

Week 2

Summary

In this week, we studied about quantum circuits in detail and also implemented some of the algorithms on qiskit. This week was application intensive.

We started by revisiting single qubit operations and Bloch sphere representation of matrices. Then, I studied about rotation matrices that were obtained by exponentiating Pauli matrices. This chapter was supplemented by a lot of computation intensive and non trivial problems and I found some of them quite challenging. Then came the important result that any Hermitian matrix can be represented as a product of global phase and rotation matrices. Also, another general representation of any matrix as rotation about a particular axis \hat{n} by angle θ was studied. Then I personally studied about various properties of a unitary matrix, how each can be represented as e exponentiated to a Hermitian matrix etc. Then another representation was introduced in which any unitary matrix can be presented as a product of global phase, X gates and single qubit gates, Thus any quantum gate could be broken down to a product of a global phase and single qubit gates. Then, I solved all of the problems which aimed to represent / decompose Hadamard gate to each of these decompositions.

Then, controlled qubit operations were reintroduced. Density operator was introduced in a problem and thus I studied about density operator and their properties for both pure and mixed states.

Then using the above decomposition theorems, we studied about a lot of circuits involving them.

After that, I studied about the two important principles of measurements and another prototype for the teleportation circuit which I also implemented in qiskit.

After this I studied about how every unitary matrix can be decomposed and implemented with the help of only CNOT, phase and Hadamard gate to an arbitrary accuracy.

This was followed by implementation exercises in qiskit. I installed the prerequisites from their official site and learnt the basic syntax of qiskit by reading all of the pages on it till Section 3. Thereafter, I implemented all of the mandatory problems and displayed their Bloch spheres, state vectors, quantum circuits etc for seeing the output and for verification.