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TALKS

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Meeting Link
March 8, 8PM IST

Characterization of variational quantum algorithms using free fermions

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ABSTRACT

We study variational quantum algorithms from the perspective of free fermions. By deriving the explicit structure of the associated Lie algebras, we show that the Quantum Approximate Optimization Algorithm (QAOA) on a one-dimensional lattice – with and without decoupled angles – is able to prepare all fermionic Gaussian states respecting the symmetries of the circuit.

Leveraging these results, we numerically study the interplay between these symmetries and the locality of the target state, and find that an absence of symmetries makes nonlocal states easier to prepare. An efficient classical simulation of Gaussian states, with system sizes up to 80 and deep circuits, is employed to study the behaviour of the circuit when it is overparameterized.

In this regime of optimization, we find that the number of iterations to converge to the solution scales linearly with system size. Moreover, we observe that the number of iterations to converge to the solution decreases exponentially with the depth of the circuit, until it saturates at a depth which is quadratic in system size. Finally, we conclude that the improvement in the optimization can be explained in terms of better local linear approximations provided by the gradients.

BIOGRAPHY

Gabriel is a Research Scientist at Quantinuum working on quantum algorithms and natural language processing.

Prior to joining Quantinuum, Gabriel completed his PhD in Theoretical Physics at the University of Leeds supervised by Zlatko Papić and Jiannis Pachos. Before that, he completed a BSc and an MSc in Mathematics at the Instituto Superior Técnico, University of Lisbon.

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