Tensor-Networks-based Learning of Probabilistic Cellular Automata Dynamics

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Algorithms developed to solve many-body quantum problems, like tensor networks, can turn into powerful quantum-inspired tools to tackle problems in the classical domain. In this work, we focus on matrix product operators, a prominent numerical technique to study many-body quantum systems, especially in one dimension. It has been previously shown that such a tool can be used for classification, learning of deterministic sequence-to-sequence processes and of generic quantum processes. We further develop a matrix product operator algorithm to learn probabilistic sequence-to-sequence processes and apply this algorithm to probabilistic cellular automata. This new approach can accurately learn probabilistic cellular automata processes in different conditions, even when the process is a probabilistic mixture of different chaotic rules. In addition, we find that the ability to learn these dynamics is a function of the bit-wise difference between the rules and whether one is much more likely than the other.

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