CS 584 Intermediate Project Report
Group 19

Project Title:

Finance Trading using Single-Agent Reinforcement Learning with Double Deep Q-Learning(DDQL): An Exploration of Bullish and Bearish Engulfing Candlestick Patterns

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Introduction:

This report documents the ongoing progress of a project aimed at developing a finance trading strategy using reinforcement learning, with a focus on the stock of Tata Consultancy Services (TCS) from NSE India during 2004-2014. The strategy employs a Single-Agent Reinforcement Learning model, specifically a Double Deep Q-Learning (DDQL) algorithm, to navigate and profit from the stock market.

Problem Description:

The project focuses on using single-agent reinforcement learning to develop a trading strategy in the finance domain, specifically targeting stock trading. The goal is to create an intelligent agent that learns to make trading decisions based on historical market data and predefined rules, incorporating technical indicators such as weighted moving averages and candlestick patterns.

The agent will be trained using Double Deep Q-Learning (DDQL) algorithm, a variant of deep reinforcement learning suitable for sequential decision-making tasks with large action spaces. In particular, the agent will be trained to recognize and act upon bullish and bearish engulfing candlestick patterns, which are widely recognized as strong reversal signals in technical analysis.

We aim to leverage the power of reinforcement learning, specifically Double Deep Q-Learning, to develop a robust trading strategy capable of identifying and exploiting profitable opportunities in financial markets. Our focus is on incorporating domain-specific knowledge, such as candlestick patterns and trend analysis, into the reinforcement learning framework to enhance the agent's decision-making capabilities.

We are designing a custom reward function that incentivizes the agent to make profitable trades while penalizing losses, thereby encouraging risk management and prudent trading behavior. Additionally, we are integrating rules based on technical analysis principles, such as identifying bullish and bearish engulfing candlestick patterns, to guide the agent's actions in different market scenarios.

Progress Overview:

1. **Data Collection and Preprocessing:**
    - Historical market data for TCS was gathered, featuring daily intervals and including attributes like 'OPEN', 'HIGH', 'LOW', 'PREV. CLOSE', 'ltp', 'close', 'vwap', '52W H', '52W L', 'VOLUME', 'VALUE'.
    - Data was preprocessed for compatibility with the learning model, involving normalization and data structuring.

2. **DDQL Agent and Environment Development:**
    - The DDQL Agent class was created, integrating a neural network with LSTM layers, dropout, and regularized to process sequential data and avoid overfitting.
    - A Trading Environment class was established to simulate market dynamics, facilitating interaction with the DDQL agent and implementing reward mechanisms based on the agent's trading actions.

3. **Training and Model Development:**
    - The DDQL agent training was initiated with the preprocessed data. The agent's task involves making decisions based on market data, focusing on recognizing bullish and bearish engulfing candlestick patterns, a key aspect of our trading strategy.

Current Achievements:

- **Data Collection:**

  Historical market data for TCS from 2004 to 2023 has been collected. Currently we are using data from 2004 – 2014 for model building in order to understand model performance using the available resources.

- **Model Architecture:**

  Successfully developed a DDQL agent with a robust neural network architecture designed for financial data analysis.

- **Pattern Recognition:**

  The agent's ability to identify engulfing candlestick patterns is promising, a crucial element in predicting market movements.

- **Reward System:**

  Implemented a reward system that effectively penalizes illegal actions (like selling without holding stock) and incentivizes profitable trading behavior.

Challenges and Solutions:

- **Complex Market Dynamics:**

  Addressing the unpredictable nature of financial markets, the project utilized LSTM layers to better capture temporal dependencies in market data.

- **Action Space Management:**

  The environment's design includes logic to penalize invalid actions, thereby guiding the agent towards more strategic decision-making.

Next Steps:

1. **Extended Training and Optimization:**

   Continued training of the agent is planned to refine its decision-making and recognition of market patterns.

2. **Comprehensive Performance Evaluation:**

   The agent's performance will be rigorously evaluated on historical and unseen data to ensure its robustness and reliability in various market conditions.

3. **Refinement and Tuning:**

   Further adjustments to the model parameters and reward strategy will be executed for optimal performance and adaptation to market changes.

4. **Detailed Analysis and Reporting:**

   An in-depth analysis of the trading strategy's effectiveness will be conducted, focusing on profitability and adaptability.

Conclusion:

This project represents applying advanced machine learning techniques, particularly reinforcement learning, to the field of finance. The DDQL agent's development and initial training have shown potential in navigating the complexities of stock market trading. The project's future phases aim to solidify this potential into a reliable and profitable trading strategy.