Computational speedups and learning separations in quantum machine learning

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Propositions

accompanying the thesis

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1. A generalization of the Betti number problem is as hard as simulating the one clean qubit model of quantum computation, which is widely believed to require superpolynomial time on a classical computer. [Chapter 3].

2. The rank and Frobenius norm of the observables used in quantum linear classifiers are important quantities for implementing structural risk minimization [Chapter 4].

3. Reinforcement learning agents based on parameterized quantum circuits can efficiently learn how to navigate certain environments, exponentially surpassing the capabilities of agents based on classical machine learning models [Chapter 5].

4. There are several examples of exponential separations between classical and quantum learners in computational learning theory, each relying on the difficulty of different tasks demanded of the learner [Chapter 6].

5. Quantum machine learning excels in scenarios where data is generated by quantum processes, presenting a promising avenue for applications of quantum-enhanced machine learning.

6. The advancement of quantum computing not only challenges our understanding of computation in general, but also has the potential to expand our knowledge of classical models of computation.

7. The practical success of neural networks often eludes concise theoretical explanations.

8. The advent of larger quantum computers will spur extensive empirical research in quantum machine learning, which will constitute a significant driving force for advancing the field.

9. Everything is plenty for those not expecting much.

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