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Parametrized quantum circuits for reinforcement learning

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Research on quantum computing is still in its infancy, but it has a lot of potential uses. One topic with potential is machine learning, namely in the field of reinforcement learning. This work examines the integration of parametrized quantum circuits (PQC) into reinforcement learning (RL) algorithms, assessing the potential of quantum-enhanced models to solve classical RL tasks. It closely follows the example found on the TensorFlow website. This paper reviews applications of quantum reinforcement learning (QRL). We examine PQCs in a standard RL scenario, the CartPole-v1 environment from Gym, using TensorFlow Quantum and Cirq, to evaluate the relative performance of quantum versus conventional models. In comparison to conventional deep neural network (DNN) models, PQCs show slower convergence and higher processing needs, even if they are still able to learn the task and perform competitively. After they are fully trained, the quantum models show unique difficulties during the early training stages and reach a performance stability level like classical methods. This study sheds light on the present constraints as well as possible uses of quantum computing in reinforcement learning, particularly in situations with intricate, high-dimensional settings that prove difficult for classical computers to handle effectively. As we look to the future, we suggest that investigating hybrid quantum-classical algorithms, developing quantum hardware, and using quantum RL for increasingly difficult tasks are essential first steps. The study presents findings from both a classical reinforcement learning algorithm and a quantum integrated reinforcement learning algorithm. To provide a reliable comparison between quantum reinforcement algorithms and their classical equivalents, further work remains. This work lays the groundwork for future advances in the field by investigating the viability and use of quantum algorithms in reinforcement learning, even if it is not particularly unique. The purpose of this work is to help newcomers to this emerging field of study.