RICE QUANTUM GROUP MEETING SEMINAR SERIES

Presenter: Zewen Zhang

Research Group: Prof. Kaden Hazzard's group

Date: May 26, 2023, Friday

Time: 4PM - 5PM

Venue: SST 300

Counting all ground states of classical systems on a quantum computer

Abstract:

A large-scale quantum computer would be able to solve some important problems faster than any classical computer. However, only a few quantum algorithms with speedups over classical ones are known and their performances are severely subject to noises. One promising route to solving a broad range of practically important but classically hard problems on quantum computers are variational quantum algorithms, which train parameterized quantum circuits with classical optimizers to find solutions. A popular example is the Quantum Approximate Optimization Algorithm (QAOA), which alternatively applies two kinds of unitary operators to solve combinatorial optimization problems. The conventional QAOA has been shown to be powerful in finding ground states, but it generically finds only a few solutions in the solution space. We study a Grover QAOA that eliminates this bias, sampling the whole solution space evenly and thus, enables us to count all solutions in certain problems. We will describe experiments on trapped-ion machines and numericals that show Grover QAOA can find all solutions more efficiently than a classical computer. We will also show how current quantum computers, where noise is not negligible, impacts its performance. We will discuss challenges and prospects for future application of Grover QAOA in ground state counting and state preparation, and potential extensions to interesting problems such as frustrated systems and other graph problems with near-term quantum devices.

Short Bio:

Zewen Zhang is a fourth year graduate student at Prof. Kaden Hazzard's group. His research interest lies in understanding some cold atom systems with numerical and analytical tools, as well as quantum algorithms and optimization. His previous work focuses on dynamics of Rydberg atom lattices and understanding the role of atom motion during the dynamics. He is also exploring phases of SU(N) optical lattice with mean-field calculations. Recently, he is working on quantum algorithms like QAOA and implementing the algorithms to quantum hardware. Before joining Rice, he did his BS at Zhejiang University and MS at the University of Georgia.

Note: *Snacks and Coffee will be served during the event Wine & cheese will be served after the talk. Everyone is welcome to stay around after the seminar for further informal discussions.*