Proposal for Additional Semester: Software Development, Experiments, and Results

The project focuses on developing a data-driven system using advanced machine learning and reinforcement learning (RL) algorithms to optimize trading strategies to maximize returns on a stock. During the initial phases, foundational models such as LSTM, ARIMA, and traditional momentum-based methods (e.g., Moving Averages, RSI) were implemented to establish a baseline. Additionally, RL algorithms, including Deep Q-Learning (DQN) and REINFORCE, were explored to enable autonomous decision-making in trading environments. All the deliverables will be executed and implemented by me alone as I am not a part of a group.

This additional semester aims to expand the project by refining the core models, conducting in-depth experiments, and implementing a user-friendly system. Following are the things that will be developed in the upcoming semester:

**Software Development**

**Advanced Model Integration**:

* **Hybrid Models**: Develop hybrid models that combine machine learning (ML) and RL techniques. For instance, integrate LSTM and attention mechanisms with RL models like PPO (Proximal Policy Optimization) to enhance prediction accuracy.
* **Enhanced Feature Engineering**: Implement additional feature engineering pipelines that incorporate alternative data sources such as social sentiment, economic indicators, and news to enrich the training dataset and improve data quality.
* **Portfolio Optimization Module**: Build a module to optimize portfolio allocation based on expected returns and risk metrics, using algorithms such as Modern Portfolio Theory (MPT) and Monte Carlo simulations.

**User Interface Development**:

* Design and implement a web-based dashboard for end-users to interact with the trading model. The interface will include visualizations of model predictions, back test results, and performance metrics. A framework is already implemented, build on that to make it detailed.

**Experiments**

**Optimization of Hyperparameters**:

* + Conduct hyperparameter tuning for ML and RL models using Bayesian optimization and other techniques to identify the optimal parameters that maximize model performance.
  + Experiment with varying the lookback periods, batch sizes, learning rates, and hidden layer configurations to fine-tune both ML and RL models.

**A/B Testing of RL Algorithms**:

* Compare the performance of different RL algorithms (e.g., DQN, Reinforce, PPO) under same market conditions to identify the best-performing approach.

**Results**

**Enhanced Model Performance:**

* Achieve improved predictive accuracy and risk-adjusted returns by incorporating optimized features and models. Performance gains will be benchmarked against initial baselines.

**User-Friendly Interface:**

* Deliver an interactive, data-driven interface that empowers users to make informed decisions based on model predictions and risk metrics.
* Provide comprehensive visualizations and insights, making the trading system accessible to both novice and experienced users.

**Submit Research to Conferences**

* Submit preliminary results to IJCNN 2025, deadline Jan 15, 2025
* Aim to submit capstone results to research conferences ICCS 2025 and/or Descience 2025 to publish paper.

**Conclusion**

The additional semester will build on the project’s initial progress by enhancing model accuracy, adaptability, and usability. Through advanced experiments, new features, and a user interface, the project will produce a high-performance trading platform suitable for research and potential real-world application. These deliverables will contribute significantly to understanding how machine learning and reinforcement learning can optimize financial trading in complex, real-time environments.