

Q-learning for square lattice Ising model

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The exponentially large degrees of freedom of quantum many-body systems make them difficult to simulate using computational approaches. Machine learning provides new opportunities to tackle the curse of dimensionality in quantum many-body problems. We use the Q-learning [1] algorithm to study periodic Ising model on the 2-dimensional square lattice. In experiments on 2 by 2 and 4 by 4 lattices, the agent predicts correct antiferromagnetic ground states using Q-table. The learned Q-table has higher Q values for the degenerated ground states. We also implemented and tested the algorithm using Deep Q Network. We found some hyperparameters leading to stable learning curves and correct ground states. The results are compared and discussed.

[1] Richard S. Sutton and Andrew G. Barto. 2018. Reinforcement Learning: An Introduction. A Bradford Book, Cambridge, MA, USA.

