
SOFTWARE ENGINEERING PROGRAMME
UNIVERSITY OF OXFORD
www.softeng.ox.ac.uk



ASSESSMENT

Student: 1049098
Course: Quantum Computing
Date: 7th March 2022
Grade: 92

REPORT

Report for QUC Assignment (March 2022)

You display absolute excellence in both theoretical aspects of quantum computing and practical implementation of VQE. You completed all tasks, going well beyond what could be expected from a model answer.

Mark: 92

Task 1

Your explanation of the core ideas of the paper is complete, displaying excellent technical understanding. You include a ZX diagram for one of the ansatzes, to complement your textual description.

Task 2

You correctly implement the three ansatzes, using a single multi-purpose implementation. You correctly allow for arbitrary depth to be set. You include an option to use 6-qubit mapping (as in the paper) or a simplified mapping.

Task 3

You correctly infer the link between the groups in Table S2 and the minimal set of measurements necessary to evaluate the Hamiltonians. You implement custom measurement logic to perform the minimal measurements and then obtain the Hamiltonian terms by marginalisation. You display an excellent understanding of the subject matter by observing that the Hamiltonians from Table S2 don't include a constant term, and that this would account for the shift between your optimisation results and those from the paper. You go well beyond expectations and use Qiskit Nature module to compute the correct shifts for the molecules at hand. You reproduce the theoretical energy minima to a very good approximation, and offer a reasonable explanation for the residual difference.

Task 4

You correctly implement the ansatz and your overall workflow is correct. In

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your ansatz, you include interactions 0-1, 1-2 and 2-3, but you forget the interactions 3-0 (XIIX, YIIY, ZIIZ) that would close the square. You do not attempt to reproduce the results of Figure 4(c).

Task 5

You reproduce the plots of Figure S9 to a very good degree, the only difference being the behaviour as d changes. There is nothing wrong with your workflow and the behaviour you observe is consistent with the error rates for the current generation of IBMQ hardware (the 7-qubit IBMQ Jakarta today has ~ 0.2 - 0.5% 1-qubit error and ~ 0.5 - 1.5% 2-qubit error which): the machine they used in 2017 had much higher error rates, as you can indirectly infer from Table S1 (20-45us T1 times in the 2017 machine vs the 50-150us T1 times for IBMQ Jakarta today).