# Qubit Routing (Advanced)

- **Description.** In most quantum circuit simulators, you can apply controlled gates to any choice of qubits in the circuit. However, real hardware is often more restrictive. It turns out that performing even two-qubit gates reliably is a hard problem, since this requires forcing the two qubits to interact. To make this problem easier, many quantum computers will only support a small number of multi-qubit gates, such as the controlled-NOT gate and the swap gate. Moreover, the hardware design will often put restrictions on the pairs of qubits which support multi-qubit gates. These restrictions are often described by diagrams in which each dot represents a qubit, with lines appearing between valid pairs of qubits. For example, in the following diagram, qubit 0 may only interact with qubits 1 and 5.
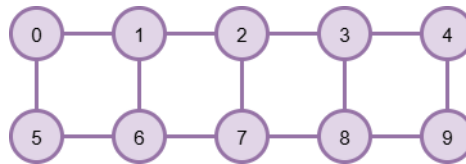
  If we were to run a quantum circuit on this hardware using all ten qubits, then IBM Quantum Platform would deal with these constraints for us automatically. In this activity, you will consider a simpler (and somewhat less realistic) quantum computer with six qubits with the following connectivity.

  Your goal is to figure out how to perform a NOT gate that targets qubit 5 and is controlled by qubit 0. Once you figure out how to do this, you should write a quantum circuit which implements your solution.

- **Note.** You may create your circuit in either Quirk or IBM Composer.

- **Submission.** A paragraph describing your solution, and an image of the corresponding circuit.