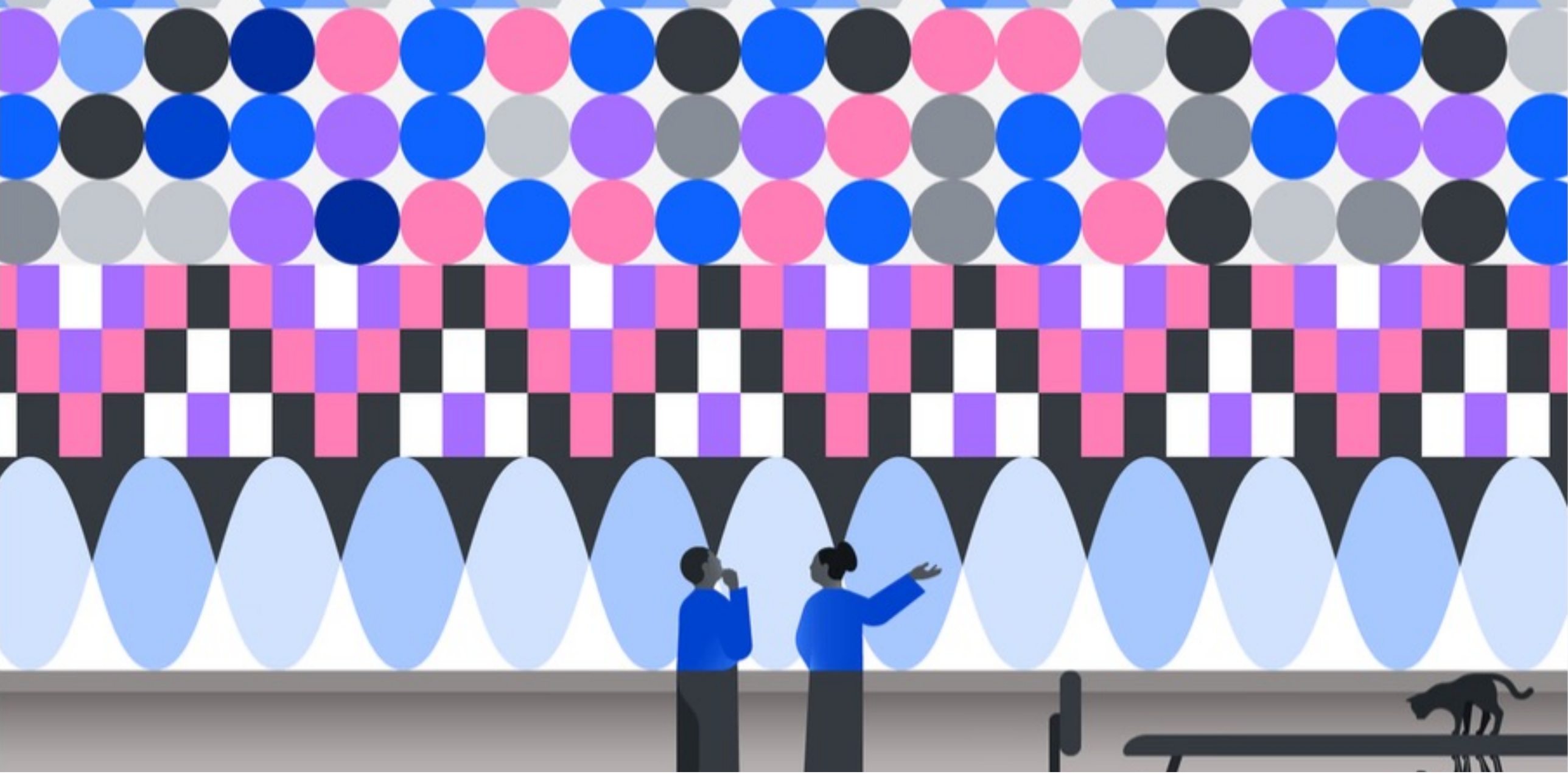


Resources for Educators

IBM **Quantum**

Welcome to the IBM Quantum Educators Resources Migration Guide

Dear Quantum Computing Educators,

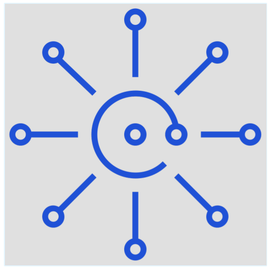
It is an exciting time for quantum computing. Quantum technology is advancing at a tremendous pace, and we are entering the new era of *quantum utility*.

Several changes have been made to the tools and resources made to educators by IBM Quantum™, enabling access to our latest technology.

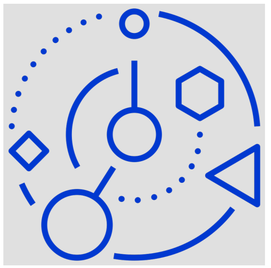
1) Addition of next generation quantum computers for the free public access through the Open Plan. 10min per 28days per user.
2) Consolidation and revision of documentation and learning resources into one location: quantum.ibm.com
3) Digital badges and new learning content created by IBM Quantum.

This document provides a brief orientation on how you can adapt and upgrade your courses reflect these changes.

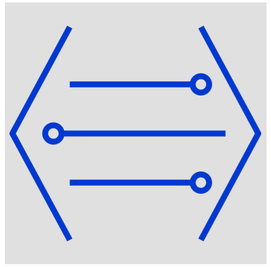
SECTIONS OVERVIEW



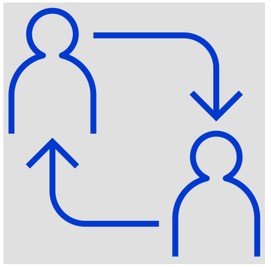
One Place for Everything –
Introducing quantum.ibm.com



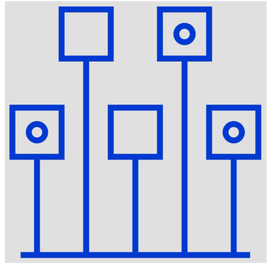
Learning Content –
New and existing courses and tutorials on the new Learning Platform



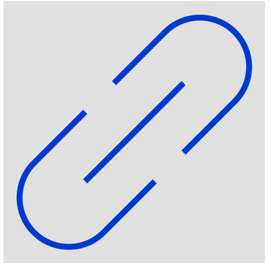
Programing Tools and Access –
What new with IBM Quantum Composer and IBM Quantum Lab



Staying in Touch –
Share your achievements and join channels for alumni, educators, and community

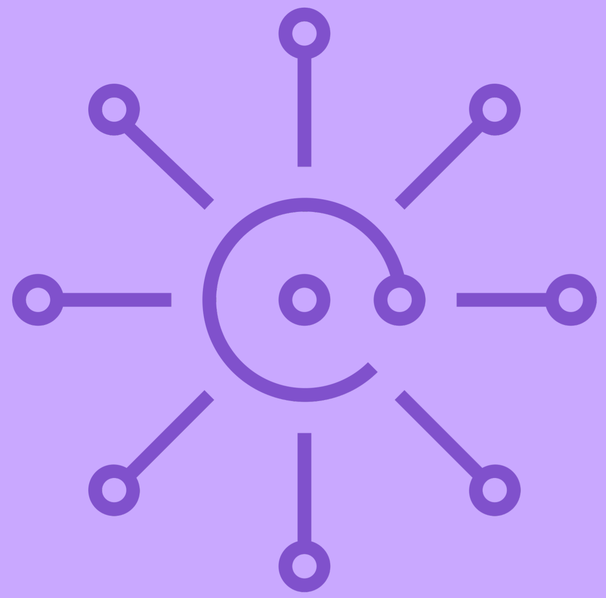


Documentation and Learning Consolidation –
For an easier learning experience



Links and Further Reading –
Additional news and resources on the web

One Place for Everything – Introducing https://quantum.ibm.com

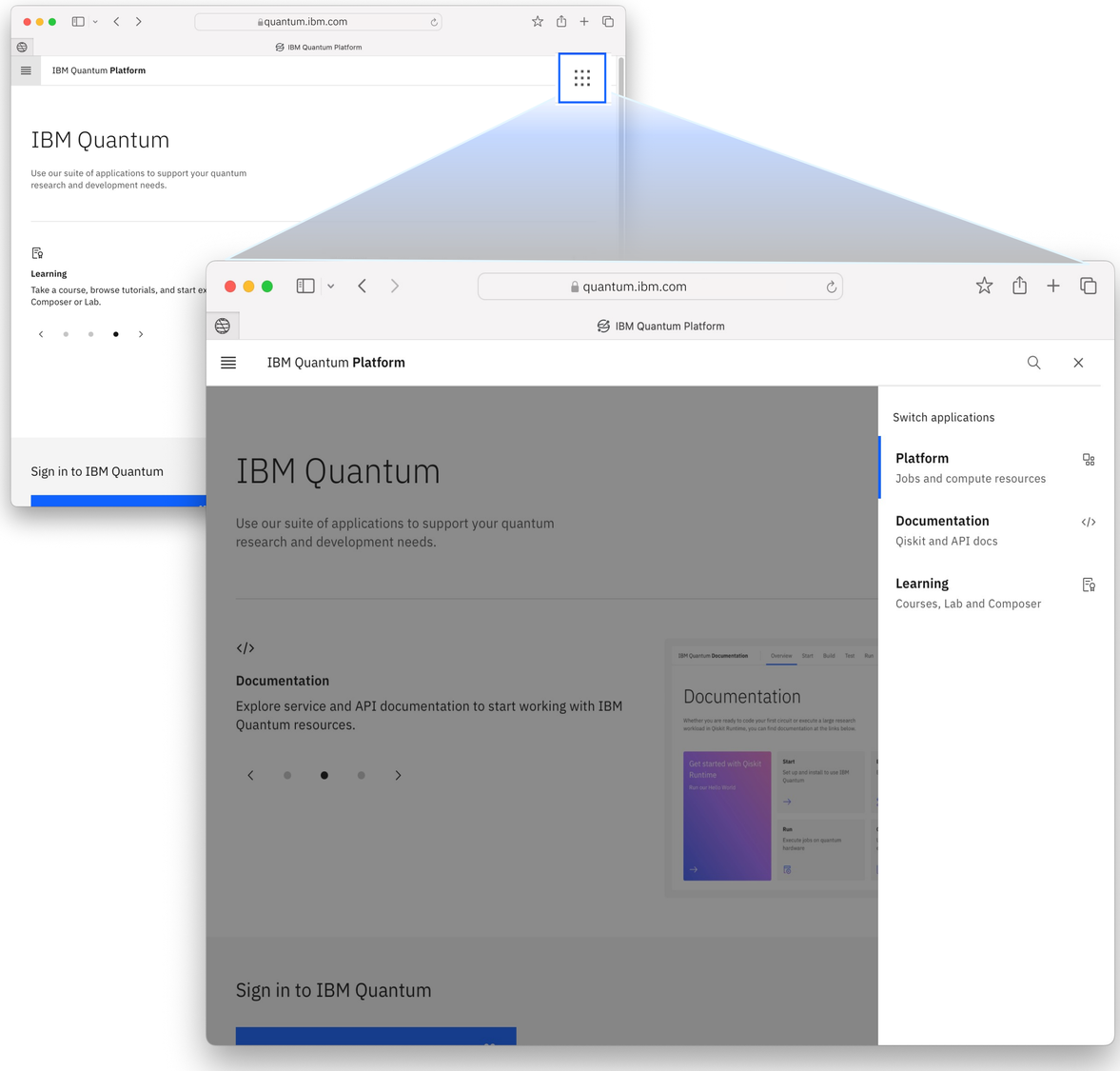


Easy access and viewing from one place

Browse and navigate to

- Platform
- Documentation
- Learning

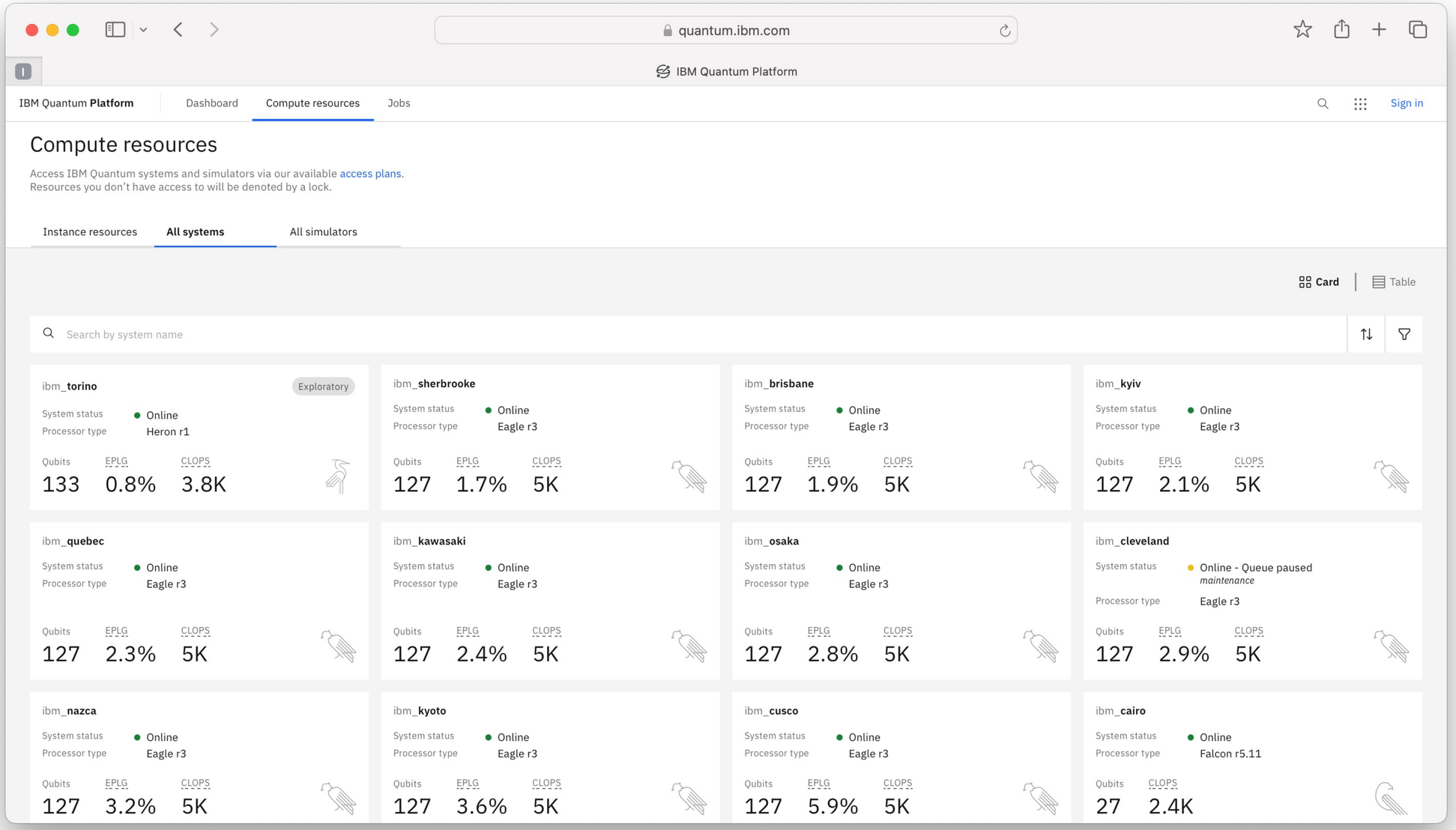
using the “Application Switcher” icon in the upper right-hand corner.



Easy access and viewing from one location

The IBM Quantum Platform – Compute resources

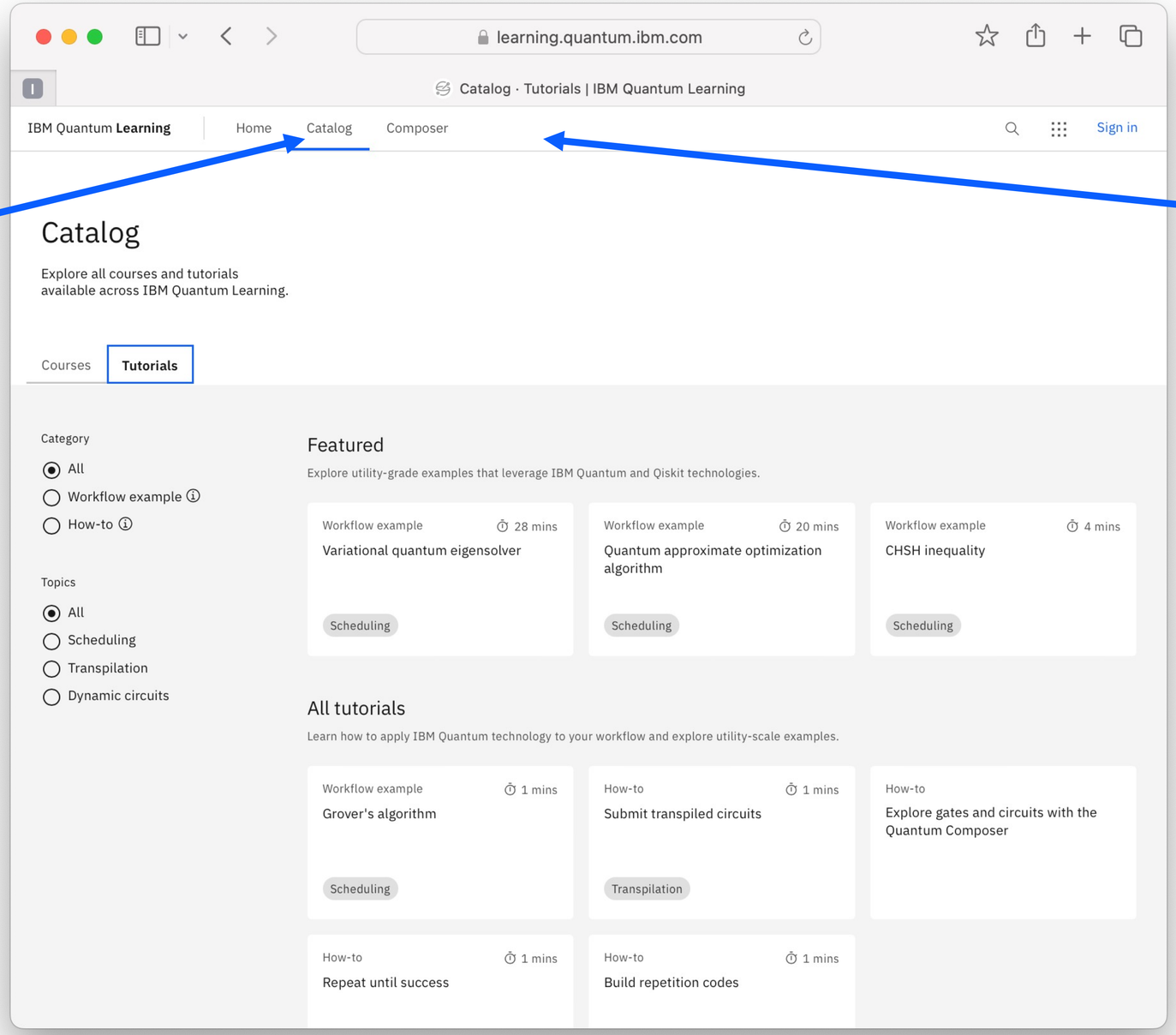
- View all compute resources and their properties
- Sign in to filter systems available on your access plan
- Find submitted jobs



Learning Resources and Tools moved to one place

NEW CATALOG

– Use the newly added Catalog to navigate the brand new courses and tutorials.

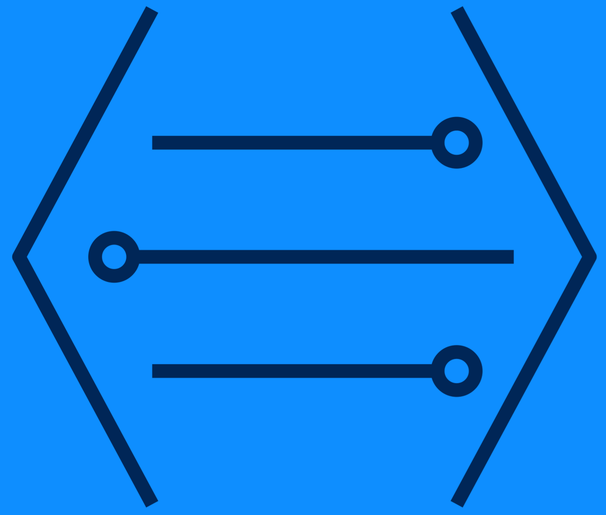


IBM QUANTUM COMPOSER MOVED

New location for learning resources: learning.quantum.ibm.com

Programing Tools and Access

Composer and Lab continue to be available for use in your lectures, enabling a frictionless entry point for learning to program quantum computers. New features and tips are highlighted on the pages that follow.



Quantum Composer – What you know and love

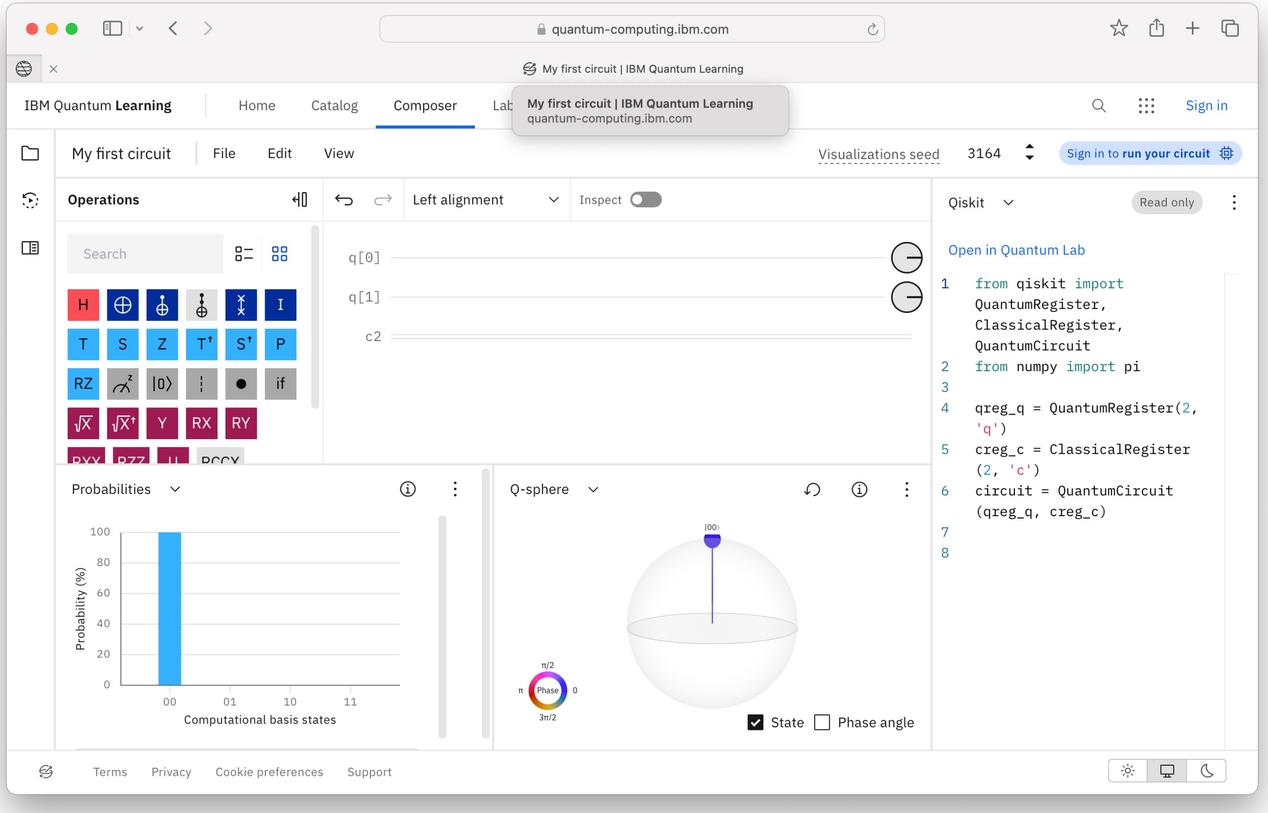
The composer's layout has been refined over the past three years to make its easy to:

1) Show the ideal behavior of gates

2) Draw graphical representations of quantum states and measurement results

3) Obtain Qiskit® and QASM code corresponding for circuits

4) Run circuits on real hardware using the open plan provider (requires sign-in)



Quantum Composer – How to use it in your course

LIVE DRAWING OF IDEAL CIRCUITS: You can project your screen to introduce and illustrate ideal introductory concepts

STUDENT LOGIN: Invite students to create a free account to be able to do exercises that use real machines.

FAIR-SHARE QUEUE: Algorithm to give everyone a fair chance to submit jobs. On days of high demand, wait time may vary.

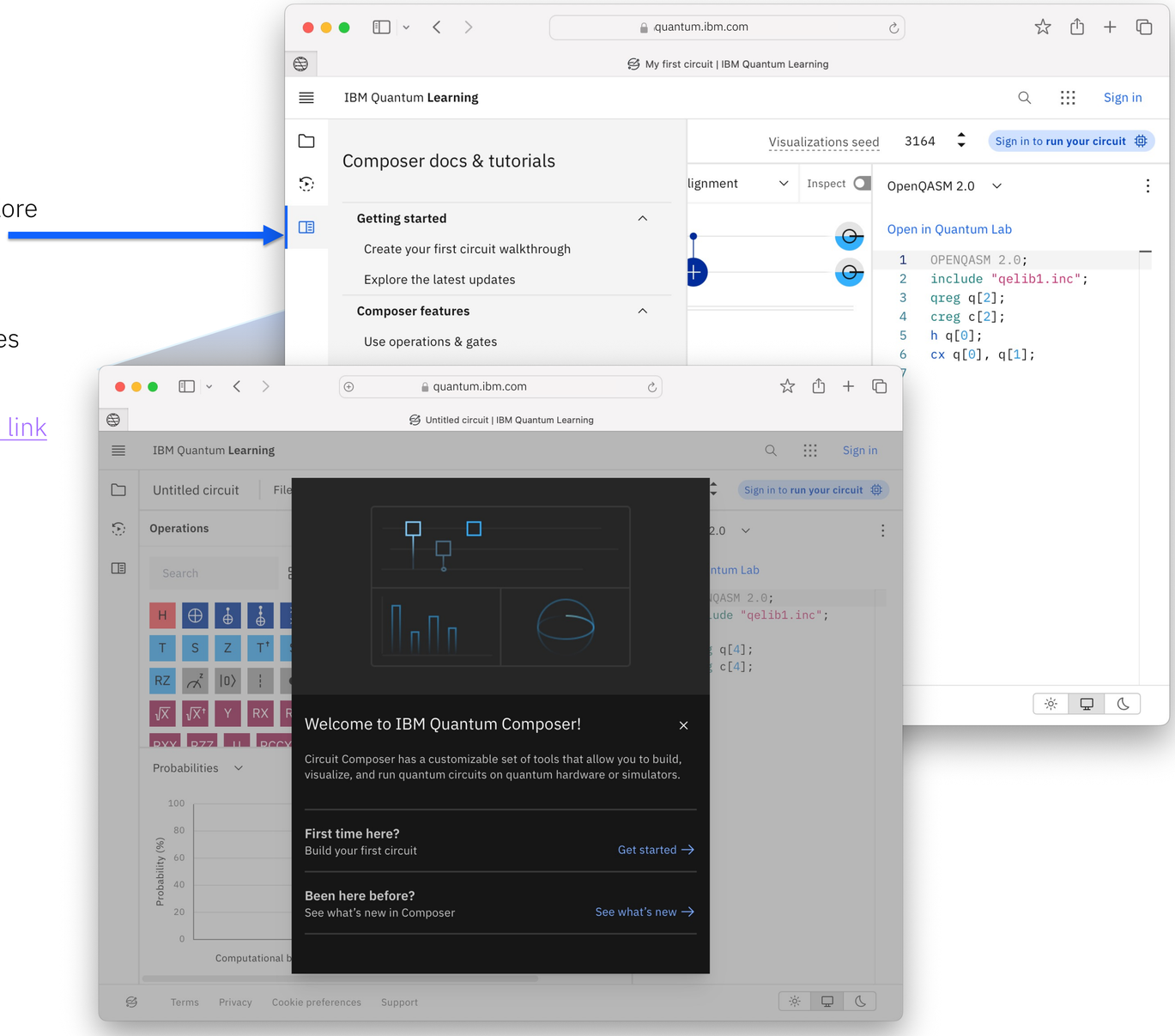
TIPS:

- Assign work on real machines as homework.
- Pre-run jobs to avoid delays in live lectures.
- Download Qiskit and simulators for offline use.
- Use noisy simulators for introductory courses and small qubit count exercises.

Quantum Composer – What is new?

New tutorials and features.

Navigate to a QuickStart guide and explore new features in the sidebar.



1. New way to use operations and gates
2. ISA transpilation added announcement link, documentation link
3. Improved editing and contextual information
4. In-line phase disk
5. Expand gates and show layers
6. Edit registers
7. New themes and options for circuit drawing and image creation

Quantum Lab & Simulators – Replacement Guide

Retirement of cloud simulators and IBM Quantum Lab to focus on utility-scale computing.

Product Announcement May 2024.

Opt-in to the product announcements setting in your account profile to stay informed of important updates like these..

Cloud simulators

In line with our focus on utility-scale quantum computing, we're retiring our cloud simulators on 15 May 2024. We invite you to start using the Qiskit Runtime local testing mode (with qiskit-ibm-runtime 0.22.0 or later), which makes it possible to perform development and testing locally prior to submitting your workloads to our >100-qubit systems.
This change emphasizes a shift toward quantum hardware capabilities, since the benefits of quantum hardware have surpassed the utility of simulators in helping determine which applications have the greatest potential for advantage.

- Guide: Migrate from cloud simulators to local simulators
- Noisy simulation with Qiskit Aer primitives
- Getting started with Qiskit Aer

IBM Quantum Lab

IBM Quantum Lab will be retired on 15 May 2024 to increase our focus on utility-era tooling.
You can execute jobs locally with Qiskit, or you can set up your own cloud-based environment. For an independent review of alternatives to host jupyter notebooks see for example the article linked here.

Download your Lab files in bulk from the Lab platform(opens in a new tab). Bulk file downloads will remain available until 15 November 2024.

Qiskit 1.0

Now with increased performance, stability, and reliability.

- 55% decrease in memory usage
- 16x faster binding and transpiling
- 23% fewer 2Q gates
- Up to 5x faster with batch parallelism
- Qiskit Patterns (link to blog)

Read more in the Qiskit 1.0 Announcement and the blog and new transpilation architecture.

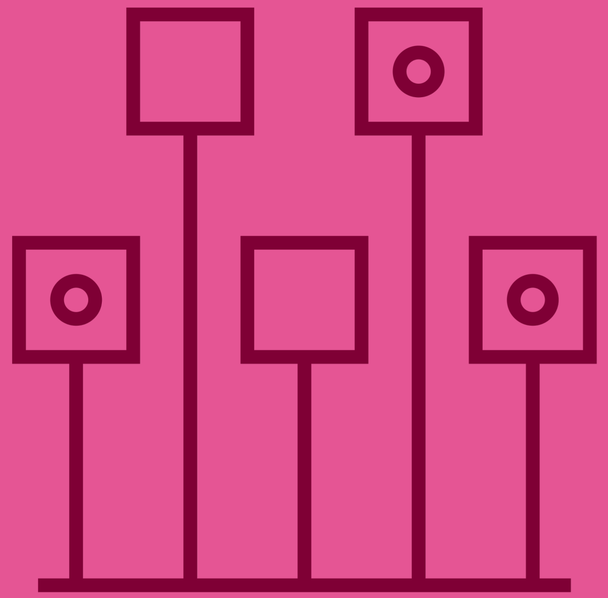
Documentation and Learning Consolidation

On November 29, 2023 Qiskit Documentation and Learning will only be live on IBM Quantum.

Learn more about these important changes here

Community-built content, such as the Qiskit Textbook, will be available via GitHub. It will not be maintained, instead we are focusing efforts on generating new content and learning tools for the new unified platform on learning.quantum.ibm.com

We will be creating new live learning content in phases into the new platform.

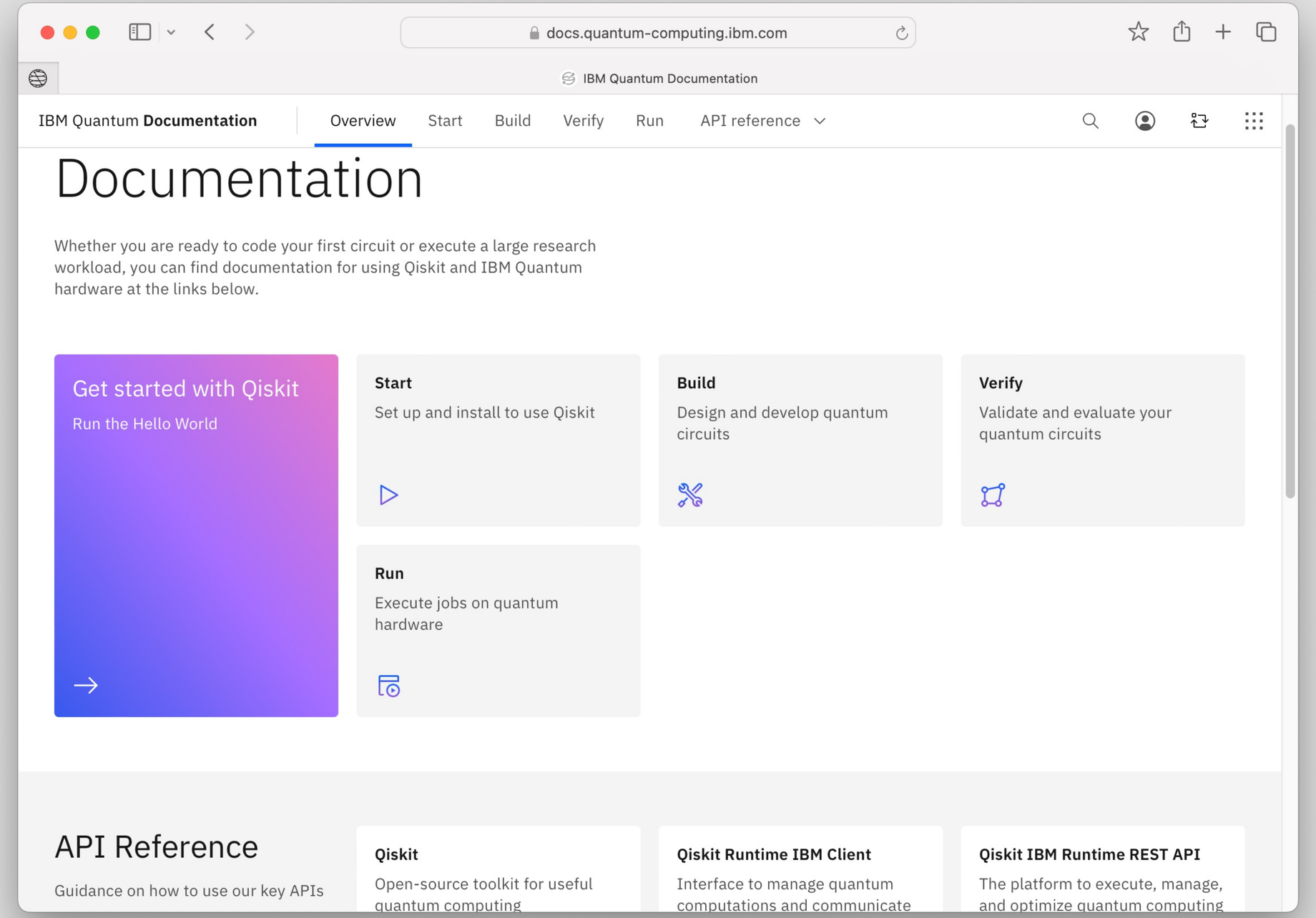


Documentation Consolidation

New documentation pages consolidate the IBM Quantum documentation and Qiskit.org documentation into one location to improve navigation and maintenance.

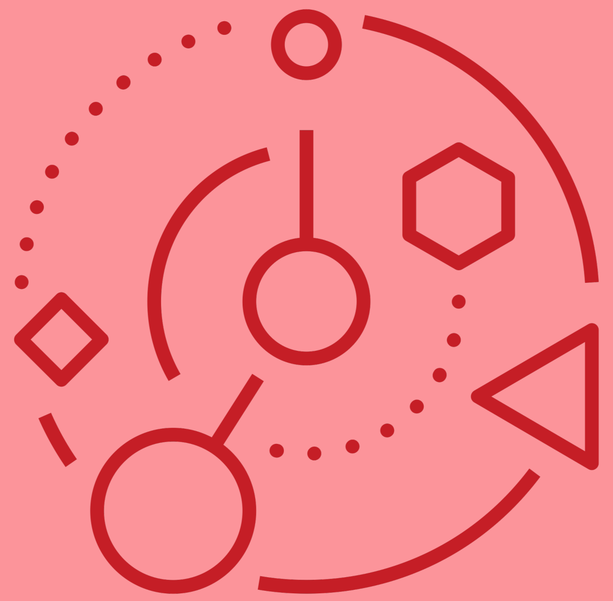
Get started with Qiskit, in 4 steps:
(1) Start,
(2) Build,
(3) Verify,
(4) Run.

Includes a complete API reference documentation for Qiskit, Qiskit Runtime and IBM providers



Learning Content –

New and existing courses and tutorials on the new Learning Platform



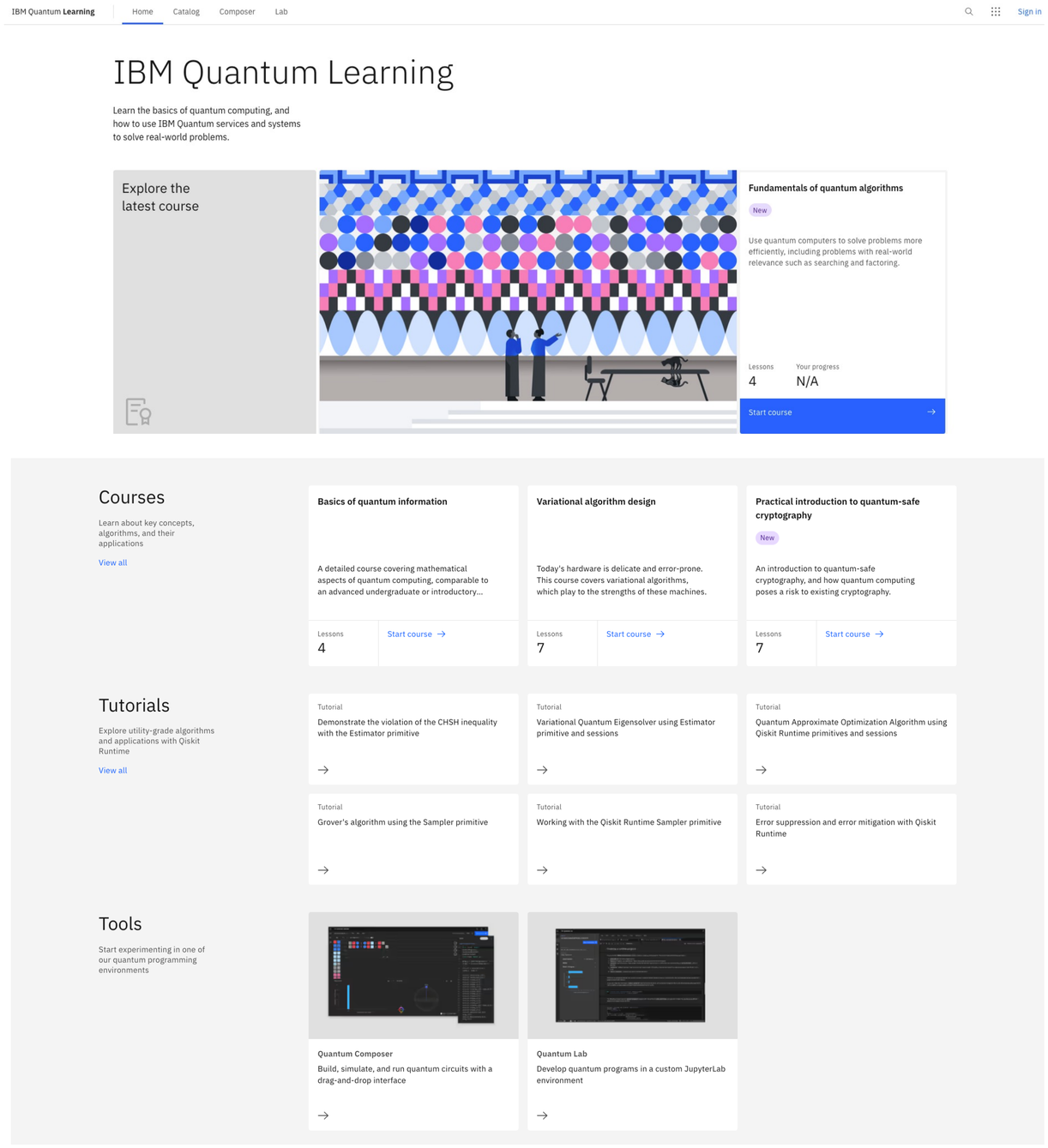
Courses

Currently available

- Basics of quantum information
- Fundamentals of quantum algorithms
- Variational algorithm design
- Practical introduction to quantum-safe cryptography

Coming in 2024

- The general formulation of quantum information
- Quantum computing in the presence of noise
- Quantum computing in practice
- Heterogeneous quantum computing



Understanding Quantum Information & Computation

Explains the theory of quantum information and computation at a detailed mathematical level.

Consists of four units, Unit 1 and 2 are available units 3 and 4 are coming later in 2024:

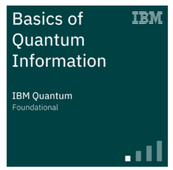
1. Basics of quantum information
2. Fundamentals of quantum algorithms
3. The general formulation of quantum information
4. Quantum computing in the presence of noise

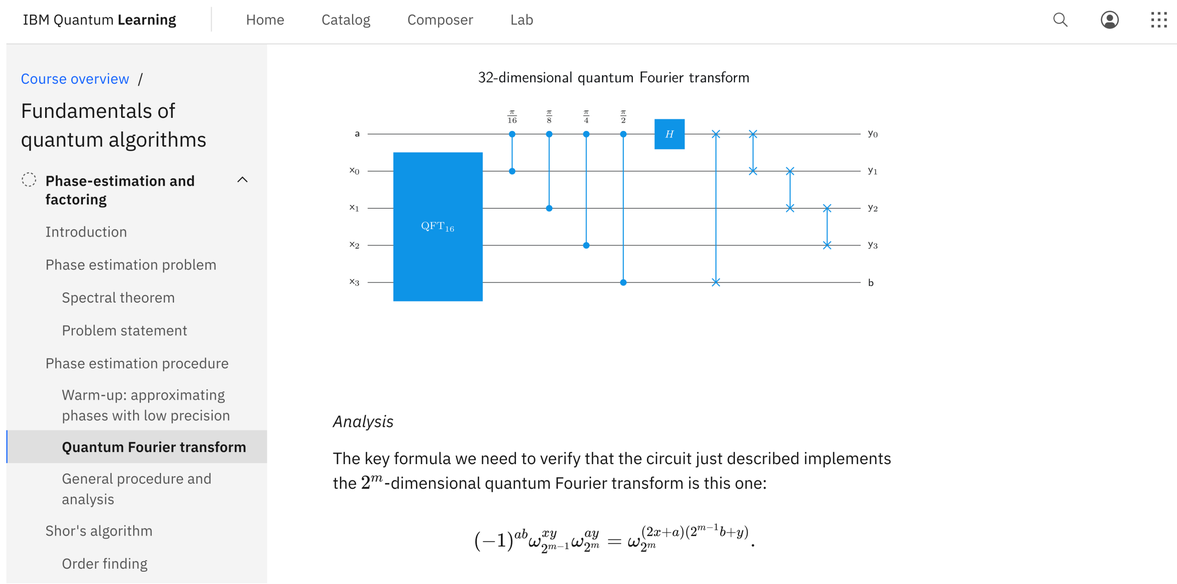
Each unit consists of 4 lessons (video and text).

Problem sets, labs, and unit summative exams.

Badge 1 available, more under construction

Awarded badge





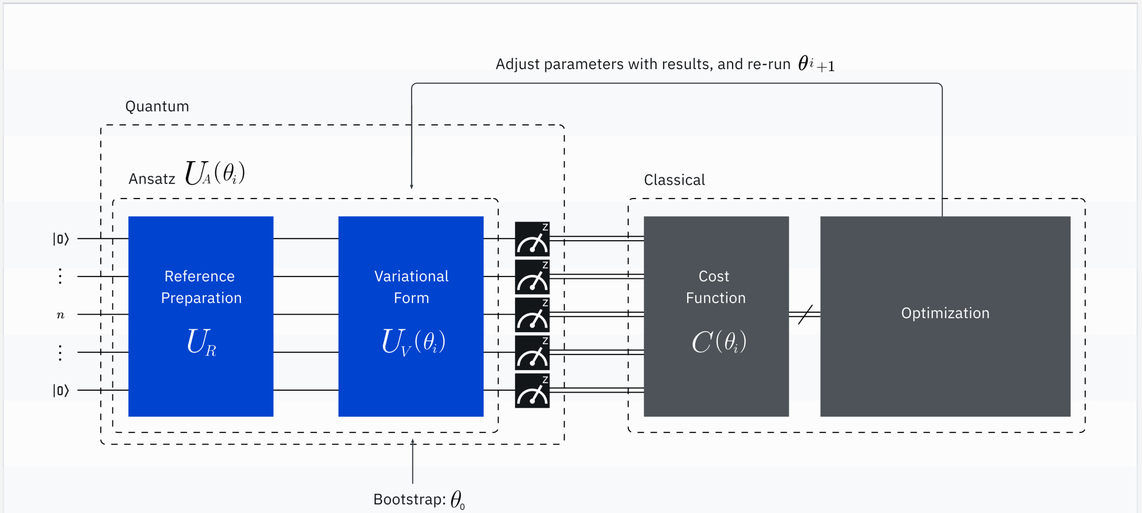
Learn how to design hybrid algorithms for today’s quantum systems.

Variational Algorithm Design introduces a class of near-term, hybrid-quantum-classical algorithms applicable for a variety of use cases across chemistry, optimization, machine learning, etc.

This course explores each step in the algorithm workflow, tradeoffs associated with each step, and how to use Qiskit Runtime primitives to optimize for speed and accuracy.

Read more here

Awarded badge



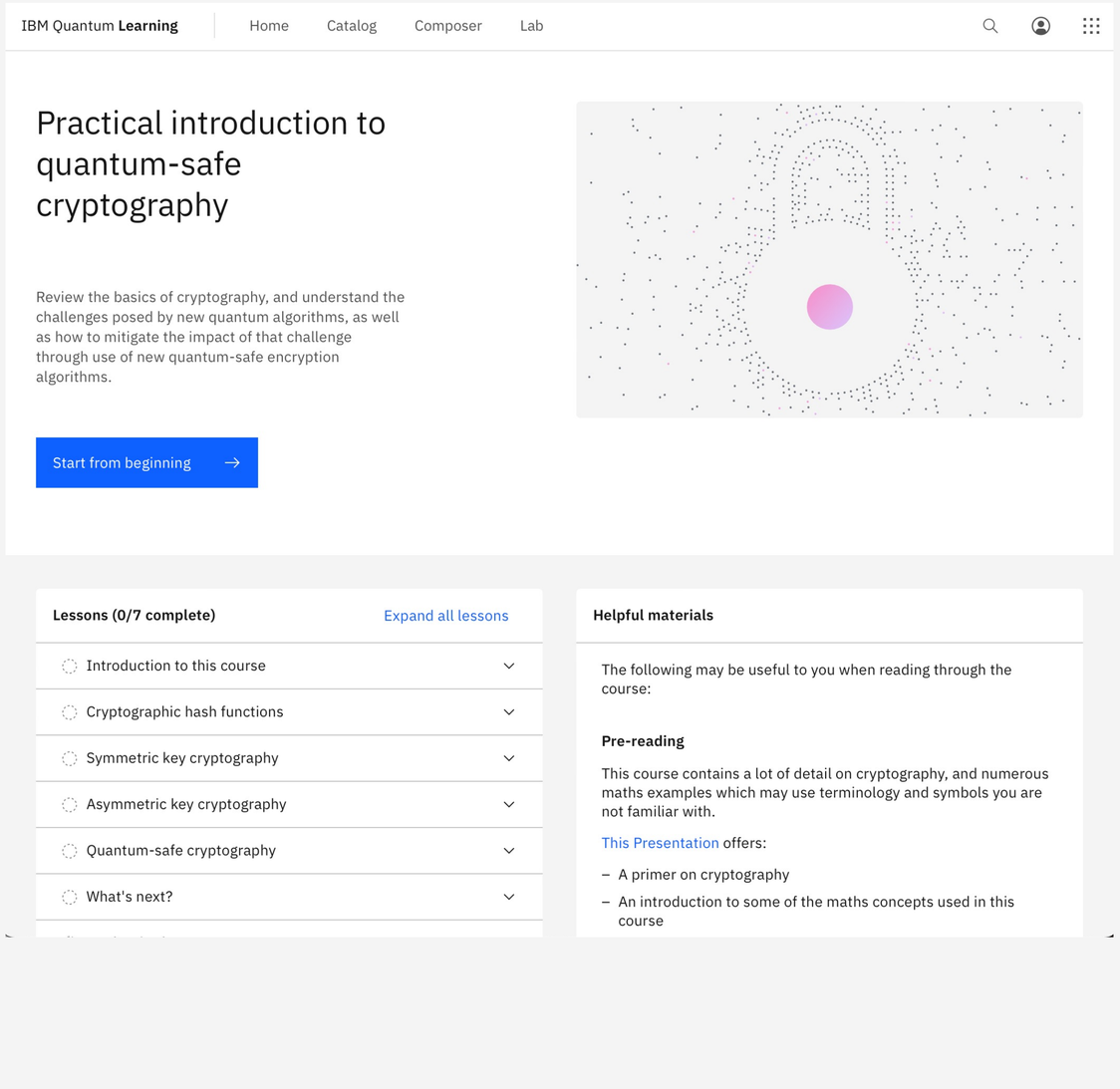
Understand how to make the world quantum-safe.

Practical Introduction to Quantum-Safe Cryptography reviews today's cryptography that secures our online banking applications, healthcare records, e-commerce transactions, and electronic messaging systems.

Review how quantum poses risks to popular encryption standards and explore the latest algorithms to secure data.

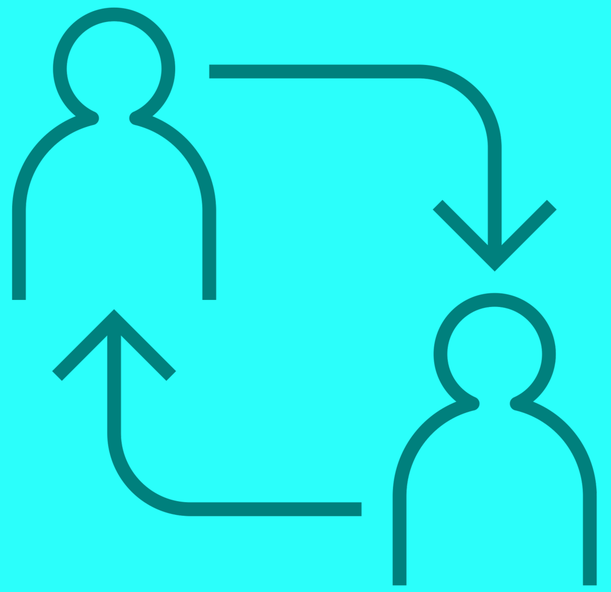
Read more here

Awarded badge



Staying in Touch

Share your achievements and join channels for alumni, educators and community



Staying in Touch

Share your achievements enabled by these resources
https://quantum-computing.ibm.com/credits-program/achievements

Explore the Qiskit partners, advocate ecosystem. Learn about community events.
https://qiskit.org

Contact email:
quantum.programs@ibm.com

Links

Further resources with news and information

Resources: Self-learning

Quantum Tools & Hardware

IBM Quantum Platform

IBM Quantum Composer

IBM Quantum Lab

OpenQASM

IBM Cloud – (for pay-as-you go option)

Learning

IBM Quantum Learning

IBM Quantum Website

Documentation & Certifications

Documentation

IBM Quantum page for Qiskit Developers

Developer Certificate Syllabus

Developer Certificate Details

YouTube Channels

IBM Research on YouTube Quantum Computing Playlist

Qiskit YouTube Channel

Resources: Web, Social Media and Blogs

Articles on new Advancements

IBM Quantum Blog

IBM Research Blog

IBM Research Europe

Database of Publications by IBM Quantum Network members

Key Information about IBM Quantum

IBM Quantum Website

IBM Quantum Summit 2023 (Webpage)

IBM Quantum Summit Keynote 2023 (Video)

IBM Quantum Summit Full Playlist (Videos)

Announcements on Social Media

Jay Gambetta

IBM Research

IBM Quantum LinkedIn

Qiskit

Community & Help

Qiskit on Slack

#qiskit-101
#qiskit-dev
#ibm-quantum-systems
#ibm-quantum-platform
...and many more

Qiskit on GitHub

Quantum computing on Stack Exchange

Stack Overflow – Qiskit tag

Application use cases

The tools of utility

IBM Quantum is not in this alone. Working groups bring together the best industry pioneers and scientists in their field to accelerate our path to achieving Quantum Advantage by 2025 across several domain areas:

Optimization

Quantum Optimization: Potential, Challenges, and the Path Forward:
https://arxiv.org/abs/2312.02279

High energy physics

Quantum Computing for High-Energy Physics: State of the Art and Challenges. Summary of the QC4HEP Working Group
arXiv:2307.03236

Materials and HPC

Quantum-centric Supercomputing for Materials Science: A Perspective on Challenges and Future Directions
https://arxiv.org/abs/2312.09733

Healthcare and life sciences

Towards quantum-enabled cell-centric therapeutics
arXiv:2307.05734