QML project

Ludovico Venturi

2024-02-08

Table of contents

Chapter 1

Introduction

1.1 Barren Plateaus

- Random circuits are often proposed as initial guesses for exploring the space of quantum states
- The exponential dimension of Hilbert space and the gradient estimation complexity … on more than a few qubits
- For a wide class of PQCs, the probability that the gradient along any reasonable direction is non-zero to some fixed precision is exponentially small as a function of the number of qubits[1]

1.1.1 Barren Plateaus on QCNNs

- The variance of the gradient vanishes no faster than polynomially[2] so QCNNs do not exhibit *barren plateaus*.
- It is guaranteed that randomly initialized QCNNs are trainable, unlike many other QNN architectures.

References

1. McClean, J. R., Boixo, S., Smelyanskiy, V. N., Babbush, R. & Neven, H. Barren plateaus in quantum neural network training landscapes. *Nat. Commun.* **9**, 1–6 (2018).
2. Pesah, A. *et al.* Absence of Barren Plateaus in Quantum Convolutional Neural Networks. *Phys. Rev. X* **11**, 041011 (2021).