NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE | College of Computing and Data Science

Interpretable Stock Market Trading

Fuzzified Stock Market Forecasting With Transformer Networks and Adaptive Portfolio Management Using Reinforcement Learning

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Abstract:

This project proposes a novel approach to stock prediction and portfolio management by combining deep learning, fuzzy logic, and reinforcement learning. A large-scale comparison of clustering algorithms for fuzzification is performed to determine the optimal interpretable Transformer network for forward returns prediction. The Advantage Actor-Critic (A2C) model is used to dynamically optimise asset allocation based on predicted prices in custom-built reinforcement learning environments. Results demonstrate the proposed model outperforms traditional methods in stock forecasting and portfolio optimization and further benefits from proper reward engineering techniques, delivering better risk-adjusted returns.

Motivation:

The increasing complexity of financial markets and the explosive growth of data necessitate advanced methods for stock price prediction and portfolio management. Traditional approaches often struggle to adapt to the intricate dynamics of modern markets while most black box deep learning techniques lack transparency.

Methodology:

- Select and preprocess stock universe
- Apply clustering algorithms to fuzzification
- Assess fuzzification techniques with Transformer
- Tune Transformer network with genetic algorithm
- Utilise best network to create trading signals
- Allocate assets with A2C based on signals

Results:

HDBSCAN emerged as the most effective clustering method when combined with the Transformer network, achieving high accuracy in predicting stock returns up to 13 days ahead. The A2C model excelled in portfolio allocation, achieving a Sharpe Ratio of 0.93, 0.91, and 1.19 in a long-only portfolio, long-short portfolio, and with reward-engineering.

Performance of A2C model for portfolio management in long-only environment compared against benchmarks

Performance of A2C model for portfolio management in long-short environment with reward engineering