Quantum methods for machine learning and classical dynamics

Barthe, A.M.

Stellingen

Behorende bij het proefschrift
"Quantum methods for machine learning and classical dynamics"

1. (Chapter 3) Parameterized quantum circuits with repeated encodings yield models with a finite Fourier representation and an inductive bias that favors lower frequencies.
2. (Chapter 4) Expectation value samplers constitute universal generative models for continuous multivariate distributions, including fully independent ones, but are more ressource efficient for highly correlated distributions.
3. (Chapter 5) Any BQP-complete problem that admits a compilation as a Parameterized quantum circuit yields a concept class with a quantum learning advantage, this includes learning tasks over exponentially large classical systems.
4. (Chapter 6) In the Koopman Von Neumann formulation, simulating classical dynamics naturally evolves distribution over solutions, rather than individual trajectories. Its implementation on a continuous variable quantum computer avoids truncation errors.
5. (Chapter 7) Simulating Gaussian bosonic circuits on exponentially many modes is BQP-complete, and adding a layer of squeezing elevates the complexity to PostBQP-hard.
6. How the complexity of simulating classical systems can be related to quantum complexity classes such as BQP, QMA and PostBQP is fundamentally interesting and a pratically relevant question.
7. Provable advantages, whether for computational or learning tasks, are unlikely to be realized on NISQ hardware and will likely require fault-tolerant quantum computers.
8. The challenges faced by variational algorithms should not lead us to discard parametrised quantum circuits, as a versatile modeling and compilation primitive they merit continued study.
9. Public engagement is integral to science, a scientist serves society by communicating her research with clarity and care.

Alice Barthe
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