Abstract

Modern technology will require immense computational power, and the current proccessor-technology is limited by physical contstraints, such as size, material and energy consumption. Quantum computing can potentially provide a solution to this computational demand by offering a new way of processing information. In this report, we have explored, and implemented, some of the basic concepts of quantum computing, and used the Variational Quantum Eigensolver (VQE) algorithm to compute the ground state energies of two simple Hamiltonians, and the Lipkin model.
We found that, by following the article in [**PhysRevC.106.024319**], with usage of the NumPy library, and simple matrix multiplications, can be used to simulate quantum circuits on a regular computer, and that the VQE algorithm can be used to good effect to find the ground states. Our implementation of the Lipkin Hamiltonian on our VQE successfully managed to capture the complex nature of entanglement in our system - and also found the avoided crossing in the energy spectrum. The conclusion is that these quantum computing algorithms have remarkable potential in solving such quantum systems, and that the future of quantum computing is brighter than ever.
The link to the GitHub repository containing all code can be found here: `https://github.com/Jonnyigeh/FYS5419-quantum-computing/tree/main/Project%201`