

# Applying Recurrent Neural Network to predict forex prices for retail traders: High-Frequency directional trading approach

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**Abstract** – This research explores the application of Long Short-Term Memory (LSTM) architectures within Recurrent Neural Networks (RNNs) for predicting forex prices in a high-frequency trading context tailored for retail traders. It addresses a significant gap in literature regarding the accessibility of sophisticated predictive tools for individual traders. The study developed and evaluated two LSTM-based models, with Model 1, optimized through random search, demonstrating superior performance over Model 2, despite both models showing poor R-squared values. The findings highlight the potential of well-optimized LSTM models to capture short-term price movements, and suggesting future exploration of hybrid modeling and real-time implementation strategies.

## 01 Introduction

Asset classes are key categories of financial instruments, including equities, and alternative assets like currencies and commodities. This study focuses on currencies, which serve as mediums of exchange, with major examples being the US Dollar, British Pound, and Euro. The rise of digital currencies has added volatility to the Foreign Exchange Market (FOREX), where currency pairs are traded based on their relative values [1]. The research emphasizes High-Frequency Trading (HFT), which uses advanced algorithms for rapid trade execution through Machine Learning (ML) techniques to improve trading strategies [2].

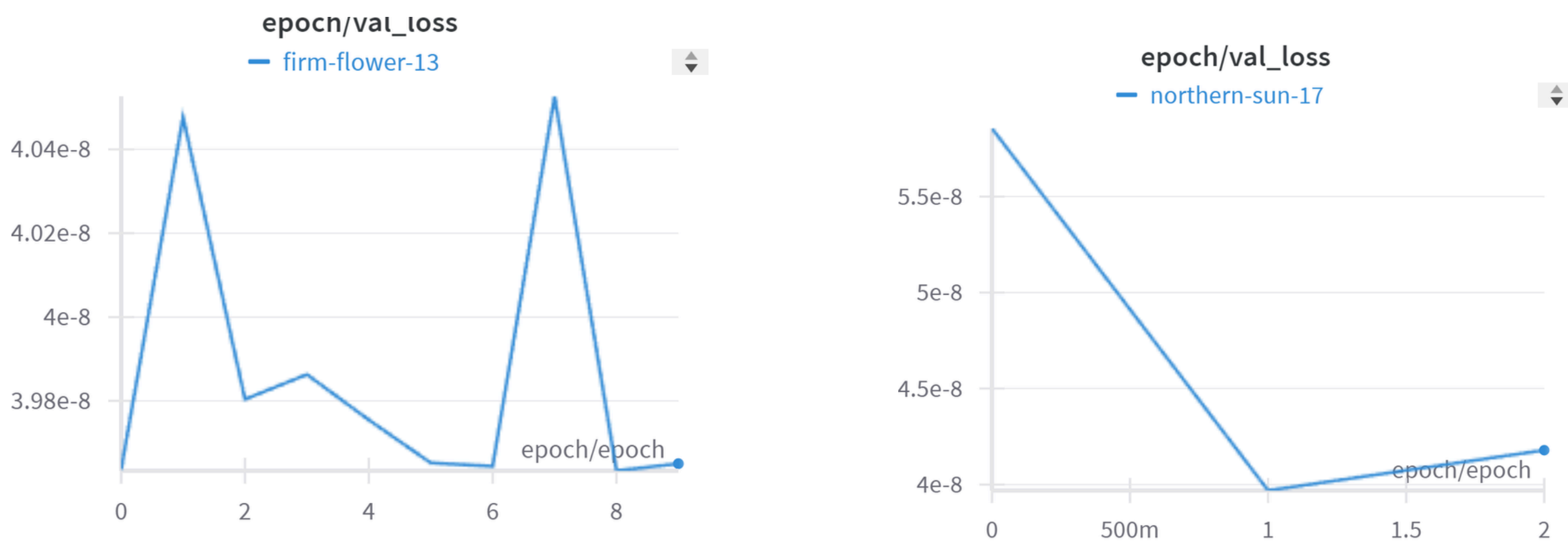
## 02 Problem & Objective

- This research addresses the significant lack of studies on HFT specifically for retail traders, who face unique challenges in accessing advanced trading technologies and market data compared to institutional traders.
- The objective is to design and implement a Recurrent Neural Network model that accurately predicts short-term one-minute forex price movements for retail traders.

## 03 Methodology

- Model Development
  - Developed two LSTM-based RNN models
- Data Collection
  - Retrieved historical high-frequency forex price movements and engineered indicators.
- Model Optimization
  - Model 1 – random search technique.
  - Model 2 – based on established literature and empirical methods.
- Performance Evaluation
  - Test loss
  - Mean Absolute Error (MAE)
  - Root Mean Squared Error (RMSE)
  - Analyzed R-squared values to evaluate model fit.

## 04 Analysis



The validation loss on model 1 (on the left) exhibited fluctuating behavior which started by increasing from epoch 1, while on model 2 (on the right) went down to its minimum on epoch 1.

## 05 Results/Findings

Main findings on model training and performance:

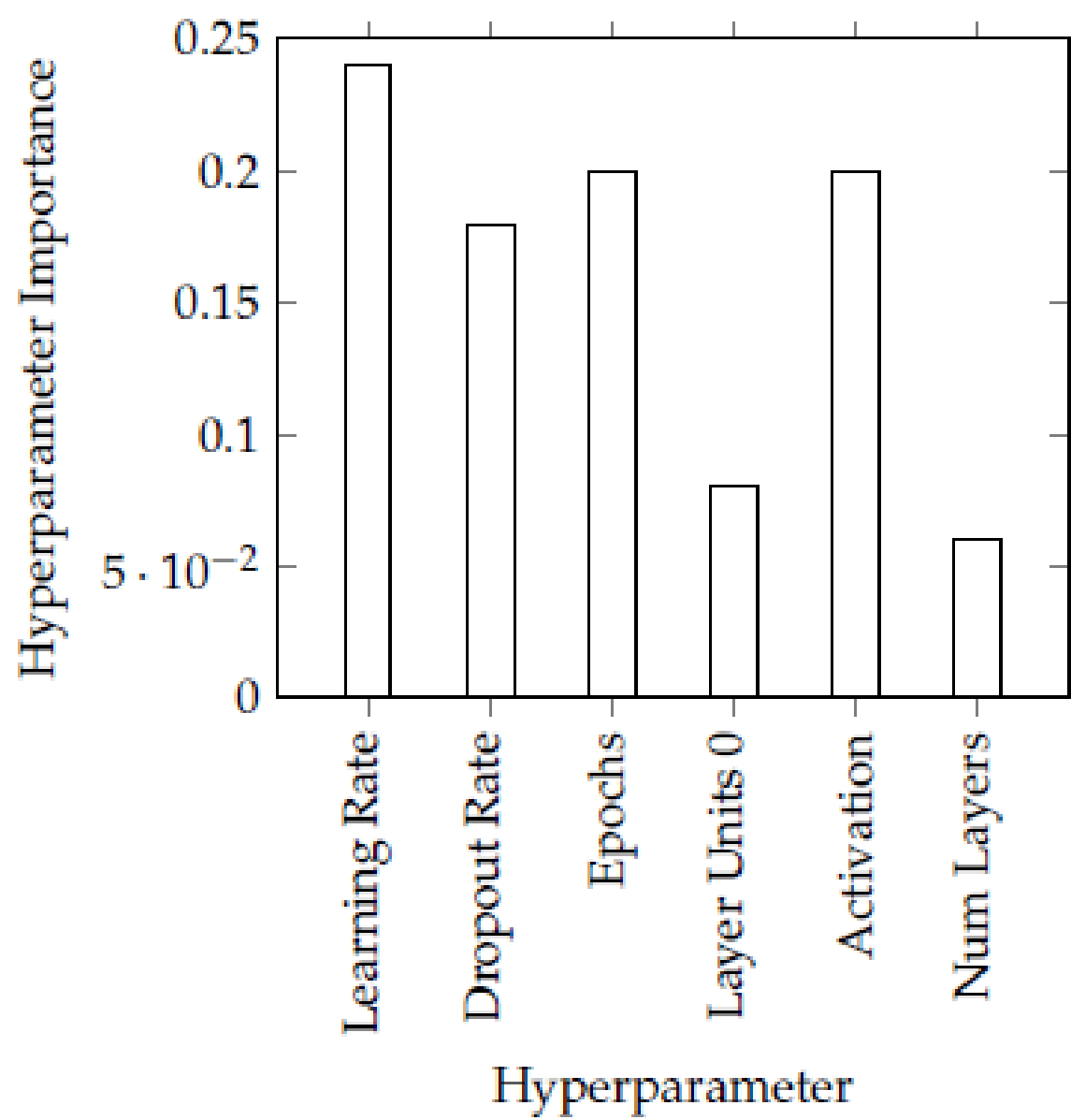
- Two LSTM-based models were developed: Model 1 (deeper, hyperparameter-optimized) and Model 2 (simpler, trial-and-error based). Model 1 outperformed Model 2 in terms of validation loss and other metrics.
- Training metrics showed Model 1 achieved lower test loss ( $3.97e-08$ ) and MAE ( $1.16e-04$ ) compared to Model 2, but both models had poor R-squared values, indicating limited explanatory power.

Main findings on Hyperparameter Tuning and evaluation:

- Random search revealed learning rate as the most critical hyperparameter for model performance.
- Model 1's deeper architecture and optimized parameters were more effective, but both models showed room for improvement in capturing variance in the target variable.

## 06 Conclusion

Model 1 outperformed Model 2 across various performance metrics, underscoring the significance of hyperparameter tuning and the potential for machine learning techniques to democratize access to advanced trading strategies. Future research should explore hybrid models that integrate LSTMs with other machine learning methods, assess real-time implementation in live trading scenarios, and investigate scalability across different asset classes to enhance understanding of machine learning applications in finance.



Learning rate came out as the most important hyperparameter, whereas number of layers came last.

### References

- [1] ERIK PAULSON et al. "Trading, Investment and Portfolio Management". PhD thesis. WORCESTER POLYTECHNIC INSTITUTE, 2017.
- [2] Peer Nagy, Jan-Peter Calliess, and Stefan Zohren. "Asynchronous Deep Double Dueling Q-learning for trading-signal execution in limit order book markets". In: Frontiers in Artificial Intelligence 6 (2023), p. 1151003.