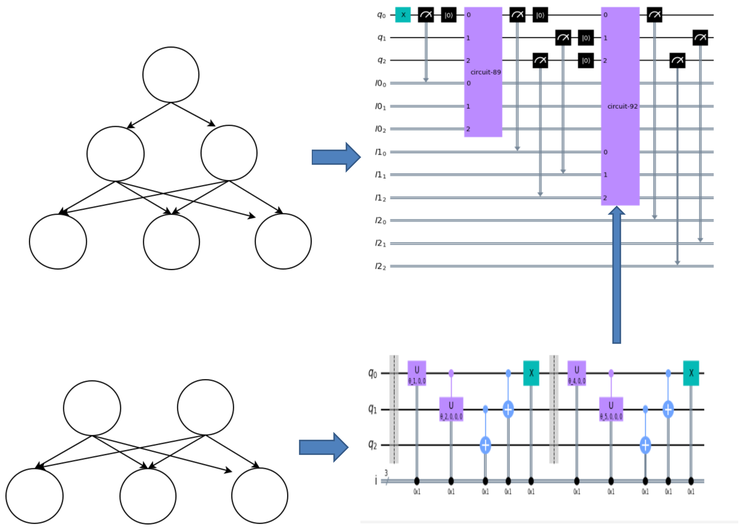
UR-302

Using Quantum Computing to Determine the Optimal Path on Cascading Graphs

INTRO/ABSTRACT

In this project, we will use quantum computers to solve a subset of a graph optimization problems using both existing and new methodologies. Our research focuses on a subset of DAGs named “Cascading Graphs” and finding the “best” path based on a predetermined metric. To solve this problem, we started with finding a mathematical algorithm and creating an implementation of the algorithm in a quantum computer.

METHODS: Using Quantum Circuits to compute Optimal path



RESULTS

In our research we where able to prove that searching for a path with the highest/lowest product of its weights on Cascading graph can be solved using an “adequate” number of random walks. With this foundation we designed an algorithm that takes advantage of superposition to represent a weight using only a single qubit. Our current algorithm runs in $O\left(\frac{|V|^2 * N * L * S}{P}\right)$ time complexity. The benefit of using this algorithm is that it is highly scalable as *P* represents the number of concurrent walks possible. It can out preform classical computers given a Quantum Computer capable of allowing for a large *P*.

The focus of our research was in finding a Quantum algorithm that can deterministically find the optimal path for a subset set of Directed Acyclic Graphs.
In addition, we aimed to show that it can possibly out preform Classical algorithms in terms of either time or space complexity

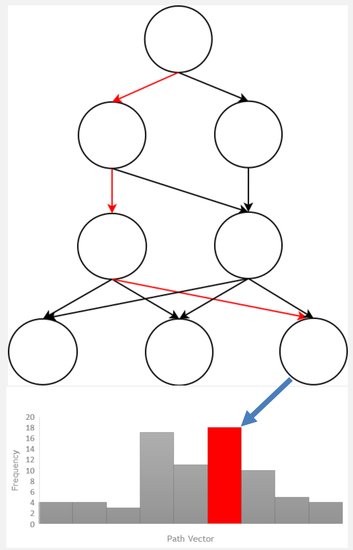


Figure: 1

Figure: 2

Figure(s) 1,2 : Showcase an example of how the optimal path is found using a PMF of the distribution created by the random walks and then selecting the walk with the highest frequency . The path indicated in red marks the optimal path on the graph which is the directed to its corresponding entire on the histogram using the blue arrow.

If you want to know more about our research, simply scan the Qrcode to learn more at our website

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