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A Deep Neural-Network Based Stock Trading System Based on Evolutionary Optimized Technical Analysis Parameters

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Abstract

In this study, we propose a stock trading system based on optimized technical analysis parameters for creating buy-sell points using genetic algorithms. The model is developed utilizing Apache Spark big data platform. The optimized parameters are then passed to a deep MLP neural network for buy-sell-hold predictions. Dow 30 stocks are chosen for model validation. Each Dow stock is trained separately using daily close prices between 1996-2016 and tested between 2007-2016. The results indicate that optimizing the technical indicator parameters not only enhances the stock trading performance but also provides a model that might be used as an alternative to Buy and Hold and other standard technical analysis models.

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1. Introduction

Computational Intelligence techniques have been used as part of stock trading systems for some time [1]. Neural networks are among one of the most popular choices. In some studies stock prices were directly used for time series forecasting, but in most cases, technical and/or fundamental analysis indicators were used as features for the neural network models [2-5]. Evolutionary algorithms, mostly genetic algorithms (GA) [6], have been used for constructing profitable trading systems [9,10], mostly for technical analysis optimization[8], or optimizing the neural network that is developed for stock trading [7]. The implementation of genetic algorithms and other evolutionary computation techniques used in financial studies are comprehensively covered in [13]. Meanwhile, combining evolutionary optimized technical analysis indicators as features for a neural network based stock trading model has not been studied extensively.

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In this study we propose a model that combines genetic algorithms and neural networks together in a stock trading system in such a way that, the features that are provided to the neural network are the optimized technical analysis buy-sell trigger points. Our motivation for introducing such a model is to find the best possible distinctive technical analysis parameters as features for a profitable automated stock trading system.

2. Model Feature

In the literature, technical analysis indicators such as Moving Average Convergence and Divergence (MACD), Relative Strength Index (RSI), William % R, Simple Moving Average (SMA) are used to determine the trend direction in the market. In our proposed model, we use RSI for buy-sell points prediction and SMA for trend forecasting.

3.1 Relative Strength Index (RSI)

Relative Strength Index (RSI) is an oscillator type technical analysis indicator that shows the historical strength and weakness of stock prices. RSI values oscillate between 0 and 100. If the value is over 70, the stock is considered to be in the "overbought" region. Meanwhile, if the value is under 30, the stock is assumed to be in the "oversold" region. RSI value also compares losses and gains in a specified time period. RSI value is calculated as illustrated in equations (1) and (2).

$$RSI = 100 - 100 / (1+RS) \qquad (1)$$

$$RS = Average\ Gain\ /\ Average\ Loss \qquad (2)$$

3.2 Simple Moving Average (SMA)

Simple Moving Average (SMA) shows the moving average of the prices for a given period. Mostly, the intersection of the SMA values with different interval values are used to determine the trend direction. If 50-days SMA goes below the 200-days SMA value, it is assumed that the trend is down, and the prices will decrease relative to current prices. If 50-days SMA goes above the 200-days SMA value, then it is assumed that the trend is up, and the prices will increase.

3. Method

In this study, we propose a novel method that uses a genetic algorithm and deep Multilayer Perceptron (MLP). In our approach, we use RSI values of the stock prices to determine the buy and sell points for stocks. We also use Apache Spark and Spark MLlib library for big data analytics. As can be seen in Figure 1, our proposed method is divided into six main steps. We aim to determine the best fit for the buy, sell, and hold points in the time series of the corresponding stock prices. In our study, the daily stock prices of Dow 30 stocks are obtained from finance.yahoo.com for training and testing purposes. Stock prices between 1/1/1997 to 12/31/2006 are used as the training data and stock prices between 1/1/2007 to 1/1/2017 are used as the test data. In Phase 0, the downloaded stock prices are first normalized according to the adjusted close prices. In Phase 1, RSI values for different intervals (1 to 20 days) and SMA values for different intervals (50 and 200 days) are calculated using TA4J[2] (Technical Analysis For Java) library. SMA values are calculated to determine whether the trend is up or down.

In GA Phase (Genetic Algorithm) (Phase 2), the best RSI values for buy and sell points in downtrend and uptrend are found in the random initialized population. The best returned RSI chromosomes are accumulated in the list for the input of the MLP as the training data set.

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[2] https://github.com/mdeverdelhan/ta4j