

TASK III

Many quantum algorithms that claim to outperform classical algorithms primarily demonstrate lower query complexity compared to their classical counterparts. These quantum algorithms leverage the superposition states of qubits and entanglement between qubits to achieve better results. It is noteworthy that a significant number of quantum algorithms utilize the Quantum Fourier Transform (QFT), which can be mathematically interpreted as extracting eigenvalue information from a matrix or transformation between an abelian symmetry group and its representations if we choose to use a more abstract representation of quantum states. Use of QFT includes early successes in quantum computing such as Shor's algorithm and is the core of hidden subgroup problem studies.

Interestingly, this operation seems to be largely absent from most quantum machine learning (QML) studies. Before the widespread use of neural networks, principal component analysis played a crucial role in the statistical methods of machine learning. I think in theory, QFT could be applied to QML for similar analyses, potentially improving performance. However, it is still unclear to me how the implementation of QFT within QML architectures can be done, as well as determine the best problem to study with this idea.