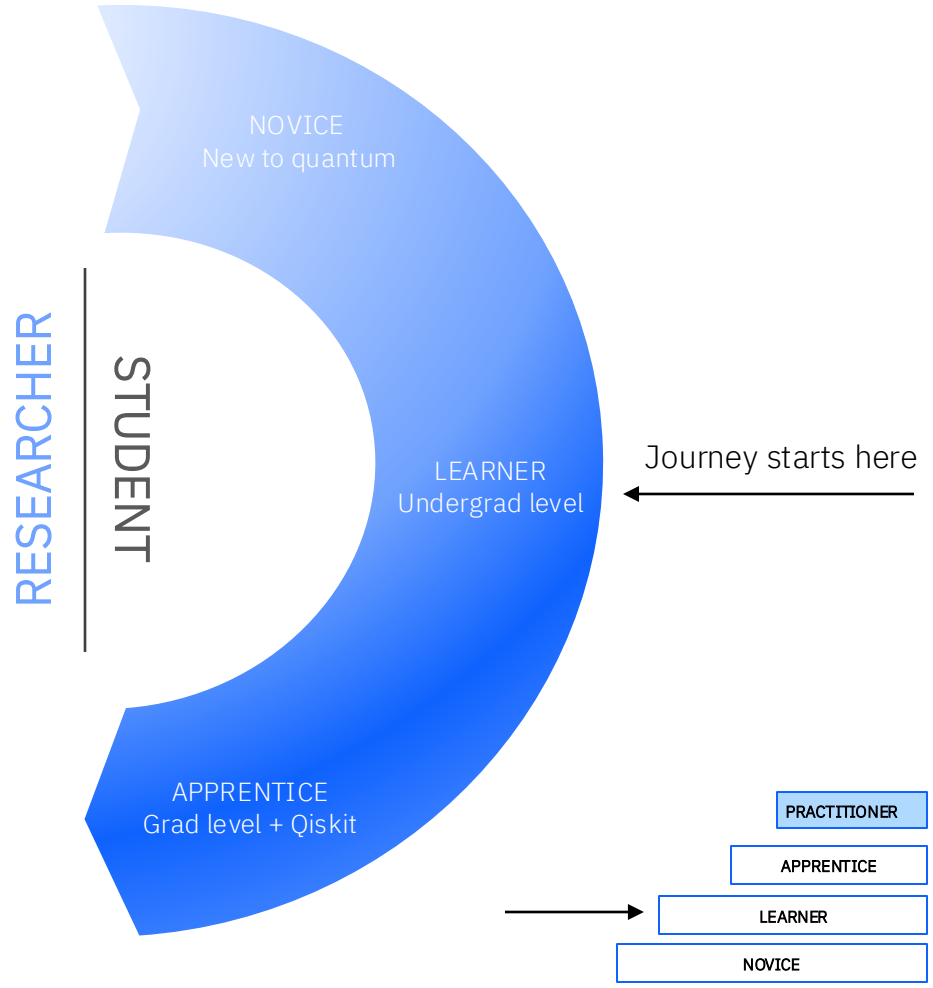
Content & usage

Quantum Computing Education

LEARNING PHASE

Road to Practitioner

In a Nutshell



Journey to become practitioner

- **Cohort-Based:** A class of peers encouraging collaborations and peer support and fostering the organic development of local communities.
- **Structured Learning Journey:** Two phases with a total of six units, integrating theory and hands-on experiences.
- **Hands-On Learning:** Emphasis on practical experience thanks to exercise sessions, code explanations and coding assignments.
- **Capstone Project:** Team-based coding project focused on applying on use cases of interest the lessons learned during the program.
- **Modular and Flexible:** Units and lectures can be adapted to the audience interests providing a more tailored experience.
- **Complementary Self-Paced Learning**: State-of-the-art digital education content from the IBM Quantum Learning page complement each lecture.
- **Guided Support:** Office hours and dedicated mentorship channels to assist learners throughout the program.
- **Solid foundation for R2U**: A learning journey designed to lay the foundational knowledge needed for the Road to Utility (R2U) program.

Road to Practitioner

Program Overview

Phase 0
Activation workshop

Unit 0: **Intro to Quantum Computing**

Goal: Create a foundational knowledge of quantum computing principles and tools as well as IBM role and offering in this domain.

Phase 1
Quantum computing basics

Unit 1: **Qiskit Basics**

Goal: Develop a first hands-on experience with quantum programing using Qiskit.

Unit 2: **Quantum Algorithm I**

Goal: Provide an overview of the historically most important quantum algorithms.

Unit 4: **Quantum Computing: Tools and Techniques**

Goal: Familiarize with Qiskit tools and quantum workflows.

Phase 2
Towards utility-scale

Unit 3: **Quantum Algorithm II**

Goal: Develop a solid understanding of important quantum algorithms.

Unit 5: **Integrating Classical and Quantum computing**

Goal: Explore domain-specific applications of quantum computing.

Unit 6: **Capstone project**

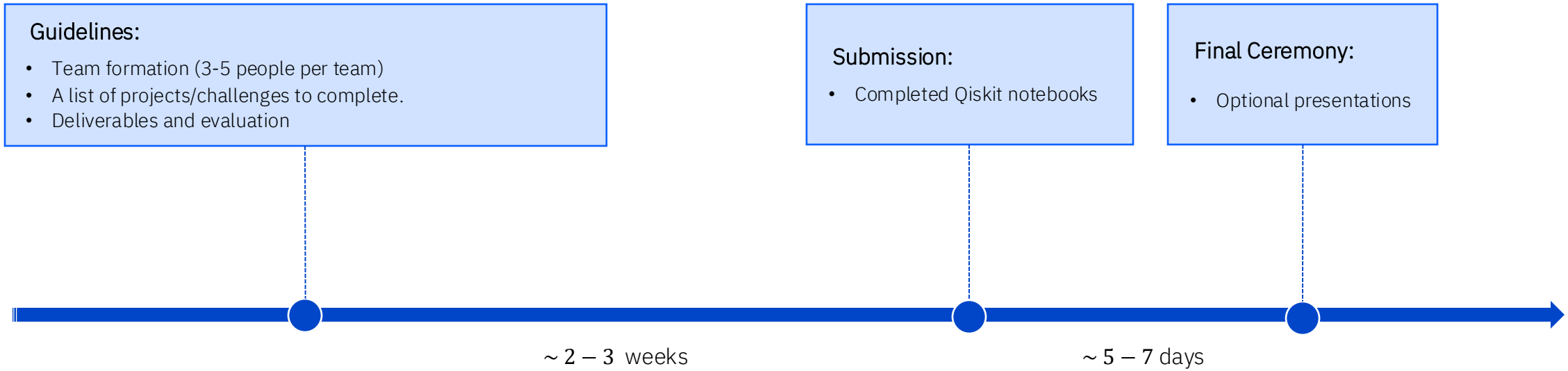
Goal: Apply the learned concepts to a team-based research project.

Road to Practitioner

Capstone Project

Objectives:

- Learn Qiskit, its capabilities and tools
- First hands-on experience with algorithms poised for quantum advantage



Road to Practitioner

Curriculum

Unit 0: Activation Workshop

Theory

- R2P program overview
- Intro to quantum computing
- Towards quantum advantage
- Intro to Qiskit SDK
- IBM Quantum Platform
- IBM Quantum Learning
- DEMO Composer

Hands-on Qiskit

- Install Qiskit and create an IBM account
- Run the first circuit: Hello World

Unit 1: Qiskit Basics

Theory

- The software stack
- Algorithm Anatomy: Qiskit Patterns
- Qiskit Addons and Functions
- Software performance: benchmarking

Hands-on Qiskit

- Qiskit Patterns
- Qiskit Code Assistant
- Scaling the GHZ state to 100 qubits
- Encodings and Ansatze
- IQP platform and manage jobs

Unit 2: Quantum Algorithms I

Theory

- Overview of Variational algorithms:
  - Case studies: VQE, QAOA
- Overview of QML and data encoding methods
- Limitations

Hands-on Qiskit

- VQE
- QAOA
- Quantum Kernel Estimation

Unit 3: Quantum Computing: Tools and Techniques

Theory

- Optimizing circuits: Transpilation
- Dealing with noise: Overview of different ES and EM techniques (DD, Twirling, REM, ZNE)
- Differences with error correction

Hands-on Qiskit

- Preset and Custom Pass Manager
- AI Transpilation service
- Comparing results different ES and EM techniques (DD, Twirling, REM, ZNE)

Unit 4: Quantum Algorithms II

Theory

- Simulating the dynamic of a Ising model (spin chain + Trotterization)
- Sample based methods: SQD/KQD/SKQD

Hands-on Qiskit

- Hamiltonian simulation (Ising model with 70 qubits)
- Time evolution (Trotterization)
- SQD for H_2O molecule
- Qiskit addons

Unit 5: Integrating Classical and Quantum computing

Theory

- Quantum Centric Supercomputing
- Programming models
- Workloads management (Slurm)
- Qiskit Serverless
- Mid-circuits measurements

Hands-on Qiskit

- Dynamic Circuits for Utility Scale applications

Unit 6: Capstone Project

Teamwork

Complete a project in cutting edge domains:

- Quantum diagonalization
- Quantum optimization
- Quantum simulations

Hands-on Qiskit

Implement the project and run it on hardware. Submission includes:

- Jupyter notebook
- Presentations (slides)

Road to Practitioner

Prerequisites

Quantum mechanics basics

- Basics of quantum states and measurements
- Fundamental quantum principles: superposition, entanglement, interference
- Basics of linear algebra: matrix multiplication
- Basics of complex numbers and probability concepts

Recommendations:
- Qiskit YouTube: What is Quantum Computing?
- Course: Basics of Quantum information
- Book: Quantum Computation and Quantum Information by Michael A. Nielson and Isaac L. Chuang – first two chapters

Python programming basics

- Variables, data types, and control structures (loops, conditionals)
- NumPy arrays and basic mathematical operations
- Functions and object-oriented programming concepts
- Experience with Jupyter notebooks
- Ability to install and manage Python packages (pip, conda)

Recommendations:
- Project Jupyter
- IBM Quantum guide: Online lab environments
- Visual Studio Code software

IBM Quantum account and Qiskit installation

- Installing Qiskit
- Creating an IBM Quantum account

Recommendations:
- Install Qiskit
- Set up your IBM Cloud Account

Course readiness & commitment

- Weekly time commitment: 1.5 hour lectures + coding assignments (variable time)
- Motivation to complete all assignments and final project/challenge

Road to Practitioner

Schedule (Q1 – Q2 2026)

February

- **Unit 0| Activation workshop**
  +
  Unit 1| Qiskit Basics
  Lecture 1: Introduction to Qiskit
  3rd of February
- **Unit 2| Quantum Algorithms I**
  Lecture 1: Variational Algorithms
  10th of February
- **Unit 2| Quantum Algorithms I**
  Lecture 2: QML
  17th of February
- **Unit 3| Quantum Computing: Tools and Techniques**
  Lecture 1: Transpilation
  24th of February

March

- **Unit 3| Quantum Computing: Tools and Techniques**
  Lecture 2: Error Mitigation and Suppression
  3rd of March
- **Unit 4| Quantum Algorithms II**
  Lecture 1: Hamiltonian Simulation
  10th of March
- **Unit 4| Quantum Algorithms II**
  Lecture 2: Sample-based Diagonalization Algorithms
  17th of March
- **Unit 5| Integrating Classical and Quantum Computing**
  Lecture 1: Hybrid Workflows
  +
  Unit 6| Capstone Project: Start
  24th of March

April

- **Unit 6| Capstone Project: Submission**
  24th of April
- **Unit 6| Capstone Project: Final Ceremony**
  28th of April