Qiskit SDK

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What is Qiskit?

- The name "**Qiskit**" is a general term referring to a collection of software for executing programs on quantum computers.

- Most notably among these software tools is the open-source **Qiskit SDK**, and the runtime environment (accessed using **Qiskit Runtime**) through which you can execute workloads on IBM's quantum computers.

- There are also many open-source projects that are part of the broader Qiskit ecosystem (such as Qiskit Optimization, Qiskit Machine Learning, Qiskit Finance etc.). It is important to note that these are maintained by the community, not IBM directly.
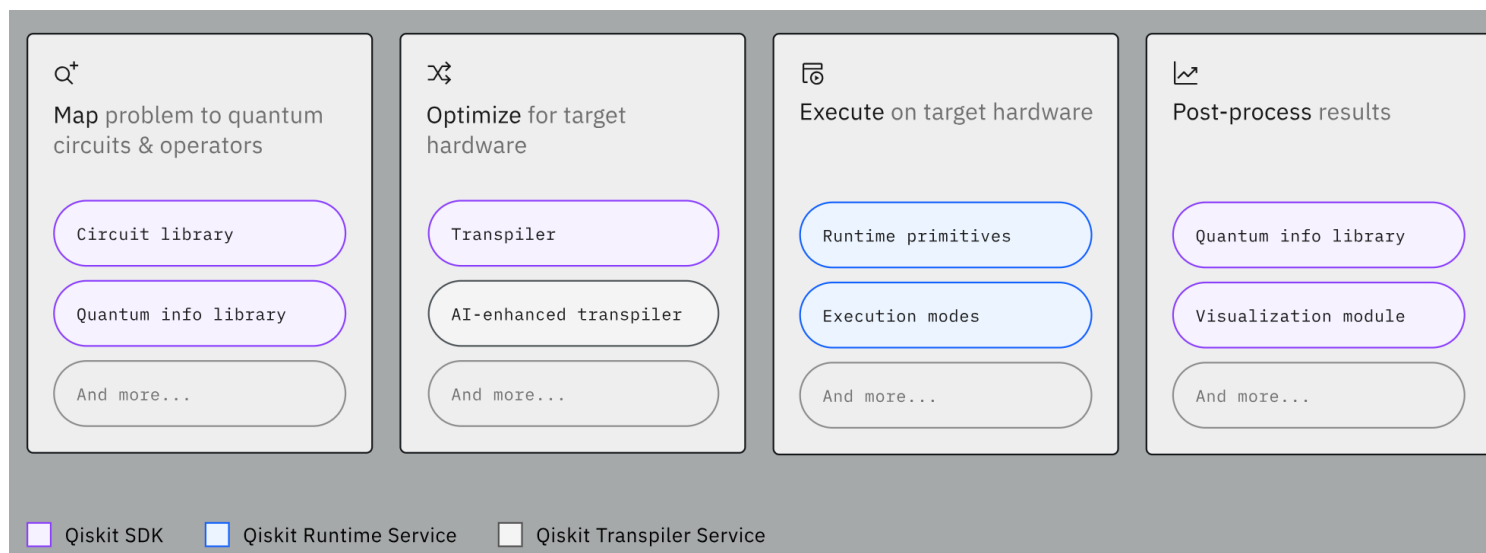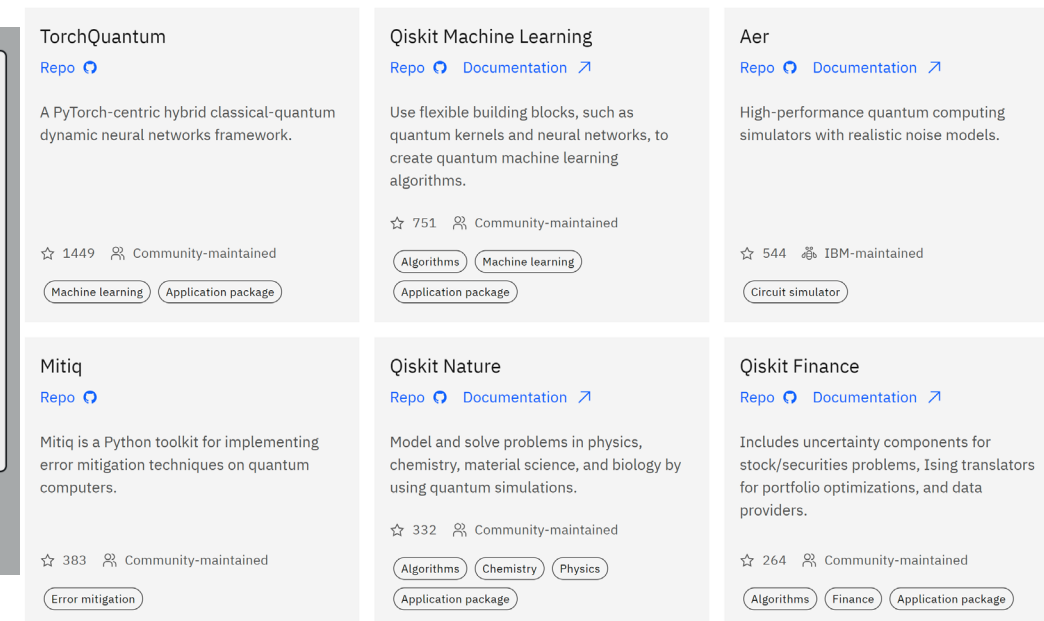

Image from: https://docs.quantum.ibm.com/guides

Image from: https://www.ibm.com/quantum/ecosystem

Performant software for best QC capabilities

- In the year 2024, Qiskit SDK was one of the focus areas for IBM Quantum. With the release of Qiskit 1.x.x (and now Qiskit 2.x.x), a comprehensive benchmarking was performed to compare different SDKs.

Benchmarking the performance of quantum computing software

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We present Benchpress, a benchmarking suite for evaluating the performance and range of functionality of multiple quantum computing software development kits. This suite consists of a collection of over 1000 tests measuring key performance metrics for a wide variety of operations on quantum circuits comprised of up to 930 qubits and $\mathcal{O}(10^6)$ two-qubit gates, as well as an execution framework for running the tests over multiple quantum software packages in a unified manner. We give a detailed overview of the benchmark suite, its methodology, and generate representative results over seven different quantum software packages. The flexibility of the Benchpress framework allows for benchmarking that not only keeps pace with quantum hardware improvements but can preemptively gauge the quantum circuit processing costs of future device architectures. Being open-source, Benchpress ensures the transparency and verification of performance claims.

a)
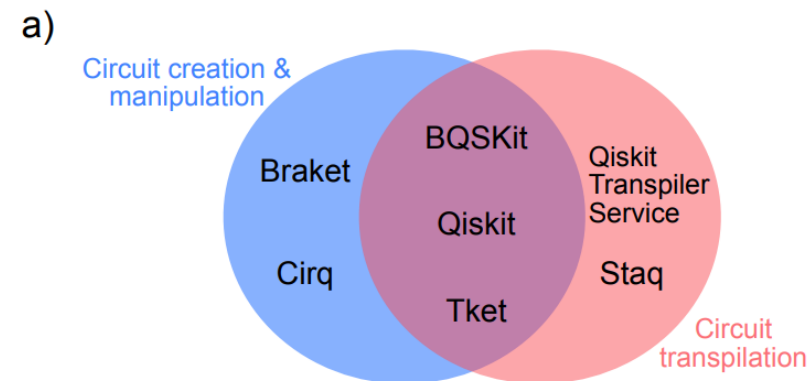
b)

	PASSED	SKIPPED	FAILED	XFAIL
BQSKit	841	22	201	2
Braket	7	1057	2	0
Cirq	10	1054	2	0
Qiskit	1044	22	0	0
QTS	1013	34	19	0
Staq	549	515	2	0
Tket	957	22	87	0

Transition to new IBM Quantum Platform

After installing Qiskit and Qiskit Runtime (can pip install both), you need to set up your IBM Cloud account and follow the steps highlighted in the documentation (https://quantum.cloud.ibm.com/docs/en/guides/cloud-setup)

1. Create your IBM Cloud account if you do not have one (https://cloud.ibm.com/registration)

2. Create an instance if necessary and create an API key.

3. If you are in a trusted Python environment, you can save your account locally. Copy your API token and use/modify the code below to save your account:

```python
from qiskit_ibm_runtime import QiskitRuntimeService
service = QiskitRuntimeService.save_account(
    token=token, # Your token is confidential, paste your API token here
    instance="<IBM Cloud CRN or instance name>", # Optionally specify the instance to use.
    plans_preference="['plan-type1', 'plan-type2']", # Optionally set the types of plans to prioritize.  This is ignored if the instance is specified.
    region="<region>", # Optionally set the region to prioritize. This is ignored if the instance is specified.
    name="<account-name>", # Optionally name this set of account credentials.
    set_as_default=True, # Optionally set these as your default credentials.
)
```

4. Now, you should be able to run your jobs on IBM Quantum computers.

5. Test it following the "Hello world" tutorial: https://quantum.cloud.ibm.com/docs/en/guides/hello-world