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Reducing Systemic Risk in a Multi-Layer Network Using Reinforcement Learning

Inter-bank lending relationships are an essential part of a working financial system. However, in the case of an extreme economic shock, lending relationships act as a mechanism for contagion. Here, we use reinforcement learning as a method to reduce the systemic risk of a financial network by modifying the lending relationships. We model a financial network as a multi-layered complex network where the nodes represent banks and the directed edges represent their lending relationships. We use deep deterministic policy gradient (DDPG), a model-free off-policy learning algorithm to reconfigure the simulated network. For the purpose of measuring the systemic risk of the network we consider its DebtRank, the potential economic loss of the network due to the economic shock experienced by individual banks. In the multi-layered network case we use an extension of the DebtRank by incorporating the level of distress from other layers of the network.