Preparing for the Qiskit developer certification exam

Here are some hopefully helpful tips and resources as you prepare to take the Qiskit developer certification exam. The exam contains questions on quantum computing with Qiskit that ensure competency in areas that include the following:

- Defining, executing, and visualizing results of quantum circuits using the Qiskit SDK
- Understanding single-qubit gates and their rotations on the Bloch sphere.
- Understanding various multi-qubit gates and their effects in quantum circuits.
- Leveraging fundamental Qiskit SDK features including commonly-used classes and functions located in qiskit.circuit, qiskit.execute, qiskit.providers, qiskit.qasm, qiskit.quantum_info, qiskit.tools, and qiskit.visualization packages.

Ideally, you will have the following skills before taking the exam:

- Working knowledge of creating, executing, and visualizing the results quantum of circuits using the online IBM Quantum Composer https://quantum-computing.ibm.com/composer
- Working knowledge of developing examples that highlight features of the Qiskit SDK, such as those found in the online IBM Quantum Lab https://quantum-computing.ibm.com/lab
- Working knowledge of modeling quantum states and evolution with complex vectors and matrices.
- Working knowledge of Pauli matrices.
- Working knowledge of quantum state measurement probabilities.
- Familiarity with common circuits such as those that result in the Bell states.

Here is a recommended path for preparing to take the exam:

1. Study the **Learn Quantum Computation using Qiskit** textbook up to, and including, the **Multiple Qubits and Entanglement** section https://qiskit.org/textbook
2. Then, it will be helpful to go through some of the tutorials that cover the following areas of the IBM Quantum Lab:
    1. Quantum circuits: https://quantum-computing.ibm.com/lab/files/qiskit-tutorials/tutorials/circuits
    2. Quantum simulators: https://quantum-computing.ibm.com/lab/files/qiskit-tutorials/tutorials/simulators
3. Then, dive a bit deeper into quantum circuits, which are a combination of quantum gates, measurements and resets. Initially, make sure you cover the below topics. To understand the circuits, please go through these websites,

- https://qiskit.org/textbook/ch-algorithms/defining-quantum-circuits.html
- https://qiskit.org/textbook/ch-states/representing-qubit-states.html
- https://qiskit.org/documentation/stubs/qiskit.circuit.Gate.html

- https://qiskit.org/documentation/tutorials/circuits_advanced/03_advanced_circuit_visualization.html

    1. Using various single-qubit gates : https://qiskit.org/textbook/ch-states/single-qubit-gates.html
    2. Using various multi-qubit gates : https://qiskit.org/textbook/ch-gates/multiple-qubits-entangled-states.html
    3. Using barrier operation : https://qiskit.org/documentation/stubs/qiskit.circuit.library.Barrier.html
    4. Returning the circuit depth : https://arnaldogunzi.medium.com/how-to-calculate-the-depth-of-a-quantum-circuit-in-qiskit-868505abc104
    5. Extending quantum circuits : https://qiskit.org/documentation/stubs/qiskit.extensions.Initialize.html
    6. Operations around the qiskit version : https://qiskit.org/documentation/install.html
    7. Operators :https://qiskit.org/documentation/tutorials/circuits_advanced/02_operators_overview.html
    8. Fidelity: https://qiskit.org/documentation/stubs/qiskit.quantum_info.state_fidelity.html

- A topic to study next would be quantum registers. Visiting these resources will shed some additional light in this area:
- https://qiskit.org/documentation/getting_started.html

    1. Constructing Quantum Circuits : https://qiskit.org/textbook/ch-algorithms/defining-quantum-circuits.html
    2. Constructing multi-qubit quantum registers : https://qiskit.org/textbook/ch-gates/multiple-qubits-entangled-states.html
    3. Measuring quantum circuits into classical registers: https://qiskit.org/documentation/stubs/qiskit.circuit.Measure.html
    4. Classical and quantum registers: https://qiskit.org/documentation/stubs/qiskit.circuit.QuantumRegister.html
    5. Executing a quantum circuit: https://qiskit.org/documentation/apidoc/execute.html

- The next topic to consider is simulators. Simulators are used to mimic the actual quantum device. Below are the links to follow through these topics,
- https://qiskit.org/documentation/tutorials/simulators/1_aer_provider.html
- https://qiskit.org/documentation/apidoc/providers_basicaer.html

    1. Returning the histogram data of an experiment
    2. Returning the statevector of an experiment
    3. Returning the unitary of an experiment
    4. Available simulators
    5. Accessing a statevector_simulator backend
    6. Accessing a qasm_simulator backend
    7. Accessing a unitary_simulator backend

- Open QASM is Open Quantum Assembly Language is an intermediate language for quantum instructions. Below are some resources to understand the Open QASM and how to use it in Qiskit.
- https://qiskit.org/documentation/stubs/qiskit.qasm.Qasm.html
- https://medium.com/qiskit/a-new-openqasm-for-a-new-era-of-dynamic-circuits-87f031cac49
- https://github.com/Qiskit/openqasm

    1. Returning the OpenQASM string for a circuit
    2. Reading a QASM file

- Qiskit Backend refers to the functions used in IBM Quantum Experience device. To understand how the Qiskit Backend works, go through the resources below,
- https://quantum-computing.ibm.com/docs/manage/account/ibmq
- https://qiskit.org/documentation/stubs/qiskit.providers.ibmq.IBMQBackend.html
- https://medium.com/qiskit/qiskit-backends-what-they-are-and-how-to-work-with-them-fb66b3bd0463

    1. Monitor the status of a job instance
    2. Qiskit Backend Overview

- Visualization deals with the plotting various data in Qiskit. Below are some resources to understand these concepts,
- https://qiskit.org/documentation/tutorials/circuits/2_plotting_data_in_qiskit.html
- https://qiskit.org/documentation/tutorials/circuits_advanced/03_advanced_circuit_visualization.html

    1. Drawing a circuit Plotting a histogram of data
    2. Plotting a Bloch multivector
    3. Plotting a Bloch vector
    4. Plotting a QSphere
    5. Plotting a density matrix
    6. Plotting a gate map with error rates