

Stock Price Prediction Using Q-learning

PADAMATA KANISHKA SAI

200001058

CS432

Reinforcement Learning Course Project
IIT INDORE

Submitted To: Dr. Surya Prakash

EMAIL : cse200001058@iiti.ac.in

PROJECT PROPOSAL

Abstract:

This project investigates the effectiveness of Q-learning, a reinforcement learning (RL) algorithm, for predicting stock price movements. It will utilize historical closing prices to train a Q-learning agent to make "buy" or "sell" decisions, aiming to maximize profits within a simulated trading environment.

Objectives:

- Train a Q-learning agent on historical closing stock prices obtained from Yahoo! Finance.
- Design a reward function that incentivizes the agent to make profitable trading decisions.
- Evaluate the agent's performance on unseen test data, comparing its profitability with a buy-and-hold baseline strategy.
- Analyze the strengths and weaknesses of Q-learning for stock prediction.
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Dataset Information:

- *Source:* The project will utilize publicly available daily closing price data for a chosen stock from Yahoo! Finance in CSV format
- *Structure:* Each row represents a day, with columns for Date, Open, High, Low, Close, Adj Close, and Volume.
- The data will be preprocessed to create a suitable state representation for the Q-learning agent (e.g., n-day windows of closing prices).

Proposed Solution:

1. Environment Design:

- Develop a simulated trading environment where the agent observes historical closing prices for a defined window size.
- Actions available to the agent are "buy", "sell", or "hold".

2. Q-Learning Agent:

- Implement a Q-learning algorithm where the agent learns a Q-value for each state-action pair.
- The Q-value represents the expected future reward for taking a specific action in a given state.

3. Reward Function:

- Design a reward function that penalizes the agent for losses and rewards it for profitable trades.
- The reward function should consider transaction costs and holding times to reflect realistic trading scenarios.

4. Training:

- Train the Q-learning agent through trial and error, allowing it to learn and improve its trading decisions over time.
- Utilize techniques like experience replay to improve the agent's learning efficiency.
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Performance Metrics:

- **Total Profit:** The cumulative profit earned by the agent over the test period.
- **Sharpe Ratio:** A risk-adjusted performance measure that compares the agent's returns to the risk-free rate.
- **Win Rate:** The percentage of trades where the agent makes a profitable decision.
- **Comparison with Baseline:** Compare the agent's performance metrics with a simple buy-and-hold strategy to assess its effectiveness.

Expected Outcome:

This project aims to demonstrate the potential of Q-learning for short-term stock prediction. By analyzing the results and limitations of the agent, we can gain insights into the suitability of RL for stock market applications.