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Stock Price Prediction using Bat Algorithm

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Abstract— : There is no such thing as a safe path of investment in the stock market because it is highly unpredictable, which has been a major concern of investors globally. As a result, stock market or stock price prediction has been a hot topic for scholars and researchers and a popular topic for investors worldwide.

Keywords- Machine learning; BAT algorithm;stock price prediction.

I. INTRODUCTION

The majority of people in India are not even familiar with phrases like "stock market," "shares," etc. Since the majority of people in India are currently middle class, many of them are uninformed of various investment alternatives, such as stock markets, so investing in stocks is a big deal for most of us. We prefer to be cautious and want a guarantee for every rupee invested. For the majority of middle-class people, investing savings in an erratic and risky sector is a significant decision.

People are searching for a safe method to investing in the stock market for safe and simple earnings, and the stock market has recently been a hot issue in the field of finance due to the increase in the number of companies listed. Even though predicting stock prices is extremely difficult when they fluctuate constantly, machine learning algorithms can help to some extent.

In this research, the BAT algorithm will be used. Yang's BAT algorithm was developed in the year 2010, and it is a cutting-edge method based on the population way of prediction.

This machine learning technique provides predictions based on factors like loudness and frequency and is utilized in a variety of optimization problems. It works by mimicking the echolocation behavior of bats.

Stock price prediction is crucial for many of the people active in the stock market, which is an assembly of buyers and sellers of stocks. This study work focuses on forecasting the next day's stock prices using the BAT algorithm.

II. LITERATURE REVIEW

A significant amount of research has already been done in this area by numerous researchers. Some of them consist of

[1] Paper1 : A New Metaheuristic Bat-Inspired Algorithm
This study includes some combinations and benefits of new bat algorithm and current methods. a thorough formulation and justification of how it should be used.

[2] Paper2 : Bat Algorithm: Literature Review and Applications.
This work was read in order to have a more thorough analysis of the Bat algorithm. The bat algorithm and its new variants are timely reviewed in this paper. Here, a variety of diverse applications and case studies are also examined and succinctly summarized.

[3] Paper 3 : Critical Analysis: Bat Algorithm based Investigation and Application on several Domains
This reader will receive a thorough analysis of the bat algorithm in this study, along with information on its drawbacks, the domains in which it has been used, a variety of optimization problems in various fields, and all studies that compare its performance to that of other meta-heuristic algorithms.
Paper 3 : Citation
Umar, S.U. and Rashid, T.A. (2021), "Critical analysis: bat algorithm-based investigation and application on several domains", World Journal of Engineering, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/WJE-10-2020-049

III. METHODOLOGIES

We used the Bat algorithm for the stock price prediction. This algorithm was inspired by nature and is developed by observing bat's behavior. The only mammals that can also use echolocation are bats. flying at different frequencies, decibel levels, and pulse emission rates, Bat's ability in avoiding obstacles and in finding prey and can be used to construct equations for updating the algorithm, In 2010 Bat algorithm was developed by Xin-She Yang.

The way that microbats echolocate can be summed up as follows: Virtual bats fly randomly at position and velocity xi and vi respectively, and variable frequency, wavelength and loudness Ai."

When searching for prey, an animal will alter its frequency, pulse emission rate, and loudness.

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Best candidates for prey are selected continuously up until set of stop criteria are met.

Frequency-tuning techniques are used to tune dynamic behavior of bats, and algorithm's dependent parameters can be tuned to alter the ratio of exploitation to exploration.

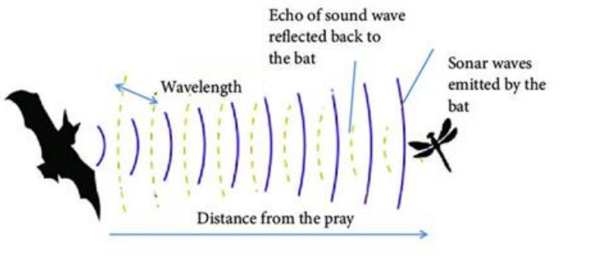

Figure 1: Bat's frequency-tuning methods

IV. Dataset Description

In this research paper, we used a dataset of Tesla stock prices that includes data on the company's stock prices over a range of years, as well as data corresponding to labels like "Open," "High," "Low," "Close," and "Adj. Close Volume," which are parameters needed to forecast Tesla's stock price for the day ahead. The data set is accessible via the Kaggle repository of Meet Nagadia. The dataset we used includes 1259 training parameters for testing, training, and stock price prediction.

Figure 2: Dataset Visualization

V. Platform Utilized

In this paper, We made use of Google Collab which is a free, open-source used in training the Deep Learning and Machine Learning models also when Dealing With large datasets, Google collab is excellent choice as it provides the free GPUs, TPUs and CPUs over cloud .Along essential hardware resources google colab also comes with fully configured with the required packages and libraries like tensorflow, keras with Nvidia CuDNN and many other packages.

VI. Proposed Model

When tackling this issue of accurate stock price prediction, we chose the Bat algorithm. After investigating the many machine learning techniques available, we discovered that the Bat algorithm was particularly special and probably suited for stock price prediction.

SUPPOSITION

- Bat's utilize their ability to echolocation to assess parameters like distance. They can differentiate between background barriers, food and prey.
- Depending on how close their target is, bats fly at location x I and velocity v i. They can change the emission rate of pulses r [0, 1] or automatically alter the frequency and wavelength from the pulses they emit.
- Loudness might vary in a variety of ways, but for this instance, we'll assume that it varies from a high value to a low value , (A 0 to A min).

Types	Parameters	Descriptions
Controlling parameters	N	Population size
	Ω	Weight factor
	H	Flying-time factor
	A	Loudness deceasing factor
	ρ	Pulse rate decreasing factor
Given parameters	D	Problem dimension
	X	Bat position
Random parameters	B	Random walk
	f_i, f_{min}, f_{max}	Pulse frequency
	A_i, A_{min}, A_{max}	Pulse loudness

Figure3: Parameters of bat algorithm

BAT ALGORITHM

```
Bat Algorithm
  Objective function f(x),   x = (x_1, ..., x_d)^T
  Initialize the bat population x_i (i = 1, 2, ..., n) and v_i
  Define pulse frequency f_i at x_i
  Initialize pulse rates r_i and the loudness A_i
  while (t <Max number of iterations)
  Generate new solutions by adjusting frequency,
  and updating velocities and locations/solutions [equations (2) to (4)]
     if (rand > r_i)
     Select a solution among the best solutions
     Generate a local solution around the selected best solution
     end if
     Generate a new solution by flying randomly
     if (rand < A_i & f(x_i) < f(x_*))
     Accept the new solutions
     Increase r_i and reduce A_i
     end if
  Rank the bats and find the current best x_*
  end while
  Postprocess results and visualization
```

Figure4: Bat algorithm

The algorithm begins by initializing bats population inside an n-dimensional search space. Bat's position is indicated by the

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notation xit, while its velocity at time t is shown by the notation vit. Hence, new positions One can find xit+1 by using

$$f_i = f_{min} + (f_{max} - f_{min})\beta$$

$$v_i^{t+1} = v_i^t + (x_i^t - x_*) f_i$$

$$x_i^{t+1} = x_i^t + v_i^{t+1}$$

From a uniform distribution random vector $\beta \in [0, 1]$

after comparing all available solutions among all the n bats and locating them, global best location currently is x_*, at current moment fi is frequency of pulse emitted by bat i, Minimum and maximum of pulse frequency values are fmin and fmax respectively.

Random walk thought of as a local search process that uses the chosen solution to generate new solutions. This equation changes the matching position of a randomly selected bat.

$$x_{new} = x_{old} + \varepsilon A^{(t)}$$

$$x_{new} = x_{old} + \sigma \varepsilon_t A^{(t)}$$

$\varepsilon \in [-1, 1]$ Here, is a random number, At t time step, of all the bats A(t) is an average loudness.

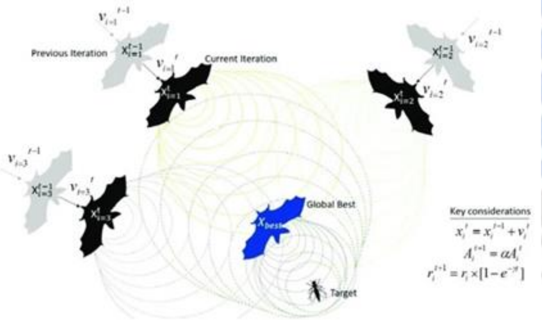

Figure5: Reactions of bat approaching prey

As iterations proceed the pulse rate of emission r i and loudness A i accordingly to be updated as they balance the combination between global and local moves. Once bat has caught the prey, the loudness decreases while rate of pulse increases. But in the beginning pulsing rate is small and the loudness is strong.

$$A_i^{t+1} = \alpha A_i^t$$

$$r_i^{t+1} = r_i^0 [1 - \exp(-\gamma t)]$$

$0 < \alpha < 1$ and $\gamma > 0$, where γ and α are constants.
Assuming that $A_i = A_{min} = 0$, means bat has found its prey and emitting sound has stopped.

$$A_i^t \rightarrow 0, r_i^t \rightarrow r_i^0, \text{as } t \rightarrow \infty$$

Final equation

$$f = x^2 + y^2 + 25(\sin^2 x + \sin^2 y), (x, y) \in [-2\pi, 2\pi] \times [-2\pi, 2\pi]$$

VII. RESULTS

PREDICTIONS : Below are the predictions done by the Bat algorithm in predicting the stock prices.

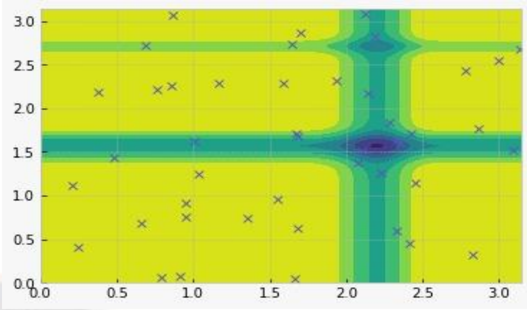

Figure6: Graph showing bats position in the first epoch

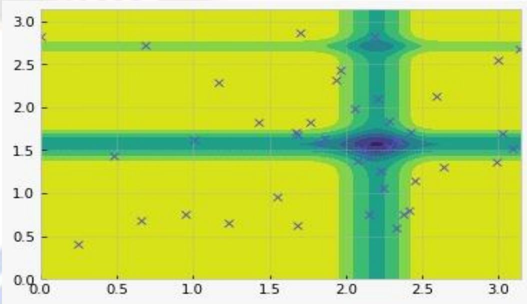

Figure7: Graph showing bats position in the 200epoch

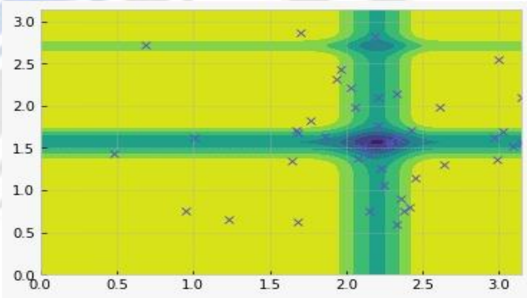

Figure8: Graph showing bats position in the 500 epoch

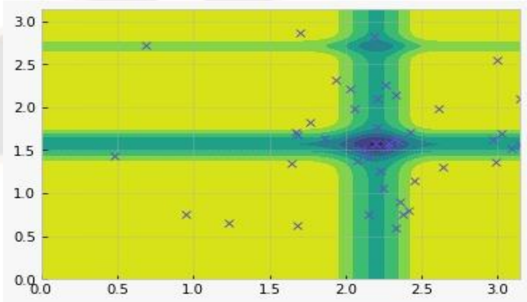

Figure 9: Graph showing bats position in the 1500 epoch

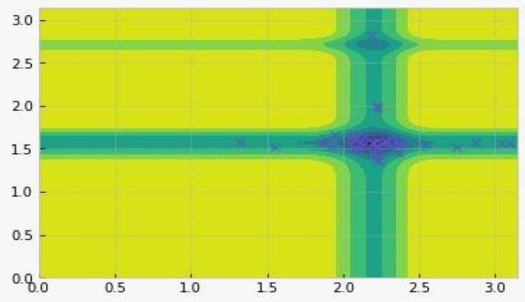

Figure 10: Graph showing bats position in the final epoch

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best_fitness=  -1.801054480114572 best_pos=  [2.2021143502244533, 1.5683663040022755]
[709.440002 617.690002 599.359985 604.869995 668.059998 623.309998
 623.309998 704.73999  656.570007 677.       671.869995 688.719971
 680.76001  679.700012 677.919983 678.900024 659.580017 709.440002
 652.809998 656.950012 621.440002 668.539978 653.380005 650.599976
 644.219971 646.219971 660.5      655.289978 655.289978 643.380005
 854.690002 644.780029 646.97998  796.219971 687.200012 709.669983
 709.73999  710.919983 714.630005 699.099976 713.76001  714.630005
 707.820007 804.820007 717.169983]
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