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APPLICATION OF EXTREME LEARNING MACHINE AUTOENCODER FOR FINANCIAL TIME SERIES DATA

Abstract: This paper explores the application of Extreme Learning Machine Autoencoder (ELM-AE) for the prediction of financial time series data, with a focus on cryptocurrency markets. Extreme Learning Machines (ELMs) offer fast training speeds and strong generalization capabilities, making them well-suited for modeling complex, non-linear financial data. By integrating an autoencoder architecture, the model effectively extracts meaningful features from noisy and high-dimensional financial datasets. We present a practical implementation of ELM-AE for predicting Bitcoin price movements, leveraging historical price data, technical indicators, and relevant market features. The proposed model is evaluated using performance metrics such as Mean Squared Error (MSE) and directional accuracy, demonstrating its effectiveness in capturing market trends. Additionally, we develop a software prototype that visualizes the prediction process, providing an interactive demonstration of Bitcoin price forecasting.

Keywords: Extreme Learning Machine, Autoencoder, Financial Time Series, Bitcoin Prediction, Machine Learning, Cryptocurrency Forecasting.

INTRODUCTION

Financial time series prediction is a challenging yet critical task in quantitative finance, algorithmic trading, and risk management. The inherent noise, non-linearity, and volatility of financial markets—particularly in cryptocurrency assets like Bitcoin—make traditional statistical models often inadequate. Machine learning techniques have gained prominence in this domain due to their ability to capture complex patterns in high-dimensional data. Among these techniques, Extreme Learning Machines (ELMs) have emerged as an efficient alternative to traditional

neural networks, offering rapid training speeds and strong generalization performance without the need for iterative tuning.

Autoencoders, a type of neural network used for unsupervised feature learning, can enhance predictive models by reducing noise and extracting meaningful representations from raw financial data. By combining the strengths of ELMs with the feature extraction capabilities of autoencoders, the Extreme Learning Machine Autoencoder (ELM-AE) presents a promising approach for financial forecasting. This hybrid model leverages the fast training of ELMs while benefiting from the dimensionality reduction and noise resilience of autoencoders.

In this paper, we investigate the application of ELM-AE to Bitcoin price prediction, a particularly volatile and high-frequency financial time series. Bitcoin's decentralized nature, susceptibility to speculative trading, and sensitivity to macroeconomic factors make it an ideal candidate for testing advanced forecasting models. We implement a software framework that demonstrates the ELM-AE's predictive capabilities, using historical price data, technical indicators, and market sentiment features. Our experiments evaluate the model's accuracy in directional prediction and volatility estimation, comparing its performance against traditional machine learning approaches.

RESULTS

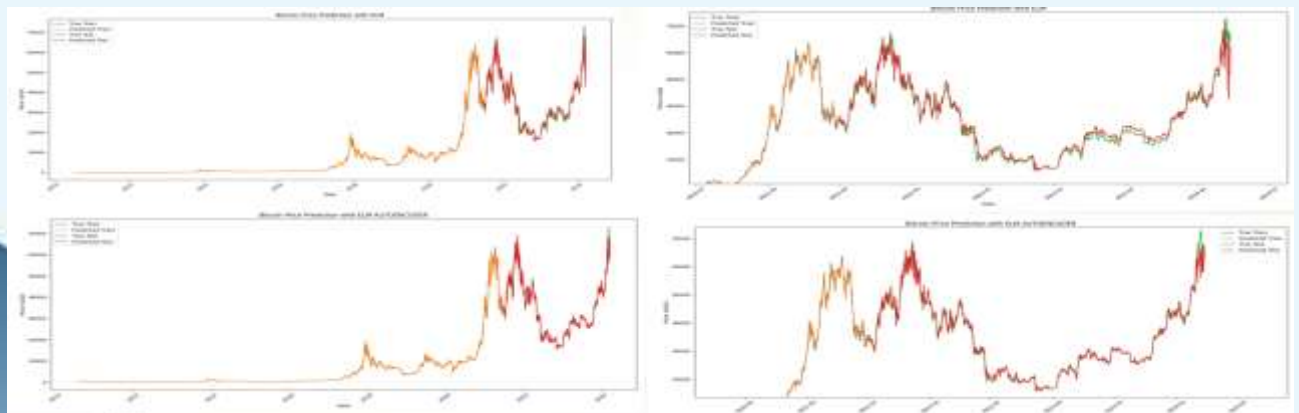


Fig.1. Comparison between ELM and ELM-AE

CONCLUSION

In this paper, we explored the application of the Extreme Learning Machine Autoencoder (ELM-AE) for financial time series prediction, with a focus on Bitcoin price forecasting. The proposed model leverages the fast training and generalization

capabilities of ELMs while incorporating the feature extraction and noise-reduction benefits of autoencoders. Our experiments demonstrated that ELM-AE can effectively capture nonlinear patterns in volatile cryptocurrency markets, achieving competitive predictive accuracy compared to traditional machine learning approaches.

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