An Introduction to Quantum Computing

v. 1.0

February 27, 2024

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Exercise 3

Unitary matrices play a huge role in quantum computing. Please answer the following questions:

- Give some (at least 3) examples of unitary 2×2 matrices. Prove the matrices are unitary.
- Give some (at least 3) examples of non-unitary 2×2 matrices. Prove the matrices are non-unitary.

Related to the two-state gates on page 26 please:

1. Calculate the output to input states $|0\rangle$ and $|1\rangle$ and explain what the qgate does for all qgates on page 26 in the lecture slides. At least one matrix should have at least one complex entry.
2. Optional: If possible, try to simulate the behavior of the gates on page 26 in the lecture slides, and compare with your calculations. At least one matrix should have at least one complex entry.

Qubits and Qgates
Exercise 3.3

In Example 2 in Lecture 3 try to expand the code to allow you to input the number of 'shots'.

1. Once you have the implementation try to make a histogram for `shots=10000`, `shots=100`, and `shots=1`. Compare the results and explain what you see.
2. Try to investigate the convergence versus `shots` for some different two-state Qgates on page 26 in the lecture slides.