Predicting Cryptocurrency Price Using RNN and LSTM Method

Dzaki Mahadika Gunarto[1], Siti Sa'adah, S.T., M.T.[2], Dr. Dody Qori Utama, S T., M T.[3]

[1,2,3]School of Computing, Telkom University, Bandung
[1]dzakimahadika@hotmail.com, [2]sitisaadah@telkomuniversity.ac.id,
[3]dodyqori@telkomuniversity.ac.id

Abstract

Cryptocurrency price prediction is a crucial task for financial investors as it helps determine appropriate investment strategies and mitigate risk. In recent years, deep learning methods have shown promise in predicting time-series data, making them a viable approach for cryptocurrency price prediction. In this study, we compare the effectiveness of two deep learning techniques, the Recurrent Neural Network (RNN) and Long-Short Term Memory (LSTM), in predicting the prices of Bitcoin and Ethereum. Results of this research show that the LSTM method outperformed the RNN method, obtaining lower Root Mean Squared Error (RMSE) and Mean Absolute Percentage Error (MAPE) values for predicting both cryptocurrencies. Bitcoin and Ethereum. Specifically, the LSTM model had a RMSE of 0.061 and MAPE of 5.66% for predicting Bitcoin, and a RMSE of 0.036 and MAPE of 4.58% for predicting Ethereum. In this research, we found that the LSTM model is a more effective method for predicting cryptocurrency prices than the RNN model.

Keywords— Cryptocurrency, RNN, LSTM, RMSE, MAPE

Abstrak

Prediksi harga cryptocurrency merupakan tugas yang sangat penting bagi investor keuangan karena dapat membantu menentukan strategi investasi yang sesuai dan mengurangi risiko. Dalam beberapa tahun terakhir, metode deep learning telah menunjukkan potensi dalam memprediksi data time-series, sehingga menjadi metode yang layak untuk prediksi harga cryptocurrency. Dalam studi ini, kami membandingkan efektivitas dua teknik deep learning, yaitu Recurrent Neural Network (RNN) dan Long-Short Term Memory (LSTM), dalam memprediksi harga Bitcoin dan Ethereum. Hasil penelitian ini menunjukkan bahwa metode LSTM lebih unggul dibanding metode RNN, dengan nilai Root Mean Squared Error (RMSE) dan Mean Absolute Percentage Error (MAPE) yang lebih rendah untuk memprediksi kedua cryptocurrency tersebut. Bitcoin dan Ethereum. Secara spesifik, model LSTM memiliki nilai RMSE sebesar 0,061 dan MAPE sebesar 5,66% untuk memprediksi Bitcoin, serta nilai RMSE sebesar 0,036 dan MAPE sebesar 4,58% untuk memprediksi Ethereum. Dalam penelitian ini, kami menemukan bahwa model LSTM merupakan metode yang lebih efektif untuk memprediksi harga cryptocurrency dibanding model RNN.

Kata Kunci— Cryptocurrency, RNN, LSTM, RMSE, MAPE

1. Introduction

1.1. Background

Cryptocurrencies are digital or virtual currencies that are used to exchange and transfer assets digitally. They use cryptography to ensure the secure transfer of assets, to regulate the creation of new cryptocurrencies, and to protect the integrity of transactions [1], [2]. This blockchain-based digital currencies have experienced significant fluctuations in value in recent years [3]. Cryptocurrency tokens, which are based on blockchain

technology, can represent a variety of physical and non-physical assets, such as financial instruments, stocks, and bonds. They have been widely adopted in various fields. A key aspect of studying the behavior of cryptocurrency tokens is the ability to model and forecast their pricing [4]. An essential component of researching the behavior of cryptocurrency tokens is the modeling and prediction of their prices [5].

In recent years, deep learning techniques have been applied to time-series prediction problems in various fields, including the cryptocurrency market [6]–[10]. These methods have been shown to be effective in improving the accuracy of time-series predictions in real-world applications. For example, in a study by [11], the Autoregressive Integrated Moving Average (ARIMA) model was used to forecast the future values of Bitcoin prices in R programming language. The results of this study showed that the mean error was less than 6% for most values. In another study, [12] used a Long Short-Term Memory Recurrent Neural Network (LSTM-RNN) model to predict the price of Bitcoin. The LSTM-RNN model was found to perform better than a traditional neural network model, and the RMSE was 0.14. Recent research on time-series prediction using RNN and LSTM networks has shown promising results in a variety of applications. However, a gap in the literature is the lack of direct comparison between the performance of RNN and LSTM methods on the same task. Many studies have employed one method or the other, but a comprehensive analysis of how these two types of models compare in terms of accuracy and computational efficiency has yet to be conducted.

Based on the research that has been discussed previously, this research will focus on measuring how good RNN and LSTM to predict cryptocurrencies prices and comparing between both methods by measuring evaluation metrics of each of the method. The dataset used in this research is two cryptocurrency datasets taken from the Kaggle page which is Bitcoin daily price and Ethereum daily price from August 8, 2015 until July 6, 2021 [13]. RNN that is used in this research is Simple RNN, while LSTM that is used is the default LSTM. Both methods are able to capture the sequential information and internal characteristics of the trajectories, which is useful for predicting future values [14]. The evaluation metrics of both systems will be measured by using RMSE and MAPE.

1.2. Formulation of Problem

Based on the research that has been discussed previously, this research will focus on measuring how good RNN and LSTM to predict cryptocurrencies prices and comparing between both methods by measuring evaluation metrics of each of the method.

1.3. Purpose

The purpose of this final project is based on the background that has been outlined, which is building a Cryptocurrency price prediction system using Deep Learning approach with the RNN and LSTM method by evaluating the accuracy using RMSE and MAPE. The purpose of this studies also compared the evaluation metrics of both RNN and LSTM method.

2. Related Study

2.1. Recurrent Neural Network (RNN)

RNN are a class of artificial neural networks that are designed to analyze sequential data. These networks are able to maintain an internal state, or memory, which enables them to exhibit temporal dynamic behaviors. RNNs have been widely employed in a variety of applications, including handwriting recognition, speech recognition, and time-series prediction. One of the key advantages of RNNs is their ability to identify patterns within sequences of input data [15]. In this research, we use simple RNN for predicting price of the cryptocurrency. Fig. 1 shows the architecture of simple RNN.

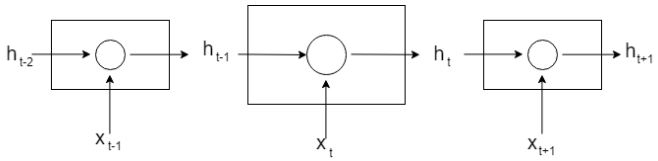

Fig. 1. Architecture of Simple RNN

A simple RNN is essentially a group of individual neural networks that are connected together, with each network transmitting a message to the next. In other words, these networks have a short-term memory that stores knowledge about the data they have seen, but they are unable to maintain long-term time series information [16]. A simple RNN equation is shown in (1):

$$h_t = g\left(W x_t + U_f h_{t-1} + b\right) \qquad (1)$$

From equation above, g(x) represents an activation function, the hyperbolic tangent function, $g(x)$ represents an activation function, the hyperbolic tangent function, $g(x) = \tanh(x)$ is usually used as the