

# Independent Set Problem Report

Report generated on: 2025-07-23 11:00:23

## Graph Details

Number of Nodes: 4

Edges of Nodes: [(0,1), (0,2), (1,2), (1,3)]

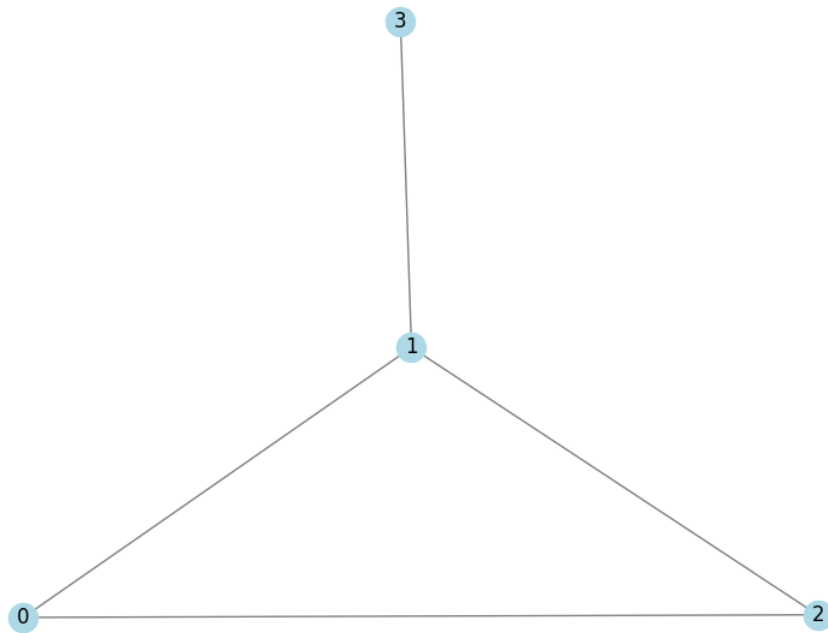


Figure 1: Graph Visualization

## 0.1 QUBO Matrix Visualization

Converted QUBO matrix visualization:

$$\begin{bmatrix} -1.0 & 2.0 & 2.0 & 0.0 \\ 0.0 & -1.0 & 2.0 & 2.0 \\ 0.0 & 0.0 & -1.0 & 0.0 \\ 0.0 & 0.0 & 0.0 & -1.0 \end{bmatrix}$$

## 0.2 Oracle Visualization

The corresponding oracle for the Independent Set problem is shown below:

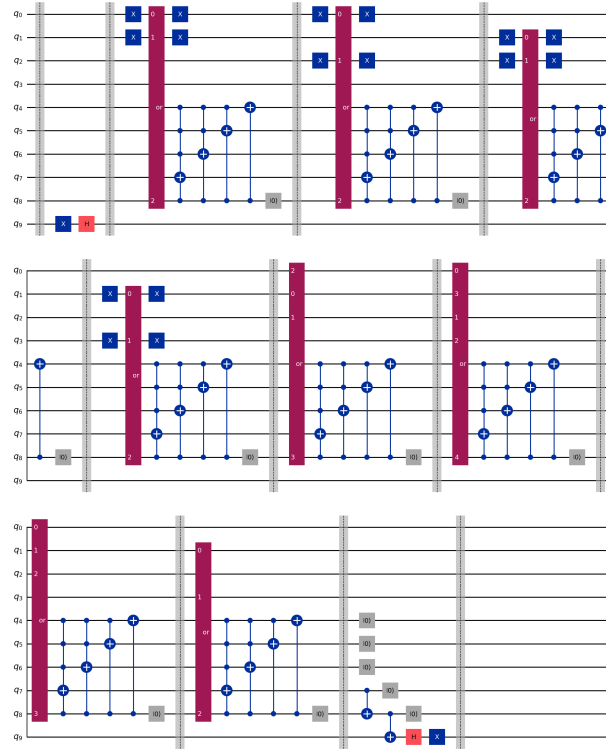


Figure 2: Corresponding Oracle Visualization for the Independent Set Problem

## QAOA Optimization Results

Most Probable Solution for QAOA:

- Variable  $x_1$  is set to true
- Variable  $x_2$  is set to true

- Variable  $x_3$  is set to false
- Variable  $x_4$  is set to false

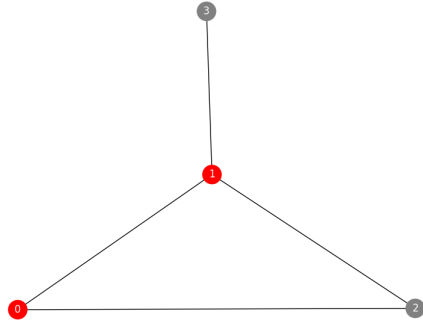


Figure 3: QAOA Result

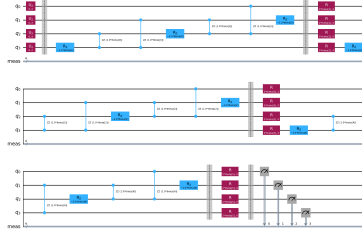


Figure 4: QAOA Quantum Circuit

## VQE Optimization Results

Most Probable Solution for VQE:

- Variable  $x_1$  is set to true
- Variable  $x_2$  is set to true
- Variable  $x_3$  is set to false
- Variable  $x_4$  is set to false

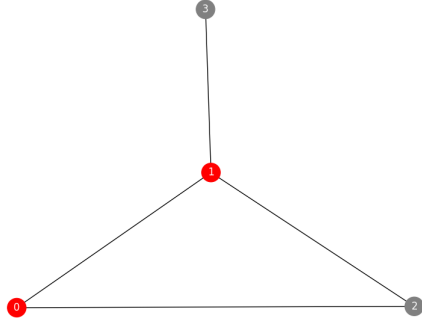


Figure 5: VQE Result

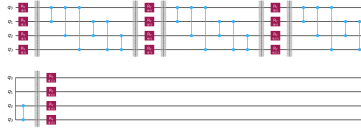


Figure 6: VQE Quantum Circuit

## Grover's Algorithm Results

Most Probable Solution for Grover's Algorithm:

- Variable  $x_1$  is set to true
- Variable  $x_2$  is set to false
- Variable  $x_3$  is set to true
- Variable  $x_4$  is set to false

## Device Recommendation Summary

\textbf{Here is the device recommendation summary based on error, time, and price:}

- Lowest error: Quantinuum H1 from Azure Quantum with a calculated error of 3.9%, time to execute: 1939.2 seconds and a price of \$56625.0.
- Lowest time: IQM Garnet from Amazon Braket with a calculated error of 79.98%, time to execute: 0.183 seconds and a price of \$87.5.
- Lowest price: Rigetti Ankaa-9Q-3 from Azure Quantum with a calculated error of 50.68%, time to execute: 0.33 seconds and a price of \$0.43.

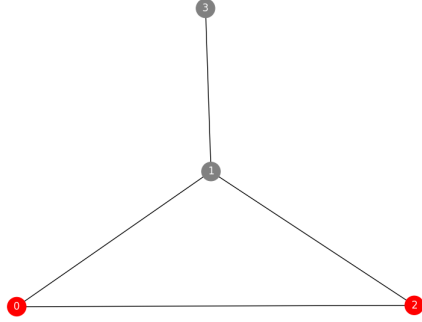


Figure 7: Grover's Algorithm Result

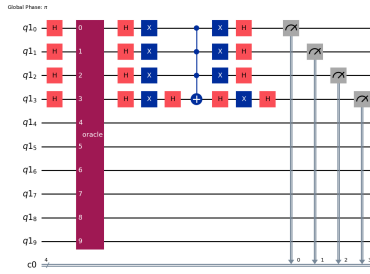


Figure 8: Grover's Quantum Circuit

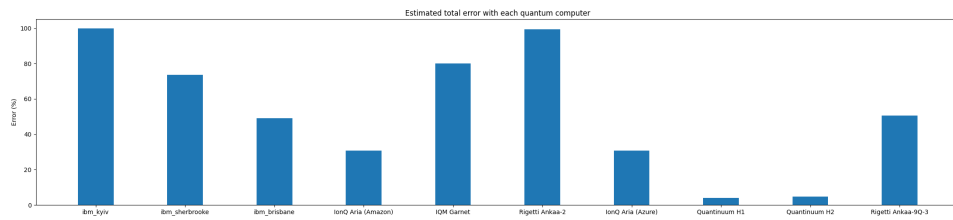


Figure 9: Estimated total error with each quantum computer

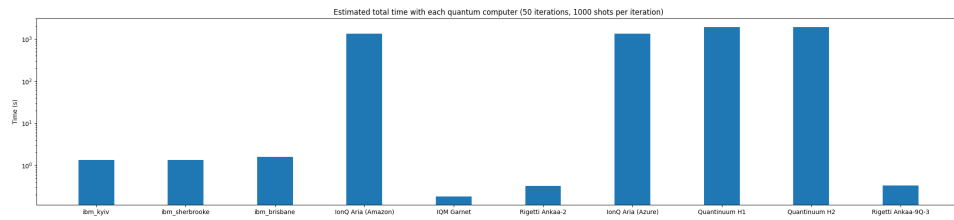


Figure 10: Estimated total time with each quantum computer

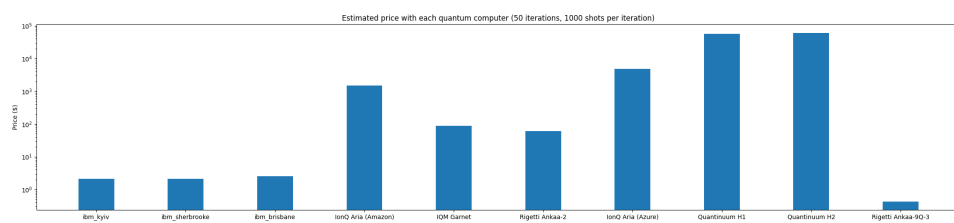


Figure 11: Estimated price with each quantum computer