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Mitigation of the barren plateaus through a Multilayer Variational Quantum Circuit

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We present a Multilayer Variational Quantum Circuit (MLVQC) classifier designed to address the challenges of barren plateaus in quantum neural network training. Our approach builds upon the concept of Variational Quantum Circuits (VQC), which are promising candidates for hybrid quantum-classical computations, particularly under the constraints of noisy intermediate-scale quantum (NISQ) devices. We leverage the multilayer architecture to mitigate the effects of barren plateaus, which are known to hinder optimization in high-dimensional quantum systems. We evaluated the performance of the proposed Multilayer VQC on benchmark datasets, including MNIST, FashionMNIST, and CIFAR-10. Our results demonstrate that incorporating normalization techniques significantly reduces the occurrence of barren plateaus, allowing for more effective training of the quantum model. Additionally, our experiments show that careful design of measurement and normalization strategies can further improve the accuracy and stability of the quantum classifier. This work contributes to the ongoing effort to enhance the scalability of variational quantum algorithms by addressing fundamental challenges, thereby advancing the applicability of quantum machine learning.

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