



PROJECT REPORT

ANALYSIS OF THE EFFECT OF LEARNING PARAMETER CONFIGURATION ON THE Q-LEARNING ALGORITHM USING THE SELF-PLAY MECHANISM FOR THE NINE MEN'S MORRIS GAME

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ABSTRACT

The development of Artificial Intelligence (AI), especially Reinforcement Learning (RL), has encouraged the development of intelligent agents capable of learning decision-making strategies independently through interaction with the environment. One of the challenges in implementing Q-Learning is determining the configuration of learning parameters that can produce a stable training process and good agent performance. This study aims to implement the Q-Learning algorithm in the Nine Men's Morris game using a self-play mechanism and analyze the effect of the learning parameter configuration on the stability of the training process and agent performance. The method used is Q-table-based Q-Learning with a training process of 5.000 episodes. Several learning parameter configurations are compared using the Self-Play Win Rate, Random Opponent Win Rate, and changes in the epsilon value metrics to determine the best model. The final model uses a learning rate of 0.05, a discount factor of 0.99, an initial epsilon of 1.0, a minimum epsilon of 0.05, and an epsilon decay of 0.9995. The results showed that the final model produced a relatively stable Self-Play Win Rate in the range of 40.2% to 41.3%, while the Random Opponent Win Rate was in the range of 37.5% to 46.5%. In addition, the training process produced a Q-table that stored 429,394 state-action pairs with a maximum Q-value of 56.6523. These results indicate that the Q-Learning algorithm with a self-play mechanism is able to learn the Nine Men's Morris game strategy, while the selection of learning parameter configurations has an impact on the stability of the training process and the agent's performance when evaluated using a random opponent.

Keyword: Q-Learning, Reinforcement Learning, Nine Men's Morris, Self-Play