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Deep Reinforcement Learning Approach for Trading Automation in The Stock Market

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Abstract : The design of adaptive systems that take advantage of financial markets while reducing the risk can bring more stagnant wealth into the global market. However, most efforts made to generate successful deals in trading financial assets rely on Supervised Learning (SL), which suffered from various limitations. Deep Reinforcement Learning (DRL) offers to solve these drawbacks of SL approaches by combining the financial assets price "prediction" step and the "allocation" step of the portfolio in one unified process to produce fully autonomous systems capable of interacting with its environment to make optimal decisions through trial and error. In this paper, a continuous action space approach is adopted to give the trading agent the ability to gradually adjust the portfolio's positions with each time step (dynamically re-allocate investments), resulting in better agent-environment interaction and faster convergence of the learning process. In addition, the approach supports the managing of a portfolio with several assets instead of a single one. This work represents a novel DRL model to generate profitable trades in the stock market, effectively overcoming the limitations of supervised learning approaches. We formulate the trading problem, or what is referred to as The Agent Environment as Partially observed Markov Decision Process (POMDP) model, considering the constraints imposed by the stock market, such as liquidity and transaction costs. More specifically, we design an environment that simulates the real-world trading process by augmenting the state representation with ten different technical indicators and sentiment analysis of news articles for each stock. We then solve the formulated POMDP problem using the Twin Delayed Deep Deterministic Policy Gradient (TD3) algorithm, which can learn policies in high-dimensional and continuous action spaces like those typically found in the stock market environment. From the point of view of stock market forecasting and the intelligent decision-making mechanism, this paper demonstrates the superiority of deep reinforcement learning in financial markets over other types of machine learning such as supervised learning and proves its credibility and advantages of strategic decision-making.

Keywords : the stock market, deep reinforcement learning, MDP, twin delayed deep deterministic policy gradient, sentiment analysis, technical indicators, autonomous agent
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