Quantum Technology Initiative Journal Club

Report of Contributions

Contribution ID: **2** Type: **not specified**

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Thursday 11 July 2024 16:00 (50 minutes)

TITLE: On the relation between trainability and dequantization of variational quantum learning models

Link to the paper: https://arxiv.org/abs/2406.07072

ABSTRACT:
The quest for successful variational quantum machine learning (QML) relies on the design of suitable parametrized quantum circuits (PQCs), as analogues to neural networks in classical machine learning. Successful QML models must fulfill the properties of trainability and non-dequantization, among others. Recent works have highlighted an intricate interplay between trainability and dequantization of such models, which is still unresolved. In this work we contribute to this debate from the perspective of machine learning, proving a number of results identifying, among others when trainability and non-dequantization are not mutually exclusive. We begin by providing a number of new somewhat broader definitions of the relevant concepts, compared to what is found in other literature, which are operationally motivated, and consistent with prior art. With these precise definitions given and motivated, we then study the relation between trainability and dequantization of variational QML. Next, we also discuss the degrees of "variationalness" of QML models, where we distinguish between models like the hardware efficient ansatz and quantum kernel methods. Finally, we introduce recipes for building PQC-based QML models which are both trainable and nondequantizable, and corresponding to different degrees of variationalness. We do not address the practical utility for such models. Our work however does point toward a way forward for finding more general constructions, for which finding applications may become feasible.

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Session Classification: CERN QTI Journal CLUB