Development of Trading Bot for Stock Prediction Using Evolution Strategy

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Amity University, Noida, Uttar Pradesh 201301, India

Abstract. This paper presents the idea of implementing a trading bot that can implement trading strategies in an automated fashion using minimal or limited interactions with the user. This Bot has been trained explicitly to understand the trading practices and the types of orders, the quantity, the profit margins and when to exit the trade. One of the most important objectives of the trading bot is to function according to the user preferences i.e., to produce stream quotes, in order to get price information which would further help in calculating indicators, placing orders and organizing the user data. The bot is also capable of checking any fluctuations in the market, study the data and cautiously contribute on the stocks that give at least 1 percent return using algorithms based on sentimental analysis and deep evolutionary strategies. The data from Twitter has been provided to the bot to make it understand and asses the market better. Using the current strategies on virtual outcome, simulation outlines that the bot used in the project is more proficient than the existing ones that are based on other different machine learning algorithms.

Keywords: Day Trading, Stock prediction, Reinforcement Learning, Sentimental Analysis, Deep Evolution Strategies, Trading Bot

1 Introduction

In the 21st century, Stock Trading has turned out to play a pivotal role for the investors of different companies and the daily traders in the market. The market irrespective of the people who invest in or tradeoff, works on its own principles. The daily market fluctuations are attributed to various facts that brings in difficulties for companies and stockbrokers to decide capital investment. These uncertainties can occur due to a plethora of reasons such as company getting dissolved, conflicts within the company or company bankruptcy, etc. Understanding these difficulties in early stages is where stockbrokers and investors lag. Day Trading [6] as rule alludes to the act of buying and selling a security inside a solitary as daily routine. While it can happen in any commercial center, it is generally normal in the unfamiliar trade and securities exchanges. The main objective to invest in the market is to get capital returns and profits. Even though if it means getting at least 1% return, depending on the investment 1% return can prove to be a huge amount as capital return. Therefore, for stockbrokers and investors reaching at least 1 percent return mark can change the face of company making it possible to reach success heights in the market. Artificial Intelligence in trading can be summarized as a technology that can think and act for itself, and therefore is perfect for complex trading applications where speed and efficiency play a crucial role. Its application can change trading in many ways which is already quite evident.

Another addition is sentiment analysis that categorizes opinions, emotions or attitudes expressed by consumers towards a particular topic, issue, event or subject in terms of

categories as positive, negative or neutral. It is a valuable tool for monitoring social media as it helps in determining an overview of the general opinion of the public behind certain subjects. Every day, large volumes of text data is created which is usually unstructured or unorganized.
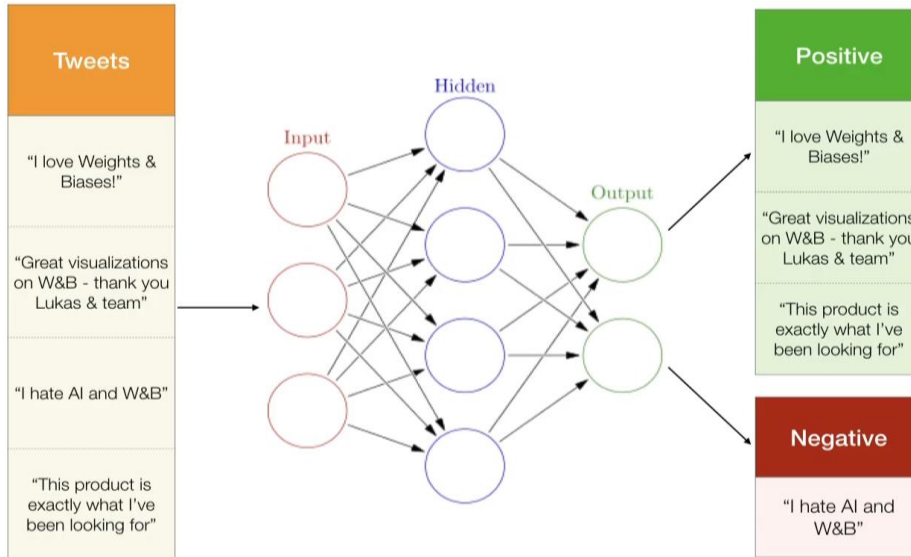

Fig.1. Categorizing Tweets using Sentimental Analysis [17]

Currently, the application of sentiment analysis is purely commercial. For example, movie producers using it to evaluate audience feedback on recent projects or corporations using the technology to assess how consumers react to the product. But with the advancement in this technology, countless applications are being developed.

The current work uses Twitter as the source for sentimental analysis as it can be seen as an ocean of sentiments. People around the world put thousands of reactions and opinions on every topic there, every second, every day [8]. It can be used to analyze millions of tech snippets in seconds with the help of machine learning [9].

Reinforcement is behavior-based learning where the outcome will be based on reward punishment system. Several components of reinforcement are[13] - Agent: Who so ever is performing the task; Environment: The circumstances in which the agent is performing the task; State: The condition of the agent at the time of task; Action: The task which is being performed; Reward: The outcome whether favorable or not.

In Evolution Strategies, the weights of the agents in its network are modified with random noise. When we get a reward from the environment, the parameters can be evaluated for a number of timesteps to observe if it provides good result or not. The ES approach can be observed as maintaining a distribution over network weight values, and having a large number of agents acting in parallel using parameters sampled from the distribution. Each agent acts in its own environment, and once it finishes a number of steps, cumulative reward is returned to the algorithm as fitness score. With this score

the parameter distribution can be moved toward that of the more successful agents, and away from that of the unsuccessful ones. By repeating this approach numerous times, with large number of agents, the weight distribution moves to a space that provides the agents with a good policy for solving the task or providing the profitable stocks. Evolution Strategies are easily scalable and parallelizable. [19]

1.1   Motivation

Day trading is considered the devil for someone who does not know how to trade and has no experience in the market. It is a tiring and time-consuming process to become a consistent trader who earns. Moreover, there is a big intellect gap when it comes to investing and understanding financial market. Risk management is a big tool incorporated when participating in trading. It has been studied [18] that more than 80% of day trader are unprofitable or lose money over the course of a year. With the increasing free stock trading applications, programs and accessibility of information, more people have used different investment strategies and failed because of several reasons such as emotions (hope, greed, fear, regret) and high risk/ profit driven investments.
Trading bots can achieve in a single trading session what many great minds would take a large amount of time to achieve. Trading using bot eradicates the fear of losing and help in determining profit targets. The user sets the rules and the trading plans are followed by the bot. With 24/7 Operational ability, bots can provide additional profits ratio. Moreover, the entry and exit in the trading practices can be timed accurately. Trading bots can become great learning tools for the beginners as it can provide data and knowledge to improve the user trading portfolio.

1.2   Contribution

The current work develops a trading bot that would be handling the stock trading process. The bot, with the help of sentiment analysis will go through different forums and sites to check for any fluctuations in the market as mentioned earlier and will carefully invest on only those which provide at least 1 percent return with the help of deep evolution strategies incorporated to build the bot. The data extracted from the database will provide a large pool of information to the bot which will ultimately navigate it through the stock trading process.

1.3   Paper Organization

The flow of work in this paper is presented in the following manner:
Section 2 details the available literature in the domain of evolution strategies and computation techniques, artificial intelligence applications in day-trading and sentimental evaluation. Section 3 emphasizes on the methods such as day-trading, sentimental analysis, evolution strategies and fetching of trading data. Section 4 reveals the results obtained from creation of trading bot and techniques used. Section 5 concludes the work providing the benefits and implementations of the work.

2   Literature Review

Graham Kendall [1] first came with usage of evolution strategy in artificial intelligence in 2001 discussing the development of an approach that used evolutionary strategy as a predictive tool. The approach was simple to implement yet produced results that compared favorably with the neural network predictions. Hans-Georg Beyer [12] introduced Evolution Strategies starting from a survey of history explaining why the strategies are realized the way they are. The theoretical issues, the basic ES algorithms and design principles along with future branches of ES research were presented. Harish Subramanian [18] in 2006 demonstrated sophisticated approaches to hybridizing simple trading rules and used genetic algorithms to achieve consistent profitability in a variety of competitive market scenarios.

Lufuno Ronald Marawala [3] in 2010 reckoned about Artificial Intelligence application in Stock Market and Trading. The main motive of this work was to make use of artificial intelligence techniques to model and predict the future price of a stock market index. The results indicate that the ranking of performances support vector machines, neuro-fuzzy systems, and neural networks is dependent on the accuracy measure used. Yong Hu [15] in 2015 provided review on applications of evolutionary computation techniques and analyzed researches of selected papers on the basis of buy and hold strategy in order to compare their models. Yong Hu revealed the gaps in EC techniques in stack trading and suggestions for research in the future. Tim Salimans [19] explored evolution strategies as an alternate to popular reinforcement learning techniques showing how ES is a better solution strategy and highlighting several advantages of ES.

Edoardo Conti [14] explained how evolution strategies are faster as they parallelize better and how different machine learning algorithms can be hybridized with evolution strategies to improve performance on deep Reinforcement Learning tasks. Luke Rose [2] in 2018 presented comparative analysis on the recent Machine Learning approaches used in predicting the direction and prices of selected stocks for a certain time range, considering short, medium, and long-term investments. Lv, Dongdong [4] in 2019 made a detailed observation and analysis on the stock day trading strategy synthetically evaluating different machine learning algorithms and observing the day trading performance of stocks under transaction cost and no transaction cost. This database provides a large pool of information to the bot which will ultimately navigate it through the stock trading process.

Recently, Nikhil Yadav [7] explained how twitter is considered a massive repository of public opinions and how it influences marketing techniques using sentimental evaluation. Different techniques used for classifying product critiques were also emphasized.

3   Methodologies

3.1   Day Trading
With the ascent of the web and internet exchanging houses, it has gotten simpler for the normal individual speculator to get in on the game. Exchanging dependent on the news

is a well-known method. Booked declarations, for example, financial insights, corporate profit, or loan fees are liable to showcase desires and market brain research. Professional day traders, the individuals who exchange professionally as opposed to as a diversion—are normally entrenched in the field. They for the most part have inside and out information on the commercial center, as well. A portion of the essentials needed to be an effective informal investor are- Information and experience in the marketplace, adequate capital, methodology and discipline.

The advantages of Artificial Intelligence equipped trading with respect to human trading is that the former pertains predetermined trading rules, trades 24 hours a day, zero emotional breakdowns, understands risk management and the list goes on.

3.2   Sentimental Analysis

Mobile phones have become an inevitable part of our lives; Daily weather report, morning alarm and other services are provided making our lives easier. But one thing the phones cannot do yet, is tell the feelings or emotions of the user. Devices like Fitbit, etc. can help in monitoring the health of the user but it is hard to understand the emotions. Sentiment analysis uses the emotional data to assist in making optimal decisions for goals that are specified like a therapist or a life coach. Firstly, URL is grabbed of which the data is scrapped off of. Polarity of the text, i.e., the sentiment (1=positive, 0=neutral, -1=negative) is received using TextBlob object. After signing up to use Twitter's API, an open-sourced app authenticates user identity with Twitter. The first dependency installed is Tweepy (library for accessing the Twitter API). The other dependency is TextBlob which helps in the actual sentiment analysis. After importing the libraries, 4 variables are created that are required to authenticate with twitter. Authentication with twitter is done by creating a variable auth and using 0AuthHandler method of Tweepy. This method takes two arguments, i.e., consumer_ key and consumer_secret. Then the set access token method is called on the auth variable which takes two arguments, i.e., access_token and access_token_secret.

Main variable is created from which the tweets would be read and communicated with the platform using its API [10, 11]. The use case for the project need to collect tweets that contain a certain keyword. A public tweets variable is created that will store a list of tweets and call the search method of the API variable to fill it. The search method takes a single argument and retrieves several tweets that contain the word inserted as the single argument (for example- name of a company). Sentiment analysis can be performed by creating an analyst variable that will store the analysis and call TextBlob with the tweet string as the only argument.

As a result, the live tweets are provided to the project and can see a sentiment report which shows the polarity and subjectivity that measures how much of an opinion it is vs how factual. Sentiments [7] play a huge role in stock trading as they decide if the stock is going to be bullish or bearish and help the consumer decide whether to sell the stock or buy it.

3.3   Evolution Strategies

Project mainly implied reinforcement learning as the technique complementary to the ES approach in order to create the Bot. 4 strategies [16] were used to train the bot:

Taking Strategy 1 into consideration- Time interval of candlestick is equal to 5 minutes in which we can either buy or sell. Say, the call is to buy. Entry point will be when the value of Relative Strength Index (RSI) will be 60 or more. Period of RSI is 30 min and 14 periods. Finally, the profit ratio considered here is 1: 3. Similarly, the next three policies as illustrated in figure 2 can be understood on above guidelines.

Strategy 1	Strategy 2
Time : 5 minutes Call: Buy Entry: 30 min Morning Average crosses above opening price and 14 period RSI index higher than 60 Profit: 1:3	Time : 15 minutes Call: Sell Entry: 15 min Morning Average crosses below opening price and parabolic SAR is 0.02,0.2,0 Profit: 0.5:1.5
Strategy 3	Strategy 4
Time : 5 minutes Call: Sell Entry: 15 min Morning Average crosses below opening price and parabolic SAR is 0.02,0.2,0 Profit: 1:3	Time : 15 minutes Call: Sell Entry: 15 min Morning Average crosses below opening price and parabolic SAR is 0.01, 0.2, 0 Profit: 1:3

Fig.2. Strategies used in the project

3.4   API

In this work, the bot uses Zerodha API for fetching live data to analyze the stocks. The data is fetched for every second in the live market. Automatic exchanging and record access can utilize Kite Connect APIs [5] to put in and oversee genuine requests across different portions, pull positions and possessions, dissect live market costs, and considerably more. It is intended for engineers who need to exchange automatically without being bound to an exchanging stage UI. The APIs are easy to comprehend, REST-like HTTP/JSON APIs that can be used with any programming language. The URL that gives information or some undertaking after sending a HTTP demand is called a Programming interface.

4   Results

A python bot is programmed in an app to trade on behalf of day traders and is able to make profit in the live market. Day traders are able to make profit in the market through intra-day trading. The bot can keep a track of all the stocks at once and is able to decide the entry and exit positions in the market. The bot is able to automate intra-day trading in stock, future, options and commodity market.

In figure 3, the application running in live market can be observed. It is depicted that on selling the stocks, profit of 1.55% was achieved. In figure 4 and 5, the user interface of the application is shown. From figure 4, the working of the bot can be observed. The green and red boxes predict the rise and downfall of the stocks respectively, helping users to track their favorite stocks and making it clear which stocks to invest in. The activity of searching the stocks is depicted in figure 5.
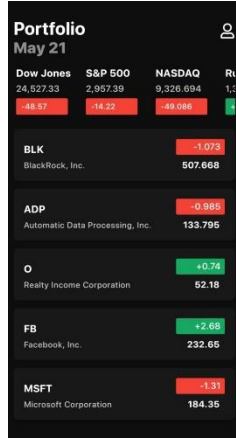
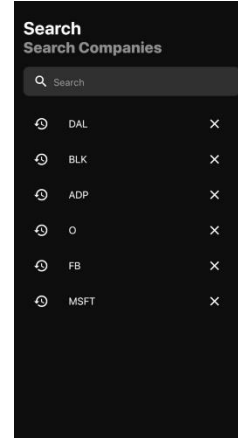**Fig.3.** Trading in live market **Fig.4.** Stock predictive indicators **Fig.5.** Application Snippet

5   Conclusion

The current work comes up with a trading bot that deals with the stock exchanging measure and devises most quantifiable data in trading. The bot, with the assistance of assessment investigation will experience various discussions and locales to check for any changes in the market as referenced before and will cautiously contribute on just those which give at any rate 1 percent return. The information will be extricated from the Zerodha Api which is one of the most popular stock exchanging applications. This information base will give a huge pool of data to the bot which will eventually explore it through the stock exchanging measure.

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