

Glued Tree is one of two parts in demonstrating that a quantum algorithm results in an exponential quantum speed up. The goal is to find the label of the EXIT mass given the label of the ENTRANCE mass and given oracle access to the network, and it is demonstrated to be solvable in  $\text{poly}(n)$  time. Thus this problem maps a system of masses and springs by putting a unit mass at each vertex and a spring of unit spring constant at every edge. Then can show that if the system starts at rest except with the ENTRANCE vertex having unit velocity, after polynomial time, the EXIT vertex will have inverse polynomial velocity. This is a different approach from that of Ref. [26] as we are not simulating the quantum walk but rather the classical dynamics obtained from Newton's equation with a quantum algorithm. The Glued tree problem shows that the paper's quantum algorithm cannot be simulated classically efficiently in the oracular setting in general.

This claim is based on the following lemma, which is proved in App. B. Lemma 7 yields the exponential lower bound in Thm. 2. In Sec. VI A shows the exponential lower bound for classical algorithms for this problem in the oracle setting, and in Sec. VI B shows that this problem is BQP-complete when the oracles can be accessed via efficient quantum circuits. Glued tree provides insight information that It's then another example like Grover's unstructured search problem.

Now please see below and follow along with ClassiQ's Glued Tree Problem