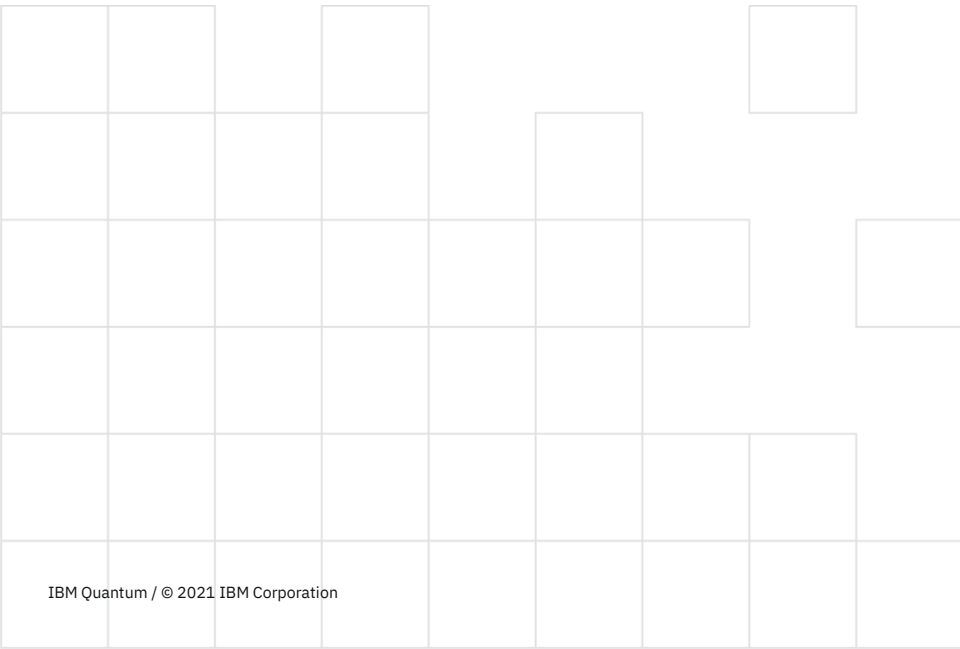


#11 Swapping Qubits

By Shilpa Mahato

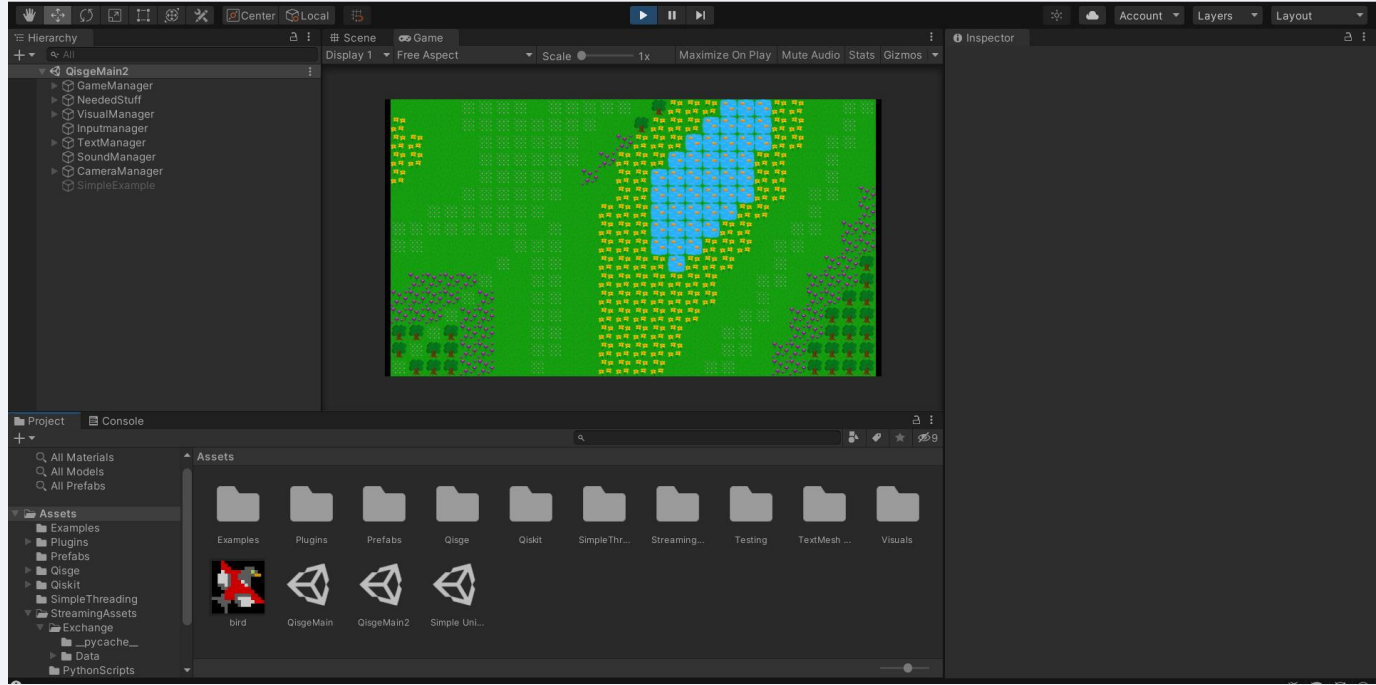
QAMP FALL 2021

Mentor: Marcel Pfaffhauser



Qisge:

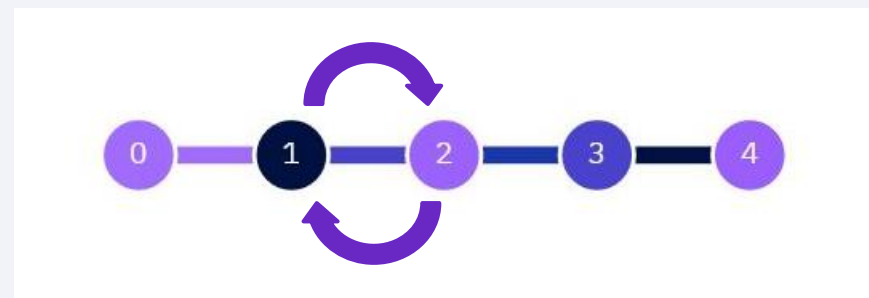
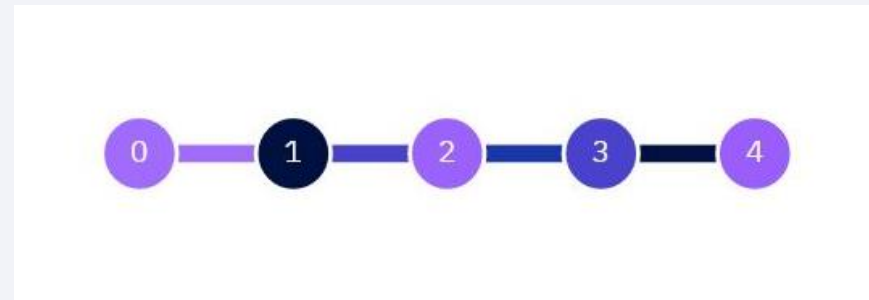
Qisge is a game engine based on Unity and Python used for making games using Qiskit.



Background:

Coupling Map shows how qubits are connected to each other inside a quantum computer. Different quantum computers have different coupling maps. For two qubits to interact (to perform a 2-qubit operation/gate like CX), the two qubits need to be physically connected. Hence to interact two disconnected qubits, we need to **SWAP** the qubits which require **3 additional CNOT gates**.

For an interaction (CNOT) between 1 and 3, we need to swap 1 and 2, so that 1 and 3 can interact directly.



Project Idea:

- The first part of the project will involve developing a game in which for a given **coupling map** and a given **list of two qubit operations**, the player needs to arrange the qubits in the coupling map in such a way such that minimum number of SWAPs are required, in order to perform all the mentioned qubit operations.
- The second part of the project will involve writing down a **step-by-step guide** to create the game which will help people learn to program using **Qiskit**.

Game example: Let the qubits be denoted by alphabets(A,B,C...) and the following be the list of operations that are required to be performed.

- A – B
- A – C
- D – E
- A – E

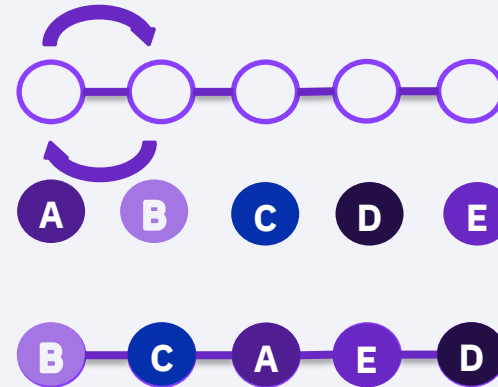
Qubits:



List of qubit interactions:



Coupling Map:



- A – B
- SWAP B with C
- A – C
- D – E
- A – E

Progress:

- ❑ Setting up and understanding the Qisge framework.
- ❑ Setting up a new game/scene within Qisge.
- ❑ First Milestone: To be able to create a suitable graphics/background for the game.

