Adaptive Quantum Computing Algorithms for Real-Time Data Processing in High-Dimensional Systems

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Abstract:

For traffic prediction, the Quantum Approximate Optimization Algorithm (QAOA) is used on the METR-LA dataset which is a problem as real-time data in a smart city context is high dimensional. Slack and Coull technologies cannot cope with such data formats due to limitations of traditional optimization methods. QAOA a combination of quantum and classical optimization digs a deep pit in front of other machine learning algorithms such as Random Forest, Support Vector Machine (SVM) and K-Nearest Neighbors (KNN) both in accuracy and by setting higher standards in precision, recall and F1 score. Regarding the analysis of the impact of the quantum circuit depth, the study establishes that deeper circuits perform better with $p = 4$. Further, incorporating greater sub-sets of sensors also improves the model returns, though at a higher rate of computation. Nevertheless, the improvement in the performance makes the applicability of QAOA in processing of dynamic data relevant. The presented results underscore the benefits of applying QML/ANN hybrid approaches in fine-tuning large-scale real-time systems, particular traffic forecasting.

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