GSOC’24 with QMLHEP

Task III: Open Task

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Introduction:

As we know, earlier the computation was focused on two states derived from the low voltage and high voltage giving us the 0 bit and 1 bit to represent information. Classical computers require high computation power in terms of RAM and GPUs for solving problems with a high degree of complexity.

Since the problems in the real world are generally complex due to the interactions between the parameters, it is better to use the help of quantum computing. Quantum algorithms give multidimensional computation space utilizing the quantum mechanics concepts of superposition, entanglement and interference.

In the past I have worked on a project based on financial modeling for option pricing in which I utilized quantum computing. Although I still consider myself new to this field, I wish to develop a good foundation in this field through GSoC while at the same time being able to contribute to this field.

Quantum Machine Learning:

Quantum Machine Learning is already being explored a lot and even beginners can develop basic models with the help of resources available and the community support.

QML has led to development of classic machine learning algorithms by replacing sub-parts with high complexity leading to better models as evident in the case of Linear classifiers.

Currently, feature maps and quantum kernels are used to map the data into higher dimensional space and build linear classifiers there. It has also been seen that Variational Quantum circuits generalize better with less training examples, therefore speeding up the training processes.

Quantum computing was initially inspired to not primarily improve solutions developed by the classical models but rather to solve new problems which were deemed impossible the classical ways. I believe it would be impactful to work on novel solutions to such problems to see learning in a new way, the quantum way.

Quantum software and algorithm I’m familiar with:

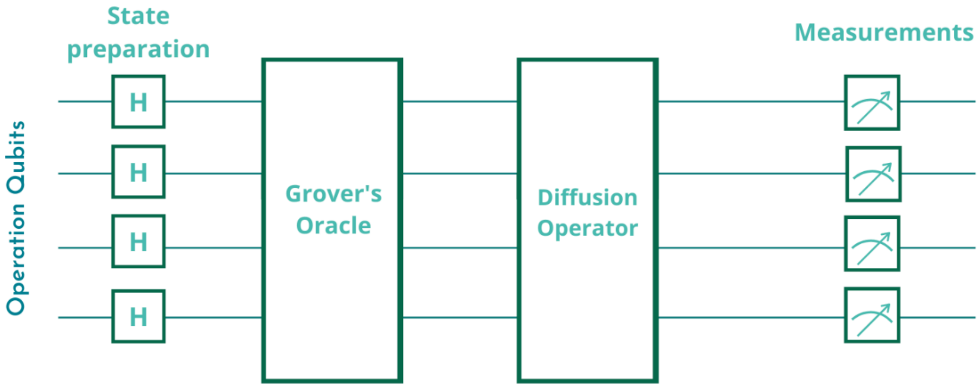
I have primarily used Qiskit for learning and building circuits. Over the course of developing solutions for the test tasks, I made myself familiar with Pennylane and Cirq.

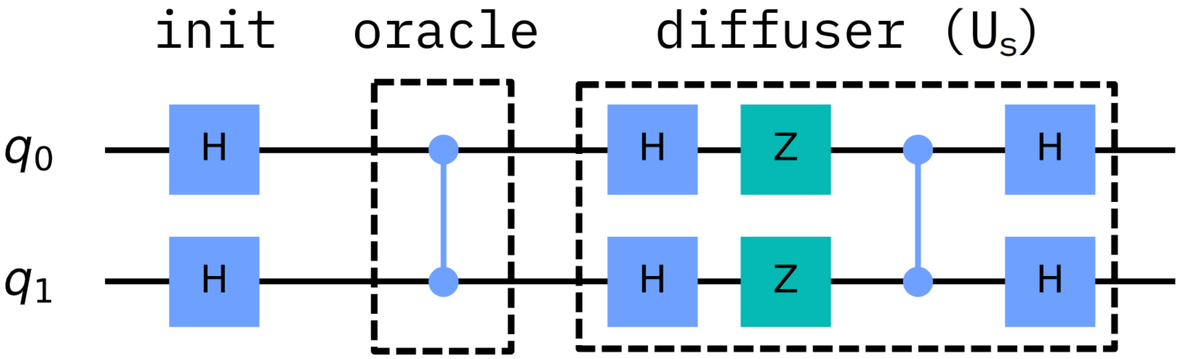
Over the course of time, I have understood a few algorithms that include:

Grover’s Algorithm

Lov Grover created this algorithm to solve the problem of an unstructured search. It can find the unique input to a black box function that produces a particular output value, using just

O(sqrt N) evaluations which would have required on average O(N) evaluations.





References:

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