Waiting for QML

Jens Eisert[1]

[1]Freie Universität Berlin, Germanny

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Quantum machine learning promises advantages in machine learning in terms of sample complexity, computational complexity or generalization, and the field has been enjoying substantial progress in the last years. Yet, a core aim - to arrive at quantum algorithms that feature proven separations of quantum over classical learners for practically relevant unstructured data - seems elusive to date. In this talk, we will try to come closer to this aim from a number of different angles. We will see that for the training of classical networks using quantum algorithms [1] and for abstract instances of density modeling [2], separations can be found. At the same time, we will elaborate on obstructions that arise from notions of dequantization in noise-free [3] and non-unital noisy settings [4]. These insights can also be seen as invitations to think outside the box, and we will rethink generalization [5] and look at instances of explainable quantum machine learning [6] or single-shot quantum machine learning [7].

[1] Nature Comm. 15, 434 (2024).
[2] Phys. Rev. A 107, 042416 (2023).
[3] arXiv:2309.11647 (2023).
[4] arXiv:2403.13927 (2024).
[5] Nature Comm. 15, 2277 (2024).
[6] In preparation (2024).
[7] arXiv:2404.03585 (2024).