Grover’s Quantum Algorithm CPSC 4110

By Kiel Baluyut and Jenna McDonnell

**Introduction**

This project is based on the use of Grover’s quantum algorithm in solving the satisfiability problem. To talk about the algorithm, we first need to discuss the satisfiability problem itself, specifically, Boolean satisfiability.

**Boolean Satisfiability**

The Boolean satisfiability problem “asks whether the variables of a given Boolean formula can be consistently replaced by the values TRUE or FALSE in such a way that the formula evaluates to TRUE” [1]. The input in this problem is a Boolean expression that connects multiple clauses (made up of k variables connected by the Boolean OR operator) using the Boolean AND operator. When k = 3, this looks like:

where n is the number of clauses, and each clause looks like some variation of:

the variation being that each of the k variables can be as written v or NOT v (, using the Boolean not operator. This is important because this sets each of the variables to TRUE or FALSE, giving us a string of Boolean values combined using OR. Let’s look at an example of the Boolean satisfiability along with one solution and one non-solution to the problem:

In this case, we see that is a solution because:

A non-solution would be because:

**Grover’s Quantum Algorithm**

**Using Grover’s Quantum Algorithm to Solve the Boolean Satisfiability Problem**

References

1. https://qiskit.org/textbook/ch-applications/satisfiability-grover.html