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Applying Predictive Analytics to Financial Markets

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ABSTRACT Within this paper we present a price prediction application that utilizes tick-level price data from financial markets in order to perform predictive analytics by way of machine learning models. The application includes a data importation tool written Python that makes use of both the PyArrow and Pandas libraries in order to import data from both CSV files and Parquet files, which is then both stored in and managed by a MySQL database. Two types of machine learning models are implemented: Long-Short-Term Memory models and transformer models. These models can be trained on specific securities in order to perform predictive analysis. Instances of fully trained models can be saved for each security in the database, where they can be retrieved for future use. This application provides two interfaces: a user interface and an administrator interface. Users are capable of viewing candlestick charts that are formed out of the tick-level price data, and can view the results of the predictive analysis performed by the machine learning models. Administrators can do the same, while also having the ability to initiate training sessions for the models, as well as any required maintainance of the database. With this application prediction future price movements of financial markets can be done simply, quickly, and accurately.

INDEX TERMS TODO

I. INTRODUCTION

IT is generally understood that accurately predicting the future is extraordinarily difficult, if not impossible; however, that hasn't stopped people from trying, especially in regards to financial markets. Of all the research that has been performed on these markets, predicting future price movements has proven to be one of the most challenging problems due to the variables involved, such as market volatility, investor sentiment, and factors external to the financial market, which include the economy, climate, politics, and more. Where simpler models often fall short due to the complexities of financial time series data, machine learning techniques, particularly deep learning, have shown promise. Of the many different types of deep learning models, Gated Recurrent Units (GRU), Long-Short-Term Memory (LSTM), and Transformer models have displayed promising performance, with our application utilizing the latter two. Extensive research has been performed on this subject, which has explored a wide variety of machine learning techniques in order to find those suitable for price prediction. These range from the more classic support vector machines (SVM) all the way to the more advanced neural networks. Studies have proven that using deep learning models for price prediction is effective, while determining which models are the most effective is an ongoing process [1]. Precision price prediction has had it's importance proven via advancements made in algorithmic trading, especially in high-frequency trading, where decisions must be made based on real-time analysis of the market [2]. Further refining the accuracy of price predictions can be done by utilizing tick-level price data, which can capture even the smallest market movements due to it's granularity [3].

Past research has performed comparisons on the performance of GRU, LSTM, and Transformer models in regards to price prediction, with the dataset consisting of Tesla (TLSA) price data ranging from 2015 to 2024. The dataset underwent preprocessing in order to correct for missing values and to normalize price fluctuations, along with other adjustments that allowed for the optimization of training each model. The results of the experiments that were performed showed that LSTM models performed better than both GRU and Transformer models, while Transformers performed the worst out

of the three [1].

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