QAGC submission

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OUTLINE

・Our algorithm is based on this paper [1]

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- **What is VQE Algorithm**
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[1] Stasja Stanisic, Jan Lukas Bosse,Observing ground-state properties of the Fermi-Hubbard model using a scalable algorithm on a quantum computer, 2022, nature communications

VQE algorithm

- VQE algorithm is a quantum algorithm to solve grand state of Hamiltonian $\hat{H} = \sum_i \alpha_i \hat{P}_i$ ($\hat{P}_i$ is subset of Pauli operator).
- This algorithm is based on fractional sampling.

$$\langle \psi | H | \psi \rangle \geq E_0$$

VQE algorithm

1. Create quantum state $|\psi(\theta)\rangle$ on quantum computer.
2. Measure the expectation value $\langle H(\theta) \rangle = \langle \psi(\theta) | H | \psi(\theta) \rangle$.
3. Determine θ such that $\langle \psi(\theta) | H | \psi(\theta) \rangle$ is small on classical computer

Repeat until $\langle \psi(\theta) | H | \psi(\theta) \rangle$ converges to get an approximate ground state.

Motivation for project

- To search algorithm to solve Fermi-Hubbard model with efficient, low depth and few parameters.

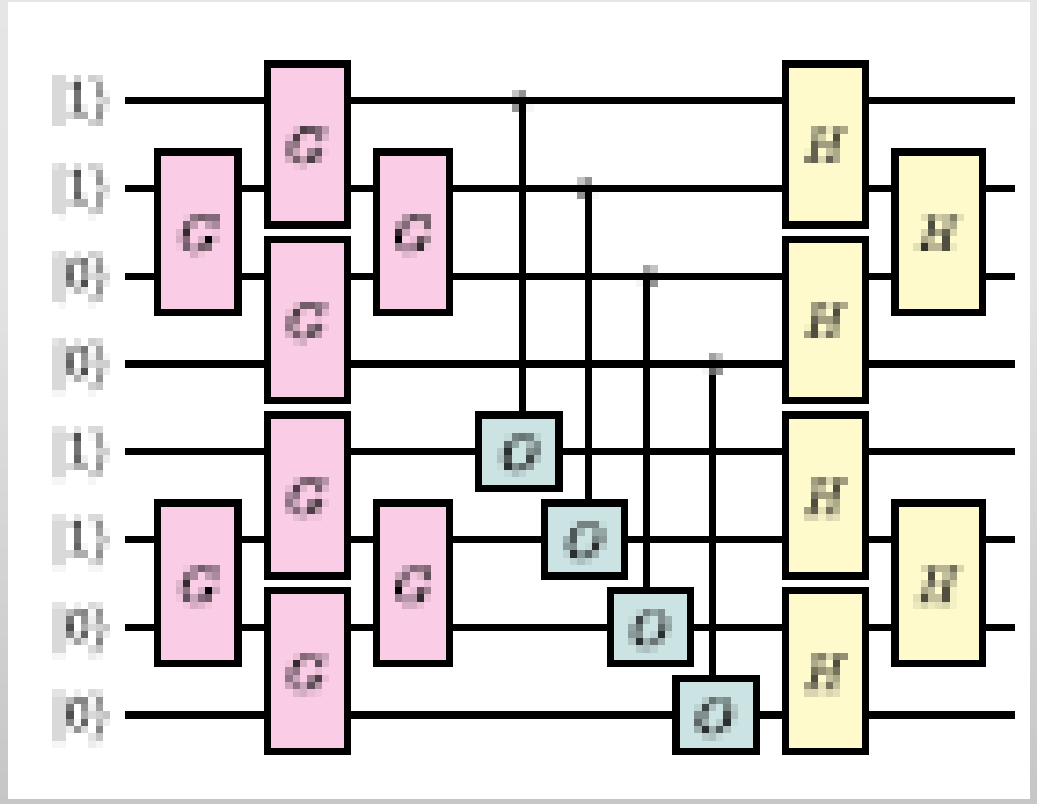
The main motivation is to make ansatz scale down without loss of accuracy.

We referred paper [1] to meet this requirement.

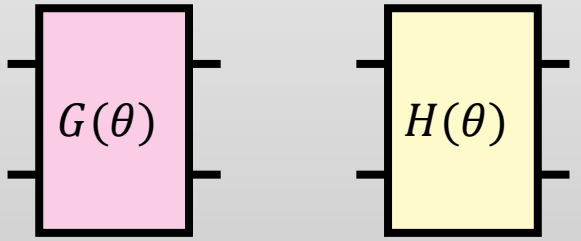
[1] Stasja Stanisic, Jan Lukas Bosse,Observing ground-state properties of the Fermi-Hubbard model using a scalable algorithm on a quantum computer, 2022, nature communications

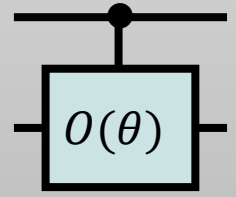
Ansatz

We designed following ansatz :



The gates named G, H and O are parameterized gats.





Thank you !!