Deep Learning for Financial Time-Series Data Analytics: An Image Processing Based Approach

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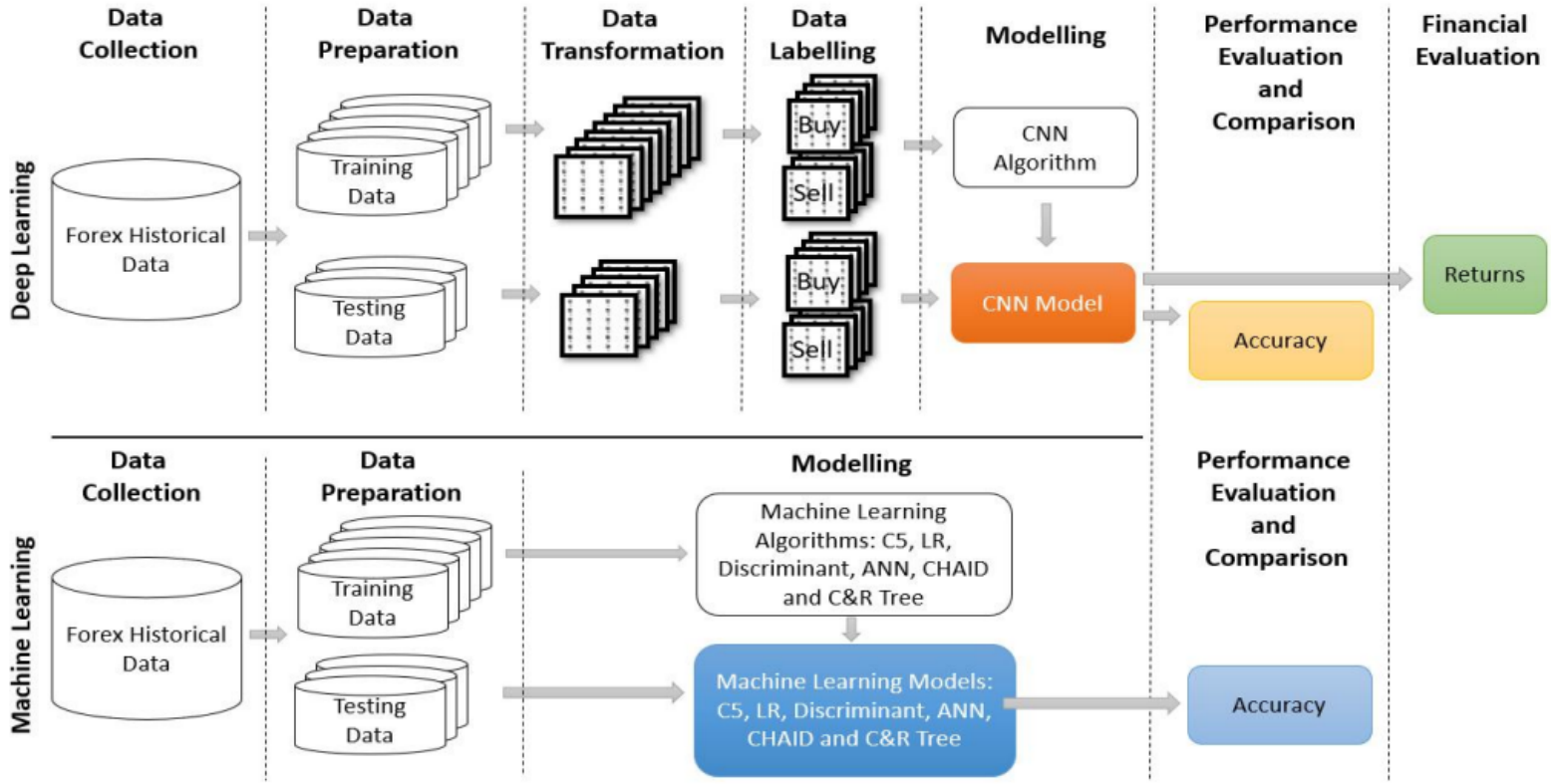
Introduction

- Foreign Exchange(Forex) is the biggest financial market in the world where currencies are traded.
- We perform technical analysis for predicting price movements which makes use of the information in chart according to time-series historical data.
- A novel model based on CNN Algorithm is proposed here that aims to accurately predict the daily movement of the Forex price.
- The idea is to convert time-series data to an image and exploit the CNN algorithm to analyze the pattern in the image.



Deep learning and machine learning model

Data collection

- The data set uses for conducting this research is forex historical data of EURUSD pairwise from 3 JAN 2000 to 4 SEP 2018
- Daily time frame
- Data consist of approximately 4865 records

Data preparation

- The data set divided in to training dataset and testing dataset using sliding window technique
- We use the year 2000-2004 as training dataset and 2005 as testing dataset.Then move one year ahead create another training and testing data set
- Approximately 25300 records

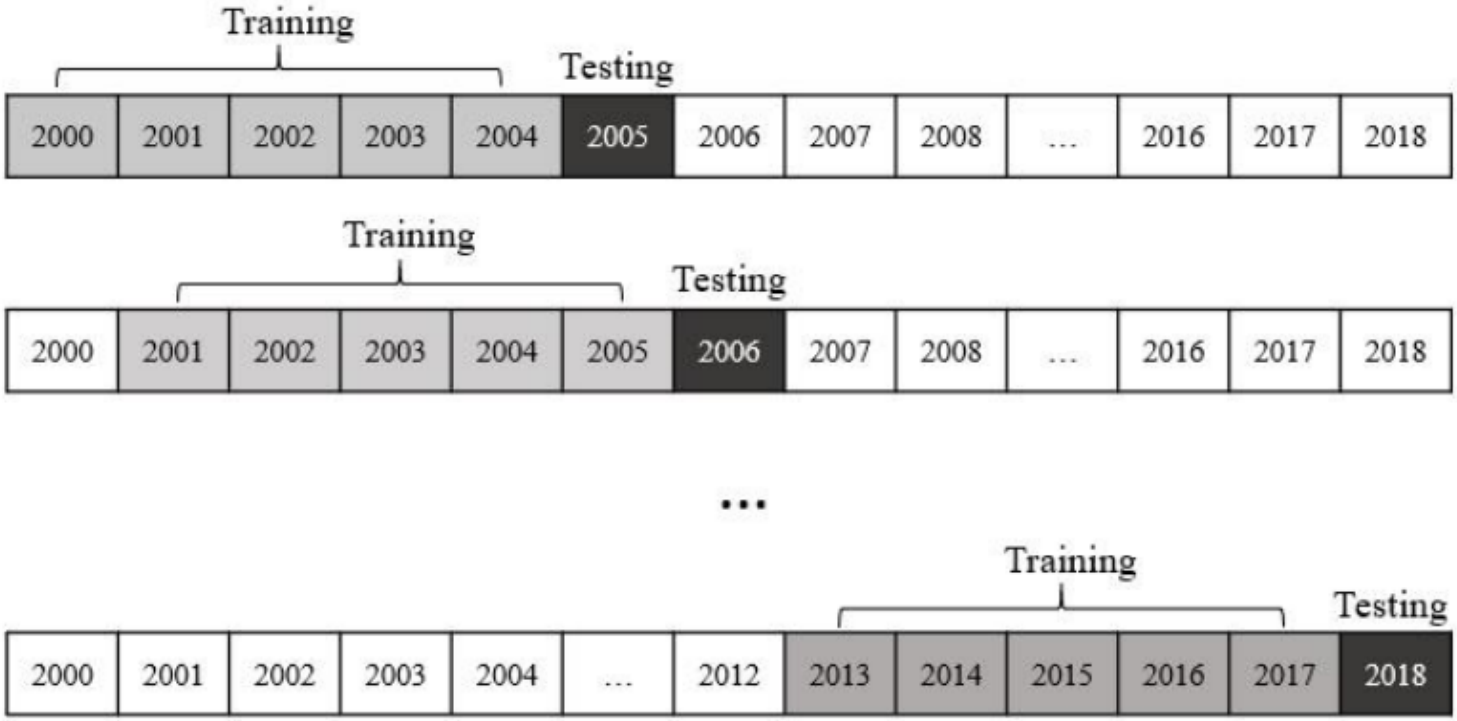


Figure: Data preparation image

Data transformation

- Data converted in to 16×16 grayscale image
- We use 15 indicators and chart information to create and image
- 16 different input of parameter used to used in order to obtain 16 different value of each indicator

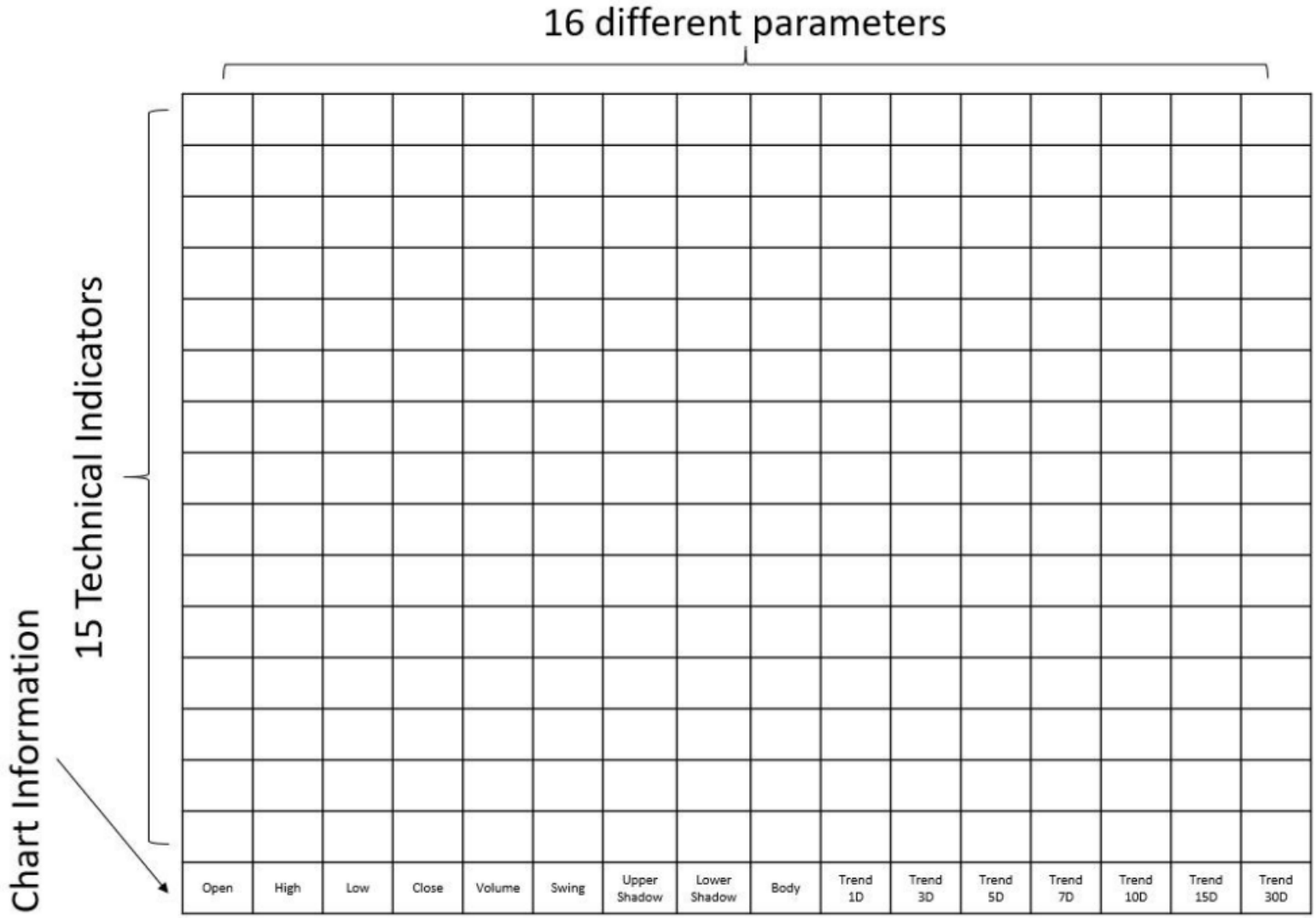


Figure: Transformation image

- To create grayscale image min-max normalisation technique is used
- its feature scaling where values of numeric range of a feature of data increased or reduced to a scale between new maximum and new minimum
- V=(v-min/(max-min))(max new-min new)+min new

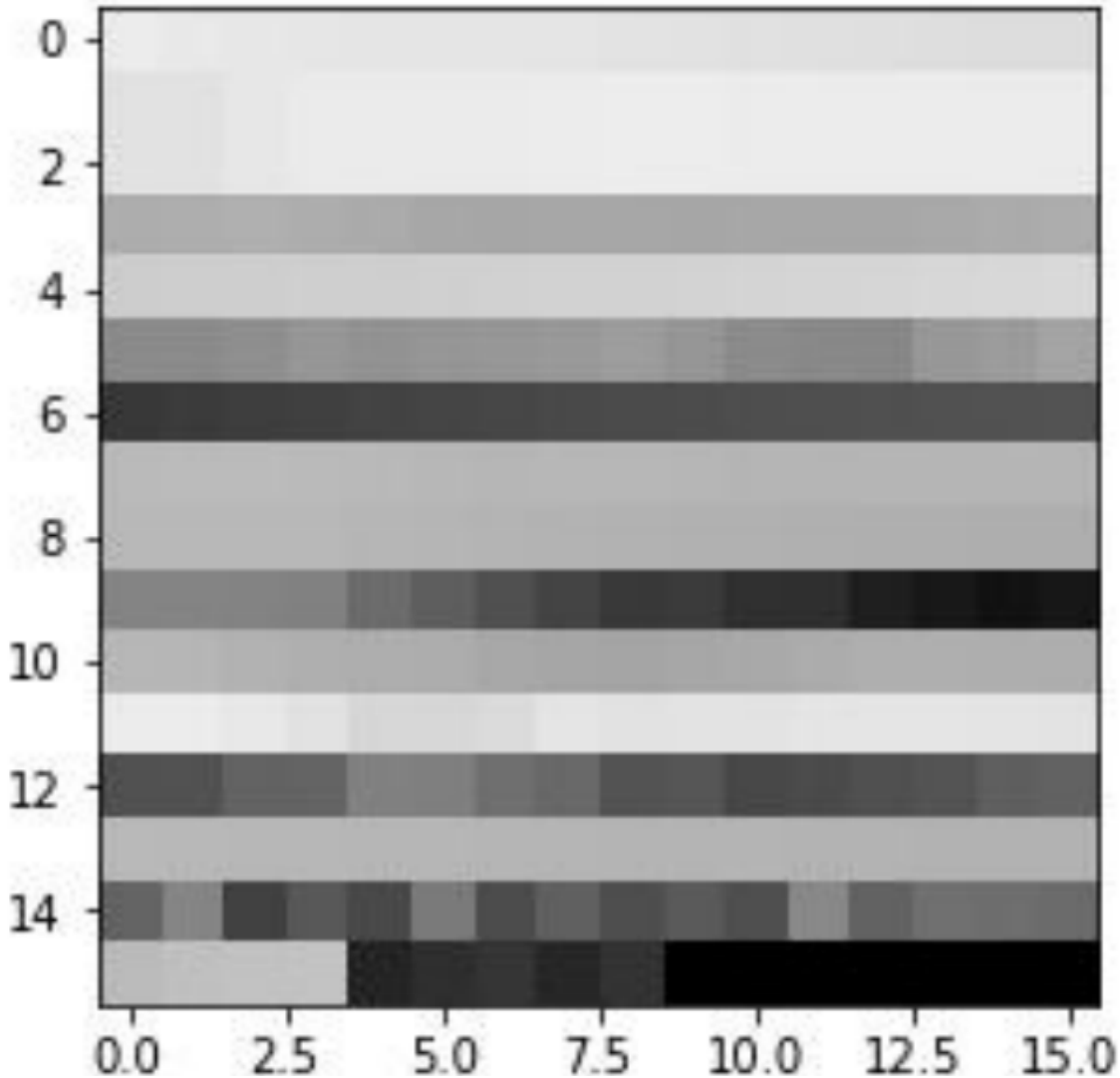


Figure: Grayscale image

Data labeling

- Label BUY if close - open greater than 0, Label SELL if close - open less than 0
- We use lagging-time for 1 day of the signal column
- we use today information with tomorrow label according to the signal class

Modeling

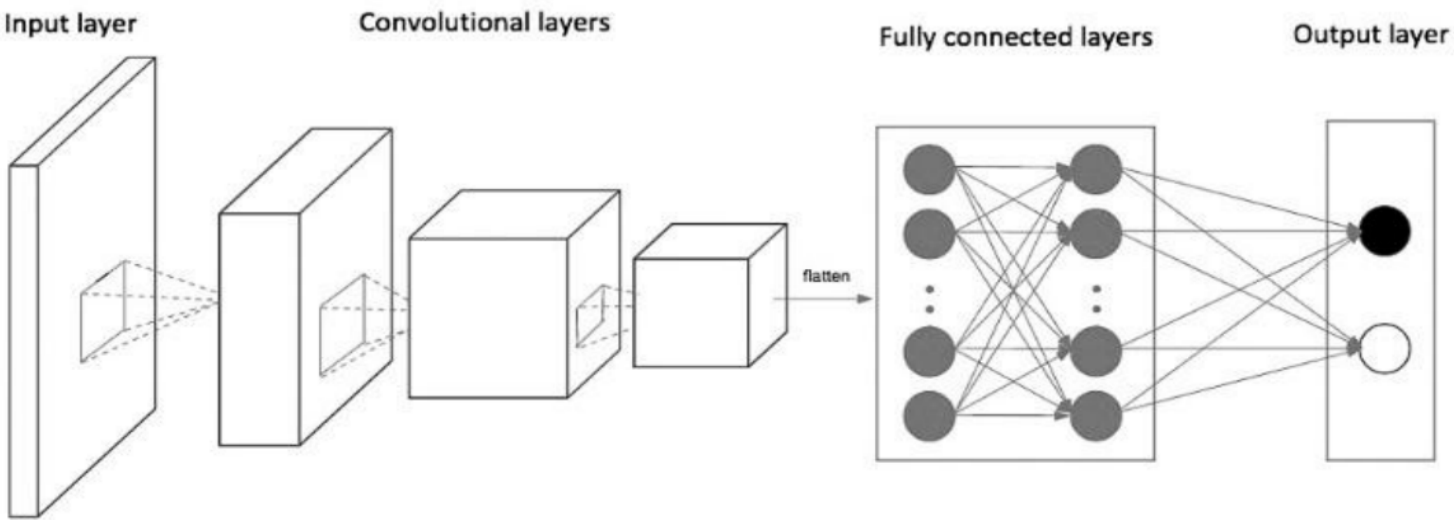
- After transforming data in to images,training set of image data is used to build the prediction model
- The model is based on convolution neural network

CNN Model

The proposed CNN model contain 9 layers

- Inputlayer(16×16)
- Three convolutional layer($16 \times 16 \times 16$,$16 \times 16 \times 34$,$16 \times 16 \times 64$)
- two max pooling layer($7 \times 7 \times 64$,$7 \times 7 \times 64$)
- A drop out layer(.25)
- A fully connected layer(128)
- Output layer(2)

- filter size used is 3×3
- implemented using keras,tensor flow infrastructure in python language



Structure of the general convolution neural network.

- convolutional layer consist of basic convolutional operation
- maxpooling layers build the deep neural network
- $e_i = \Sigma W_{i,j} x_j + b_i$

- dropout layer prevent over fitting
- Decrease filter size results in catching more details of image.

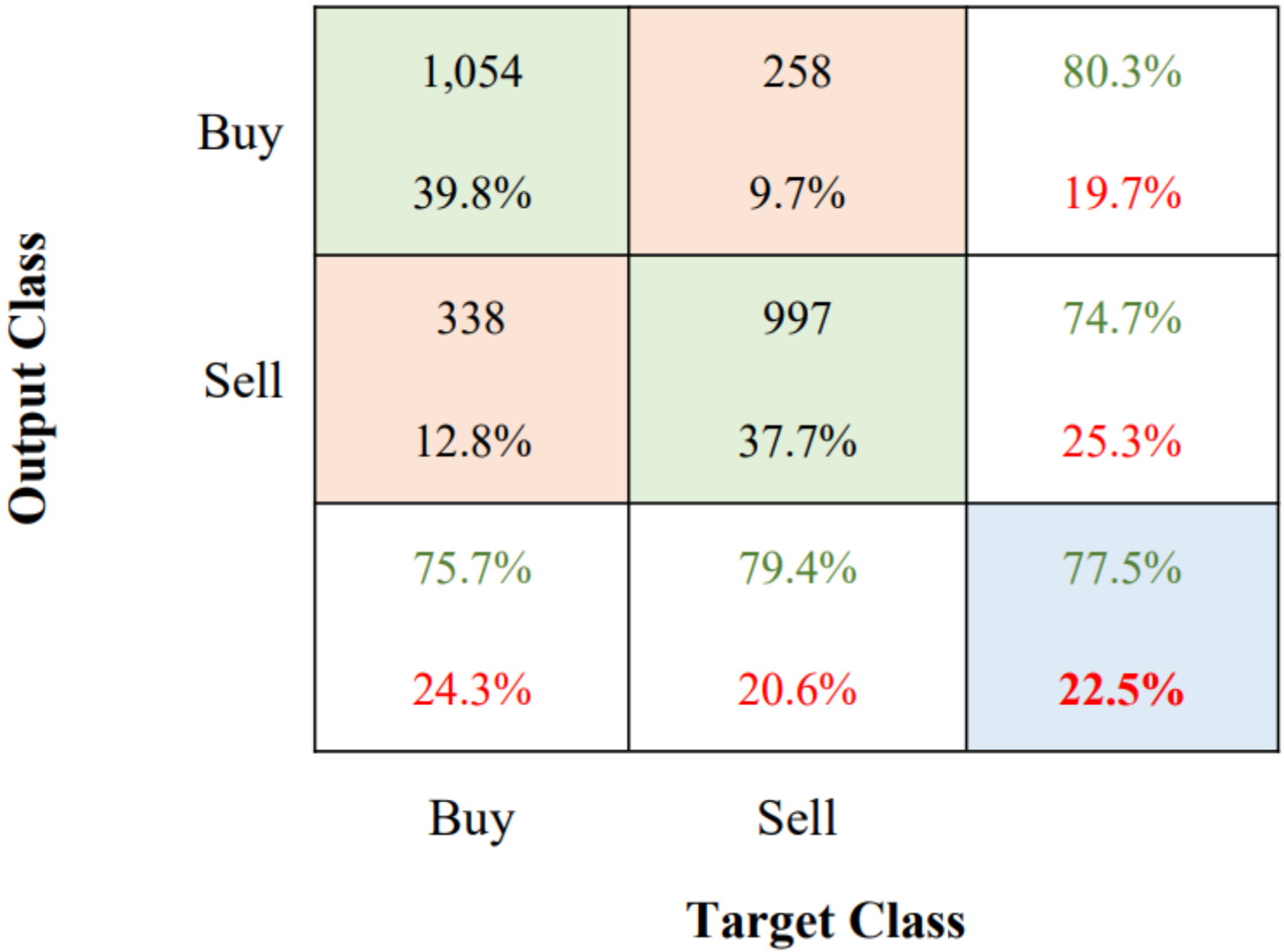
Performance evaluation

- The performance of the CNN model evaluated using accuracy of prediction
- Accuracy=(TP+TN)/(TP+FN+FP+TN)

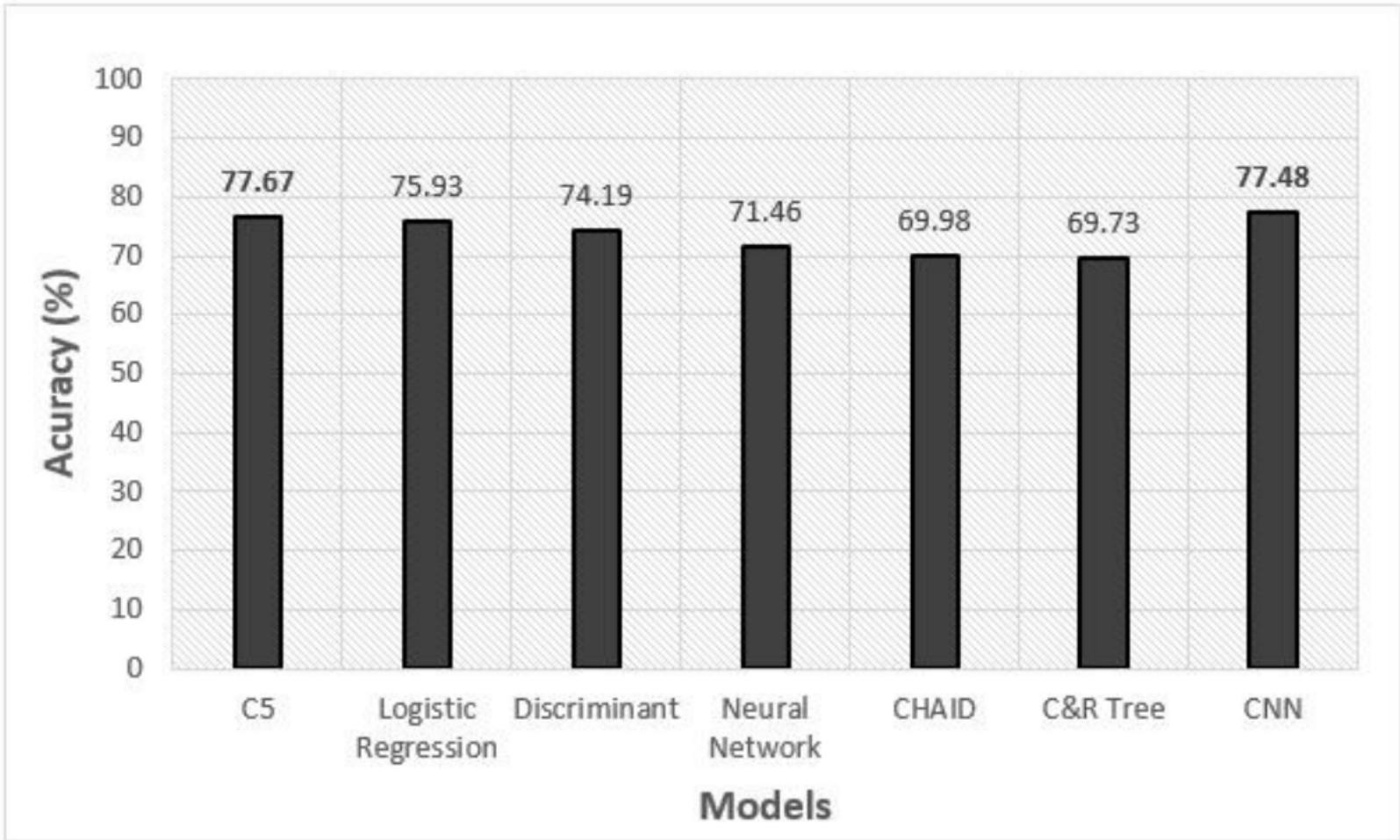
Accuracy of prediction

Scenario	Training Data	Testing Data	Accuracy (%)
1	2000 – 2004	2005	73.68
2	2001 – 2005	2006	72.73
3	2002 – 2006	2007	70.40
4	2003 – 2007	2008	73.89
5	2004 – 2008	2009	75.45
6	2005 – 2009	2010	75.74
7	2006 – 2010	2011	73.71
8	2007 – 2011	2012	74.34
9	2008 – 2012	2013	72.60
10	2009 – 2013	2014	70.71
11	2010 – 2014	2015	73.51
12	2011 – 2015	2016	74.11
13	2012 – 2016	2017	76.87

Confusion matrix



Accuracy of CNN model with other machine learning models



Conclusion

- Proposed a CNN based model for predicting the daily price movements of forex pairs.
- Compared to other algorithm based model it has a higher accuracy.
- CNN model has great potential for making profits in the forex market

Reference

- O. B. Sezer and A. M. Ozbayoglu, "Algorithmic financial trading with deep convolutional neural networks: Time series to image conversion approach," Appl. Soft Comput., 2018.
- R. Rosillo, D. la Fuente, and J. A. L. Brugos, "Technical analysis and the Spanish stock exchange: testing the RSI, MACD, momentum and stochastic rules using Spanish market companies," Appl. Econ., vol. 45, no. 12, pp. 1541–1550, 2013.

Thank you