Hackathon Prompt: Explore Quantum Circuit Transpilation

Background and motivation:

Transpilation of a quantum circuit is a complex process of converting the given circuit into the executable set of gates, matching with the topology of the target quantum device, using an optimal number of gates, and applying techniques to deal with errors. Depending on the performance of the transpiler, a circuit can shrink into one-fifth the size of the original circuit and achieve a significant reduction of errors physically. In this topic, you will explore the detailed steps of transpilation and play with your own or ready-made functions to optimize the given quantum circuit. The target circuit of this topic will be the Quantum Fourier Transform (QFT) circuit, which is one of the most important quantum subroutines, providing exponential speedup compared to classical computation.

Transpile the QFT circuit to get the best score. The circuit must perform the QFT with arbitrary inputs, matching with the target quantum device topology within the basic gate set. The score will be given based on the expected performance of the circuit, considering accuracy of each gate in the circuit.

You can find the grader file at here and the main repository of 2024 Quantum Korea Hackathon can be found here.

Getting started:

Qiskit 1.0 transpiler provides a powerful flexibility to users with its abundant options. Also, to facilitate the development and reuse of custom transpilation code by the wider community of Qiskit users, the Qiskit SDK supports a plugin interface that enables third-party Python packages to declare that they provide extended transpilation functionality accessible via Qiskit.

How about making your own transpiler and becoming a contributor? Creating a transpiler plugin is a great way to share your transpilation code with the wider Qiskit community, allowing other users to benefit from the functionality you've developed. Here you can find guidelines and instructions on how to contribute to the Qiskit community by contributing quality transpiler plugins.

Suggested resources:

- Qiskit Fall Fest 2024 Notebook 3
- Introduction to transpilation
- AI Transpiler service
- Transpiler plugins
- Qiskit ecosystem