Introduction to IBM Quantum and Qiskit

Yuri Kobayashi
IBM Quantum Workforce & Education

Qiskit

Qiskit

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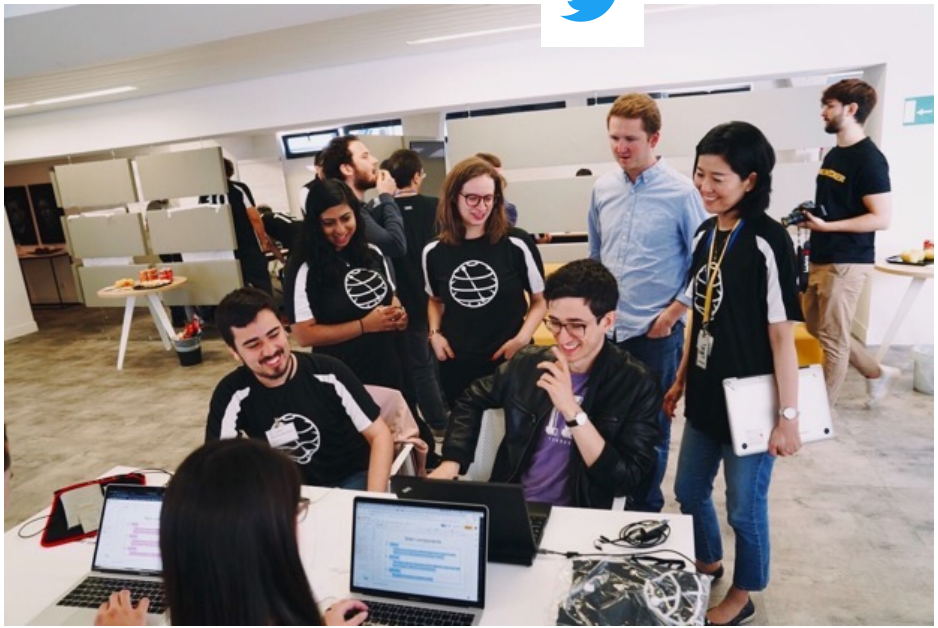
@YuriKobaya

Workforce & Education Global Lead at IBM Quantum

- Background in condensed matter and materials physics and joined IBM Research - Tokyo in 2014

- Joined IBM Quantum as Asia Pacific Community Lead in 2019 prior to current role

- Responsible for the global mission of developing effective strategy and executing unique and scalable quantum education programs.



Agenda

Qiskit

Welcome to IBM Quantum
Setting up your environment
How to use your quantum systems
- On the cloud via IBM Quantum Lab
- Running locally

Getting started with Qiskit
Quantum gates, circuits, and measurements

A quick survey

Group photo

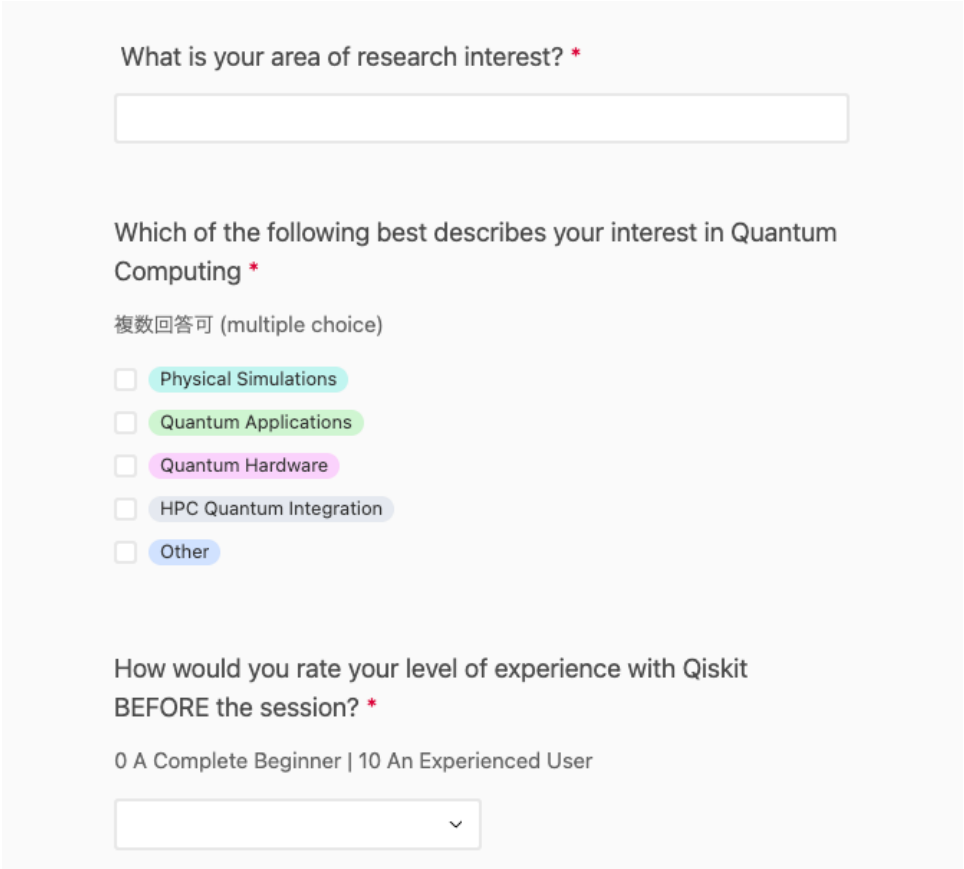
Upcoming training opportunities

Materials : ibm.biz/qiskit23

Please answer this short survey

Qiskit

https://ibm.biz/riken01182024



Welcome to IBM Quantum !

Qiskit

Qiskit is an open-source quantum computing software development framework for leveraging today's quantum processors in research, education and business.

github.com/qiskit

qiskit.slack.com

youtube.com/Qiskit

ibm.com/quantum

Quantum Systems (January 2024)

Qiskit

Premium Plan

127 Qubits
Sherbrooke (QV32)
Nazca
Cusco

27 Qubits
Mumbai (QV128)
Kolkata (QV128)
Cairo (QV64)
Hanoi (QV64)
Algiers (QV128)

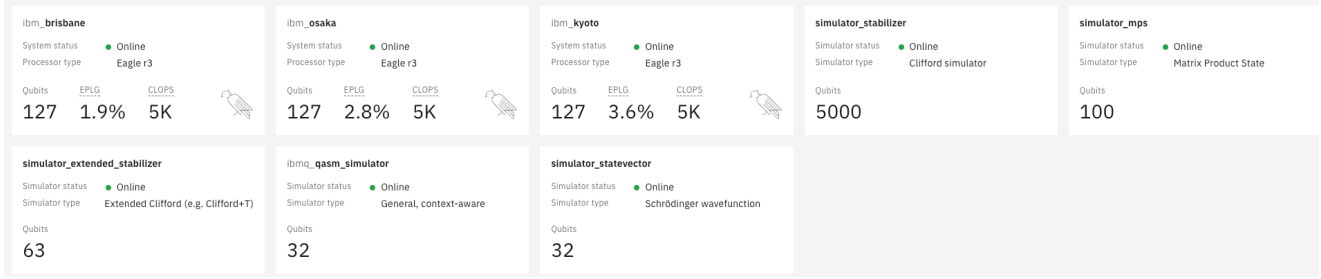
133 Qubits
Torino

Open Plan

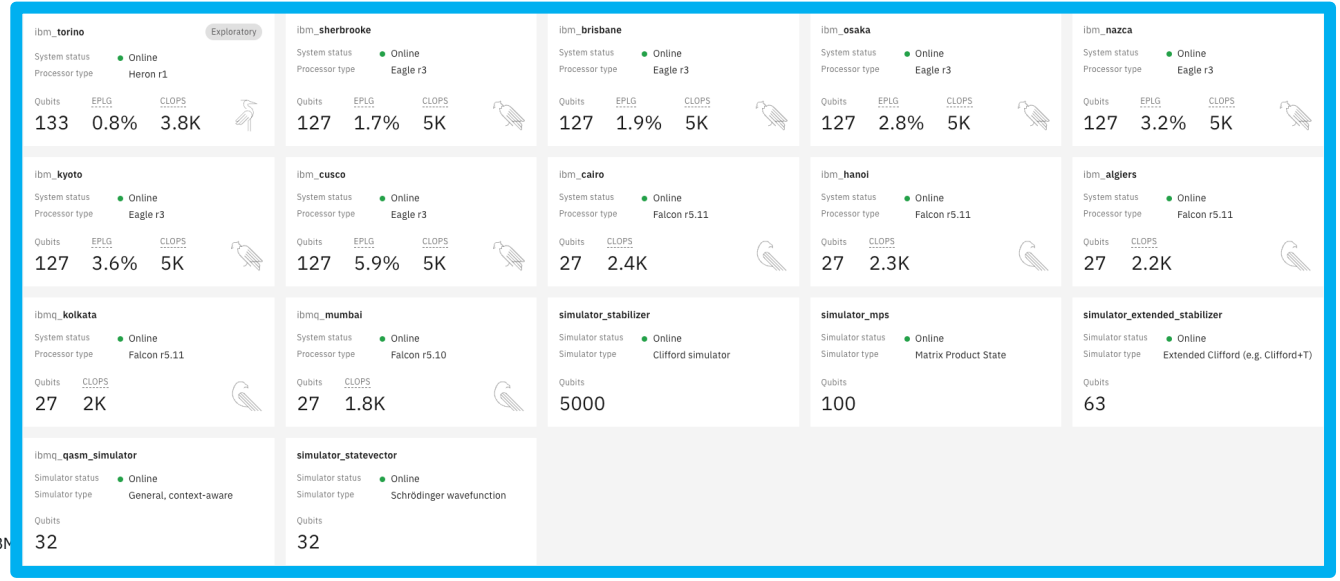
127 Qubits
Brisbane
Kyoto
Osaka

+ 5 Simulators

Quantum Systems (January 2024)



Open Plan



Premium Plan

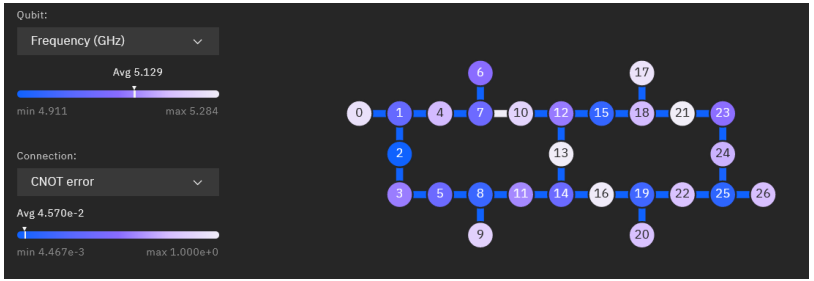
Quantum Systems

Qiskit

Systems that have been qualified

- IBM Quantum Falcon R5, Eagle R3 (or R1)
- Reliable systems, stable backbone for your science and research

ibm_cairo



Exploratory System

- “Pre-production system”: cutting edge / new features
- May be demonstrators, or undergoing qualification
- Exploratory systems today include more qubits and higher coherence (Falcon R8).

Check IBM Quantum Compute Resources page

How to use your quantum systems

Qiskit

IBM Quantum Platform :

https://quantum.ibm.com/

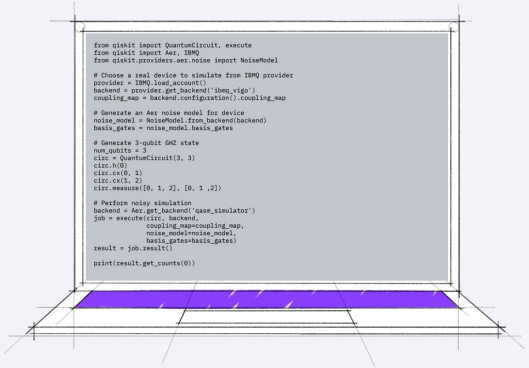
Let’s start with installing Qiskit locally first!

Install Qiskit locally :

➔Python 3.8 or later

➔Recommended to use Anaconda with notebooks and virtual environments

➔https://docs.quantum.ibm.com/start/install



```
from qiskit import QuantumCircuit, execute
from qiskit import Aer, IBMQ
from qiskit.providers.aer.noise import NoiseModel

# Choose a real device to simulate from IBMQ provider
provider = IBMQ.load_account()
backend = provider.get_backend('ibmq_vigo')
coupling_map = backend.configuration().coupling_map

# Generate an Aer noise model for device
noise_model = NoiseModel.from_backend(backend)
basis_gates = noise_model.basis_gates

# Generate 3-qubit GHZ state
num_qubits = 3
circ = QuantumCircuit(3, 3)
circ.h(0)
circ.cx(0, 1)
circ.cx(1, 2)
circ.measure([0, 1, 2], [0, 1 ,2])

# Perform noisy simulation
backend = Aer.get_backend('qasm_simulator')
job = execute(circ, backend,
              coupling_map=coupling_map,
              noise_model=noise_model,
              basis_gates=basis_gates)
result = job.result()

print(result.get_counts(0))
```

Install and set up Qiskit (macOS)

1. Create a virtual environment with Python

- python3 -m venv qiskit_env

2. Activate your new environment

- source qiskit_env/bin/activate

3. Install Qiskit and Qiskit Runtime client

- pip install qiskit
- pip install qiskit-aer
- pip install qiskit[visualization] # zsh users need to put 'qiskit[visualization]' in single quotes.
- pip install qiskit-ibm-runtime

4. Install jupyter notebook

- pip install notebook

Installation guide
https://docs.quantum.ibm.com/start/install

How venvs work

Getting started with Qiskit

Please download the notebooks from the following repo.

https://ibm.biz/01182024

IBM Quantum Support

France


François Varchon
Team Leader


Patrick Mensac


Aziz Ngoueya

New York


Léna Pérennès


Matthew Stypulkoski

India


Jagan Narayan Natarajan


Siddharth Golecha


Richa Goel

Qiskit

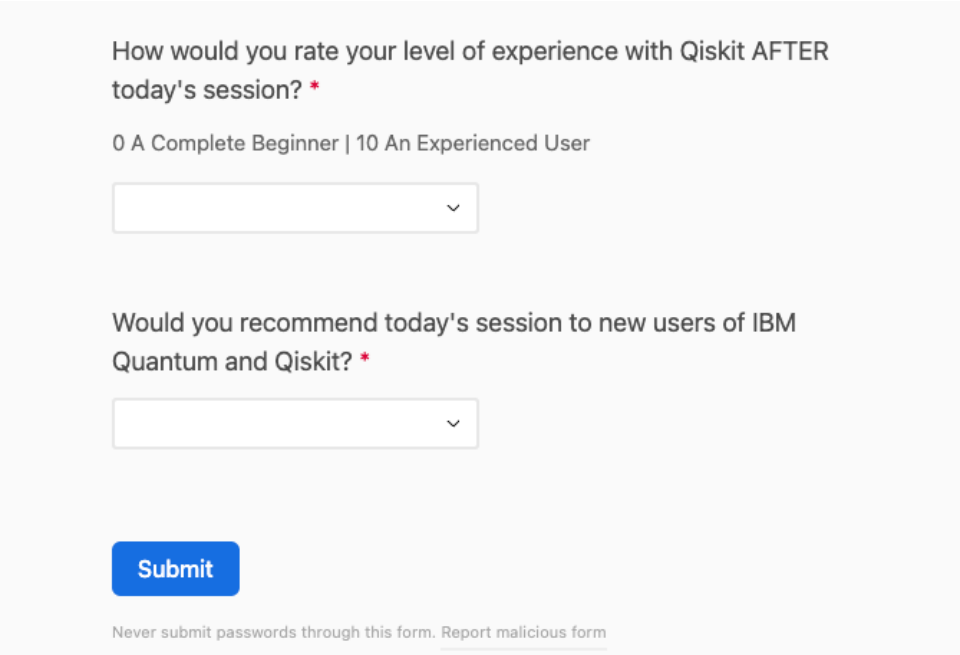
Dedicated Support at ibmquantum@ibm.com

- **Answer** your technical questions (**Email**, StackExchange, Slack)
- **Remotely guide you** through On-boarding process
- **Guide you through** IBM Quantum Administration Dashboard (IBM Admin)
- **Support** Qiskit version release
- **Provide feedback** and suggested efficiencies in Qiskit, and **Act as a channel** between you and the developers
- **Notify you** of changes within Qiskit or IBM Quantum
- **Keep you up to date** with scheduled device maintenance and downtime

Please answer this short survey

Qiskit

https://ibm.biz/riken01182024



Japan Practitioners Forum 2024

Qiskit

A full day seminar **for technical practitioners in Japan**. Learn about the latest updates on Qiskit how to effectively run utility-scale experiments through **hands-on training**.

Date: March 14, 2024 **Starts**: At 9:30AM

Place: Sosokan Multimedia room, Yagami Campus, Keio University

Agenda:

9:30-9:35 Opening by KQCC Chair Dr. Yamamoto
9:45-9:50 Quantum Summit Highlights
9:50-10:30 Qiskit 1.0 Updates
10:30-11:30 Runtime Updates
13:00-14:00 GHZ State Prep w/ Dynamic Circuits
14:30-15:00 Utility Paper Demo
15:30-16:00 Krylov Sub-expansion
16:00-16:45 Error Mitigation Deep Dive
16:45-17:30 Circuit Cutting
18:00-20:00 Dinner & Networking

Qiskit

THANK YOU!
I look forward to seeing you on March 14th.

Useful links

Qiskit

- IBM Quantum Platform https://quantum-computing.ibm.com
- Qiskit website https://www.ibm.com/quantum/qiskit
- Qiskit github https://github.com/Qiskit
- Qiskit youtube https://www.youtube.com/qiskit
- Qiskit documentation https://docs.quantum.ibm.com
- Qiskit learning https://learning.quantum.ibm.com