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Predicting the Stock Prices

"Can stock markets be predicted?" this has always been the most asked question among the traders and investors. They have always looked for the methods to forecast where the assets prices will move to. Doing so means generating huge profits in Stock, Commodity, Foreign Exchange and ETF markets. Fundamental Analysis and Technical Analysis were the methods applied by many traders during the 20th century. However, in the era of high-performance computers and artificial intelligence, we should act smart and look for the ways that yield higher returns.

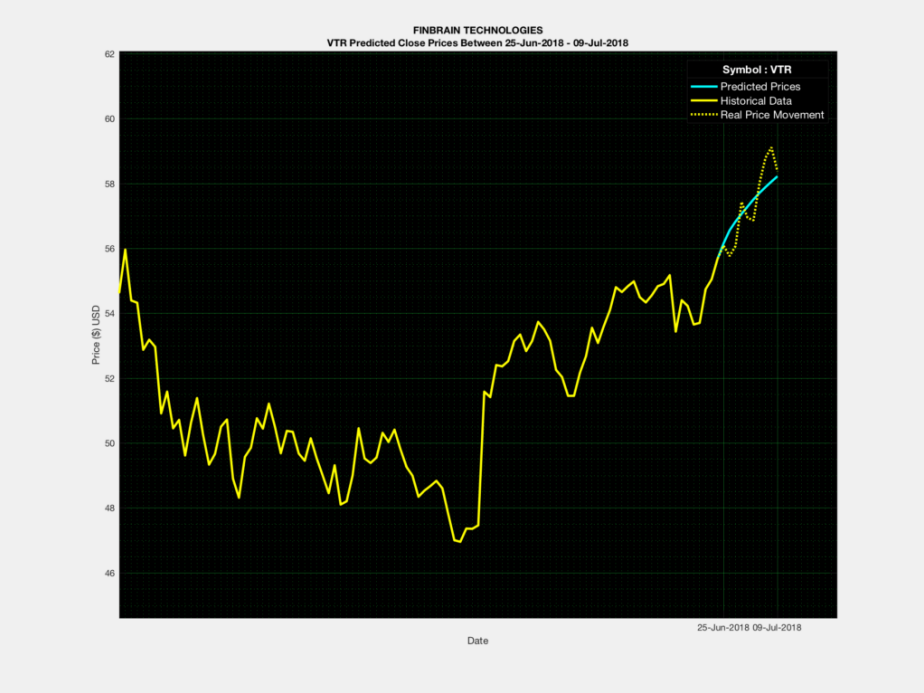


Figure 1 - Predicted and Real Price Movements of VTR for a 10-day period

Machine Learning and Deep Learning engineers have figured out ways to incorporate their algorithms into finance. They have automated the process of analyzing historical price data, company financials, technical indicators and market sentiment in order to predict the direction of the stock prices. These algorithms helped the day traders and swing traders as well as the

long-term investors in optimizing their portfolio, maximizing returns and minimizing risks.

Keep in mind that 90-95% of the traders are losing money by trading financial assets. Only 5–10% of all traders are able to make money out of stock market consistently. If you want to make money in the stock market, besides the patience and persistence, you will need reliable tools to spot the best market opportunities.

Fundamental Analysis and Technical Analysis are not enough to make consistent returns or to beat the market. You need to be able to analyze pricing data, news, reports, market sentiment, company financials and other sorts of data to decide which direction the market will move. Analyzing as much data as possible is essential to construct an accurate trading model or strategy, because technical indicators or company financials are not enough to forecast where the stocks are heading.

Stock market does not always exhibit random characteristics. If the market exhibits random characteristics, then the next moves are not predictable based on the past prices. However, mean-reverting and trending processes can very well be predicted and traded as we explained in the Predictability section of this book.

Paradigm Shift in Investing: Fundamentals Based Investing Is Losing Its Edge

Nowadays, the investing sector is experiencing a paradigm shift as the new rules are defined for the stock markets and the market dynamics are changing rapidly. The old-school and widely popular investing techniques are becoming obsolete. Take Berkshire Hathaway for example, which is a company shaping their portfolios based on fundamental analysis techniques. Berkshire's returns have been lagging behind the S&P500's returns for the last 19 years. Also, BRK-A and BRK-B's performances since the beginning of 2020 are not promising at all. This is a clear indicator that the fundamentals-based investing is losing its edge rapidly.

Machine Learning Enabled Investing Is Gaining Traction

Renaissance Technologies' Medallion Fund however, is considered to be one of the most successful hedge funds ever. Jim Simons' hedge fund is utilizing advanced mathematical models and machine learning techniques to analyze stocks and to establish profitable portfolios. This quantitative hedge fund's flagship Medallion Fund has returned 66% on average and 39% after fees, since 1998. Thanks to the Machine Learning and Natural Language Processing technologies, Renaissance has beaten the markets significantly over a long period of time.

FinBrain

FinBrain Technologies
Monthly Prediction Performances of 5 Tech Stocks Listed Under NASDAQ
www.finbrain.tech

Forecasts Were Posted on FinBrain Terminal on May 2, 2020

The Table Compares the Forecasted vs Real Prices for AAPL, FB, GOOG, NFLX and NVDA

Ticker	May 1, 2020 Price	June 1, 2020 Forecast	June 1, 2020 Real Price	Forecasted % Change	Real % Change	Result	July 1, 2020 Forecast	July 1, 2020 Real Price	Forecasted % Change	Real % Change	Result
AAPL	289.07	306.9	321.85	6.2	11.3	✔	322.36	364.11	11.5	26.0	✔
FB	202.27	210.13	231.91	3.9	14.7	✔	210.75	237.55	4.2	17.4	✔
GOOG	1320.61	1369.53	1431.82	3.7	8.4	✔	1418.92	1438.04	7.4	8.9	✔
NFLX	415.27	436.36	425.92	5.1	2.6	✔	420.70	485.64	1.3	16.9	✔
NVDA	282.78	307.62	352.25	8.8	24.6	✔	311.40	381.20	10.1	34.8	✔

FinBrain's Monthly Predictions for AAPL, FB, GOOG, NFLX and NVDA

In an investment world where fundamentals and technicals-based stock picking does not work anymore, investors are shifting to the new computer-based systems that use Machine Learning and Deep Learning technologies in some form. FinBrain Technologies has created a state-of-the-art stock predictor system based on financial data analysis using deep learning techniques. Our models help swing traders and long-term stock investors in

yielding consistent and decent profits in the stock, commodity, foreign exchange and exchange traded fund markets.

How Did the Rule-Based Strategies Lose Their Profitability Over Time?

Market behavior changes over the time and the deep learning algorithms factor in all those changes that happened over the past years. Even the most profitable strategies become obsolete as they become widely available among the traders.

The AI algorithms do not act on pre-defined rules or strategies, they generate the future predictions based on what they "learned" from many years of market data. These algorithms are adapting themselves to the changing market conditions as the new data comes in. Hence, they don't lose their profitability over the time.

The Deep Learning models are not optimized for a limited timeframe, as this is a common problem with all other rule-based strategies being used by the majority of the traders. Deep Learning algorithms can basically factor in unlimited amounts of data; therefore, they can take advantage of more information in order to generate future predictions.

You may have witnessed that, in most cases, the reverse-RSI strategy works better than the traditional "buy if RSI is below 30 and sell if RSI is above 70" strategy. This is mainly caused by the fact that the RSI strategy has become widely popular among majority of the traders out there in the market. Hence, this strategy (and many others as well) have lost their alpha generation capability over the time.

Hard-coded, rule-based strategies eventually lose their profitability especially during the times that the market conditions change very quickly. That's why traders need adaptive and continuously learning models to keep their ability to generate alpha with their trades.

You can see how our algorithms have performed over the last couple years, for different asset classes on https://blog.finbrain.tech. Please note that these results are not hypothetical back tests, but actual published prediction values before the subject period starts. Because, all back tests need to be tested in real-time and under real market conditions. We have published the expected change values prior to the given period on our website, together with the charts and tables that indicate the target price points for every single day during the given period of time.

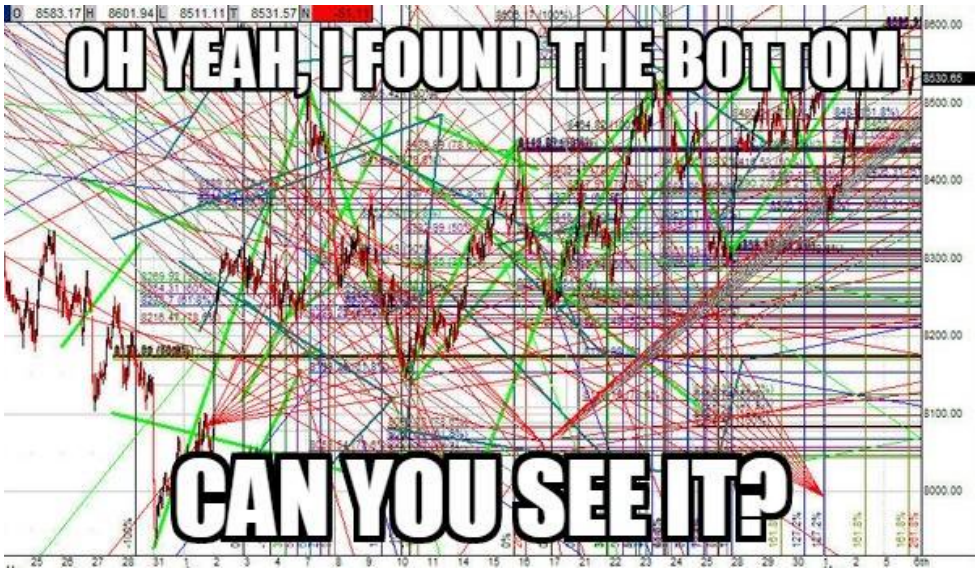
FinBrain publishes the analysis and prediction results for more than 11.000 assets listed under 14 markets on a daily basis. We also provide 12-month ahead prediction results for long term investors who utilize buy and hold strategies.

Why should traders utilize Artificial Intelligence in Financial Prediction?

For many decades, the traders and investors have looked for ways to forecast the future prices of the stocks, commodities, funds as well as currency ratios.

Fundamental Analysis suggested the value investing approach must be used when picking the best assets to invest in. The Technical Analysis approach has suggested determining support, resistance levels, drawing lines and utilizing technical indicators to figure out when to enter or exit a trade.

Both methods had some certain trade-offs, and none have yielded a reliable and robust strategy that generated high returns.



The amateur and professional traders, analysts, investors have spent years trying to develop the required skills and strategies that “might” yield a profit on their trades.

People have spent long hours in front of the screens, trying to figure out what was going on with the charts and indicators. They have spent nights and days analyzing patterns, price movements, reading the news and trying to catch the best moment to enter a trade.

The result is that, only 5% of all trades performed are generating profits, and the rest 95% are causing large losses. The traders learn to develop the winning strategies the hard way, by losing vast amounts of time and money. And these losses still don’t help finding out the winning trading strategy.

The parameters affecting the asset prices cannot be understood and analyzed by humans at once, as the human brain’s capacity has limitations. Human brain cannot take multiple inputs at the same time and analyze them numerically.

FinBrain Technologies
Top 5 Tech Stocks Listed Under NASDAQ
Prediction Performances in 5 Trading Days
www.finbrain.tech

Forecasts Were Posted on FinBrain Terminal on Jun 26, 2020 After the Markets Close

The Table Compares the Forecasted vs Real Prices for AAPL, AMZN, FB, GOOG and MSFT

Ticker	Jun 26, 2020 Price	Jul 6, 2020 Forecast	Jul 6, 2020 Real Price	Forecasted % Change	Real % Change	Result
AAPL	353.63	382.77	373.85	8.2	5.7	✔
AMZN	2692.87	2772.01	3057.04	2.9	13.5	✔
FB	216.08	232.32	240.28	7.5	11.2	✔
GOOG	1359.90	1432.45	1495.70	5.3	10.0	✔
MSFT	196.33	201.42	210.70	2.6	7.3	✔

FinBrain's Algorithms Have Generated Massive Returns for Top 5 Tech Stocks in Just 5 Trading Days

Let us make it clearer to understand; you cannot analyze the current levels of RSI, MACD, Williams %R, Stock Momentum, Various Oscillators, Market Sentiment and so on, at the same time on a numerical manner.

There are more input parameters affecting the future price movements of the assets, that human brain can receive, store, analyze and predict in a very short time interval.

You need a strong, computer backed model which collects, stores and analyzes the major components affecting the price of an asset. It is proven that; the Machine Learning and Deep Learning Models perform well on dealing with such complex tasks.

The Artificial Neural Network structure mimics the human learning process by optimizing the "weight" and "bias" values of each Artificial Neuron, as the information flows through it. These structures also have memory states

which can understand and extract the correlations between the current state and the past states of the data.

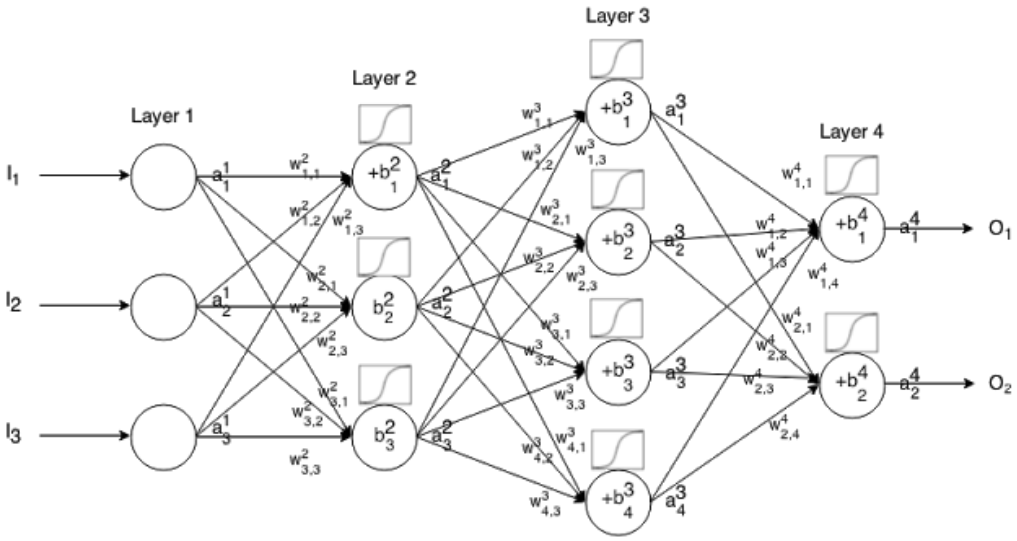


Figure 2 - A Multi-Layer Neural Network Structure

The Neural Network models learn the complex relationships between different sorts of financial data using performance optimization, error minimization and back propagation techniques.

After the network weights and biases are adjusted and the hyper parameters are optimized, the network validates and tests its performance on the unseen future data.

All these processes require massive computational power and experienced engineers to create and “train” the Neural Network Models. These models then generate the future price predictions for the subject financial assets, way more precisely than any other known method.

FinBrain Technologies has been performing Research and Development activities on Financial Prediction techniques that utilize Artificial Intelligence. Our engineers create models that collect and process massive amounts of quantitative data to predict the future prices of the assets listed under world stock indices, commodities and foreign exchange markets. We

have been running our algorithms on powerful GPUs every day to generate the most precise future projections of financial assets.

How Do Recurrent Neural Networks Learn from Financial Data?

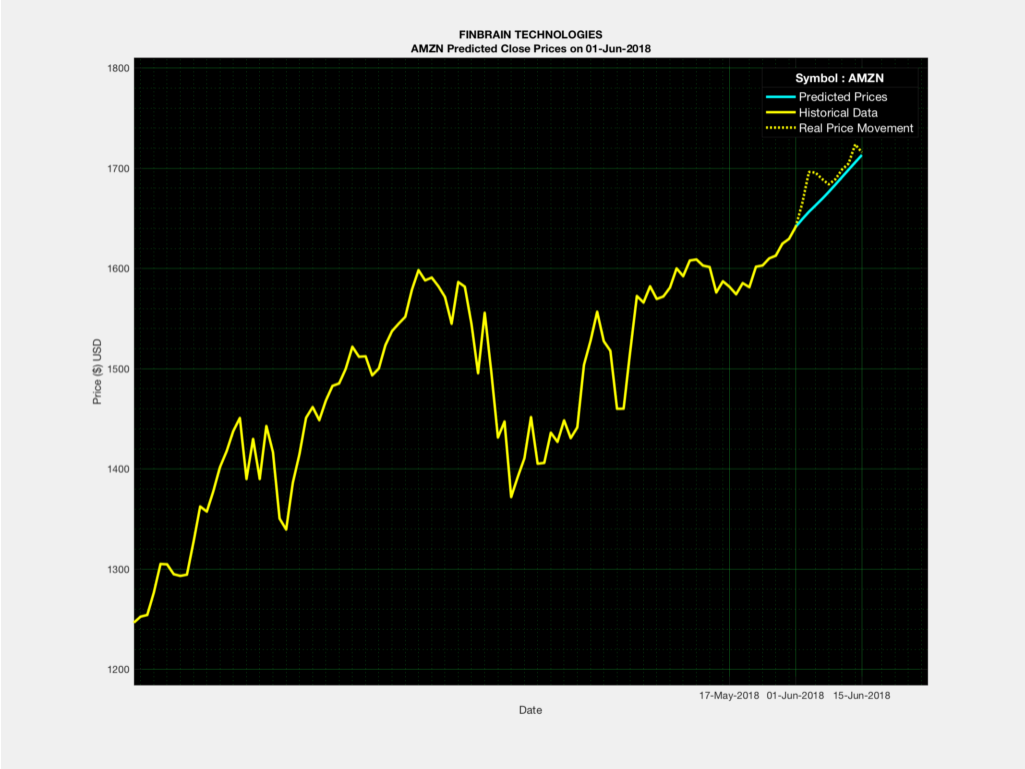


Figure 3 - Predicted and Real Price Movements of AMZN for a 10-day period

Our algorithms analyze large amounts of historical data related to every single stock using Long-Short Term Memory (LSTM) cell components of the Recurrent Neural Networks (RNN).

These special types of Artificial Neural Networks yield the best performance on understanding the relations between the vast sums of datasets, by incorporating memory component and extracting correlations.

Understanding the time series dependencies and how the inputs (stock price data, technical indicators, market sentiment data) affect the outputs

(stock close prices) are crucial to predict where the stock prices will move in the next time frame.

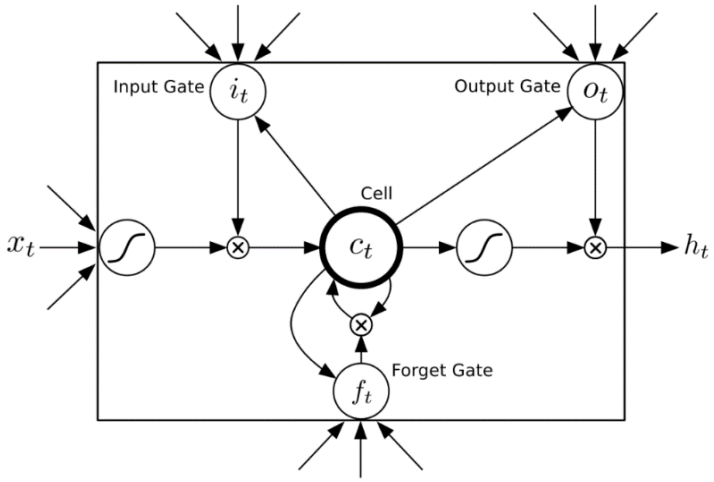


Figure 4 - An LSTM Cell Structure

The approach that we have mentioned above, outperform all other known stock forecasting models such as Fundamental Analysis and Technical Analysis. The Deep Learning algorithms determine the weights to be assigned on the input components by minimizing a cost function.

Creating the right network topology and optimizing large amount of network weights is a computationally hard task. The inputs to our artificial neural network models can be given as:

- Stock Open, High, Low, Close Prices
- Several different Technical Indicators
- Market Sentiment Data obtained by utilizing Natural Language Processing (NLP) Tools

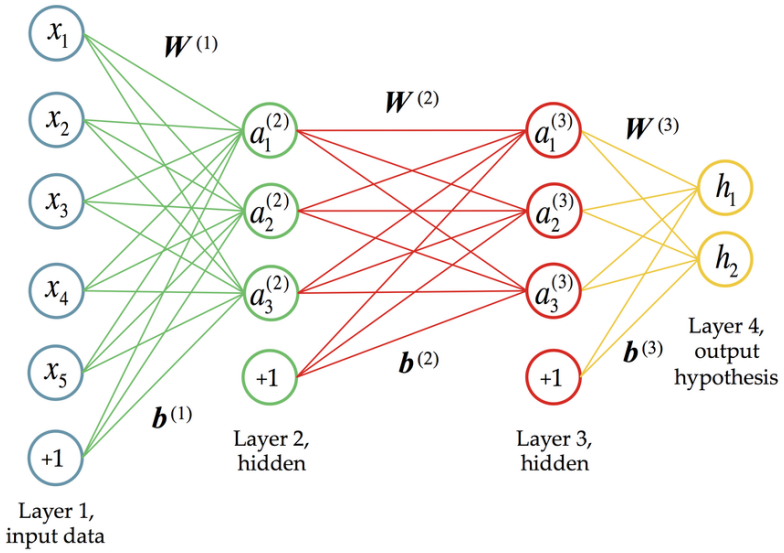


Figure 5 - A Network of Neurons Connected to Each Other

Feeding in more than 10 different input features of thousands of time steps for more than 10.000 financial assets, performing calculations and obtaining the future price predictions is not an easy task.

FinBrain runs its Deep Neural Networks on high performance Graphical Processing Units (GPUs), as training the NNs is computationally expensive. We provide our members with the predictions of the US & World Stocks, Foreign Currency Pairs, Cryptocurrencies, ETFs and Commodities after the markets close every day. FinBrain maintains a high standard in providing accurate and on-time financial data to its members, by utilizing powerful GPUs.

We have constructed and fine-tuned models that contain thousands of artificial neurons connected to each other, to learn how the asset prices, technical indicators and market sentiment behave by the time. These models assign weights to the artificial neurons through a computationally intensive optimization process, that ensures the best possible prediction accuracy.

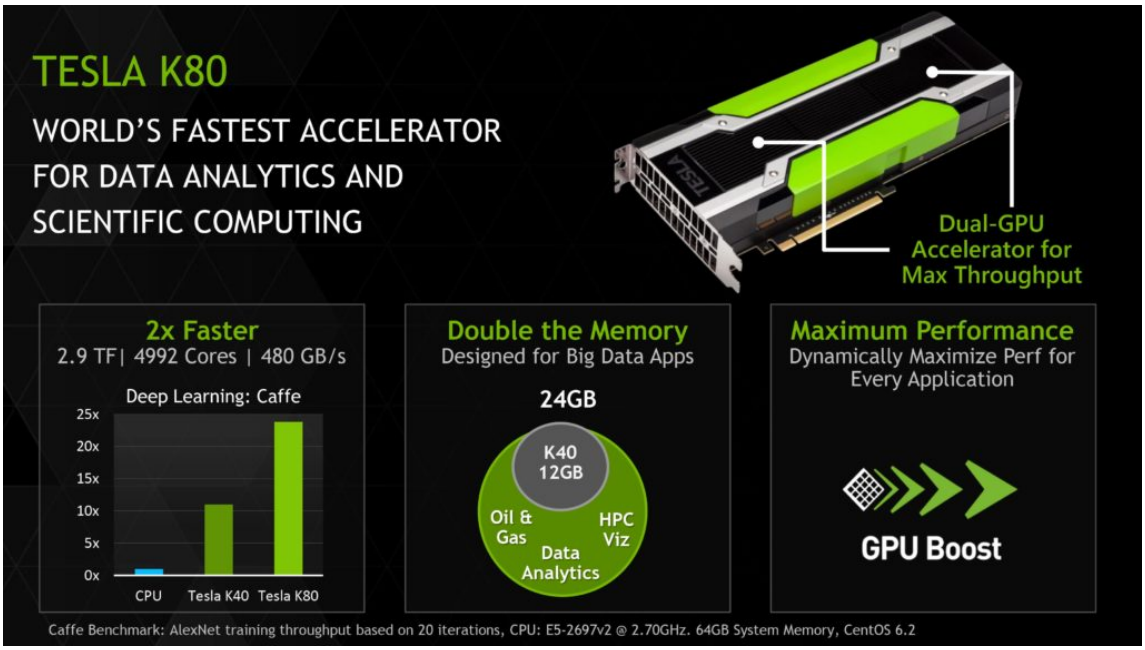


Figure 6 – An NVIDIA TESLA K80 GPU Unit Used in Deep Learning Computations

FinBrain's models utilize the cutting-edge AI technologies, which are also used by the large financial institutions for the financial analysis and prediction and are not publicly available to the individual investors. The results given on the performance results section of this book, proves why the AI algorithms are the future of investing and how you can beat the markets and generate solid returns using these technologies.

How many assets and which markets are predicted?

Currently, our algorithms collect, analyze and predict the financial data for more than 10.000 financial assets listed under S&P500, NASDAQ, NYSE, DOW30, ETFs, Commodities, Foreign Currencies, Cryptocurrencies as well as World Stock Markets: UK FTSE100, Germany DAX, Canada TSX, Hong Kong Hang Seng, Australia ASX, Saudi Arabia TASI and Mexico BMV.

- 505 Stocks in S&P500 Index
- 3269 Stocks in NASDAQ Index
- 3133 Stocks in NYSE Index
- 112 Most Traded Cryptocurrencies against USD
- 279 Foreign Currency Pairs against AUD, CAD, CHF, EUR, GBP, NZD, TRY, USD, ZAR Base Currencies
- 30 Stocks in Dow 30 Index
- 391 US Exchange Traded Funds
- 40 Most Traded Commodities
- 100 Stocks in UK FTSE100 Index
- 30 Stocks in Germany DAX Index
- 838 Stocks in Canada Toronto Stock Exchange
- 1949 Stocks in Hong Kong Hang Seng Index
- 1195 Stocks in Australia ASX Index
- 183 Stocks in Saudi Arabia Tadawul TASI Index
- 134 Stocks in Mexico BMV Index

are analyzed and predicted by FinBrain's Deep Learning Algorithms every day after the markets close, and the 10-day ahead predictions are made available before the markets open the next day. 12-month ahead predictions are also available within FinBrain Terminal.

How do we calculate the predictability of a financial asset?

There has been quite a debate about the stock market's predictability over many decades. Stock analysts, researchers, fund managers, investors and traders have both expressed their thoughts and concerns about what determines the stock market movements.

Is the Efficient Markets Hypothesis valid?

Efficient Markets Hypothesis (EMH) represented the idea that the share prices reflect all information and consistent alpha generation is impossible. This hypothesis hence said the markets are efficient and the stock prices follow a random walk process.

The idea was the prices follow no pattern and there is no way to predict where the prices are headed. EMH says that fundamental, technical and psychological factors determine the asset prices. The hypothesis has three different variants as weak, semi-strong and strong forms.

In short, these forms say that all the information is available to the public and is incorporated in the prices, where no fundamental or technical analysis and even insiders cannot generate superior returns.

Hurst Exponent for Predictability

The Hurst Exponent is used as a measure of long-term memory in a time series. As the stock prices are interpreted as time series data for FinBrain's AI algorithms, understanding the time series characteristics is essential to generate reliable predictions. Hurst Exponents helps us to figure out if a series is mean reverting, random walk or trending.

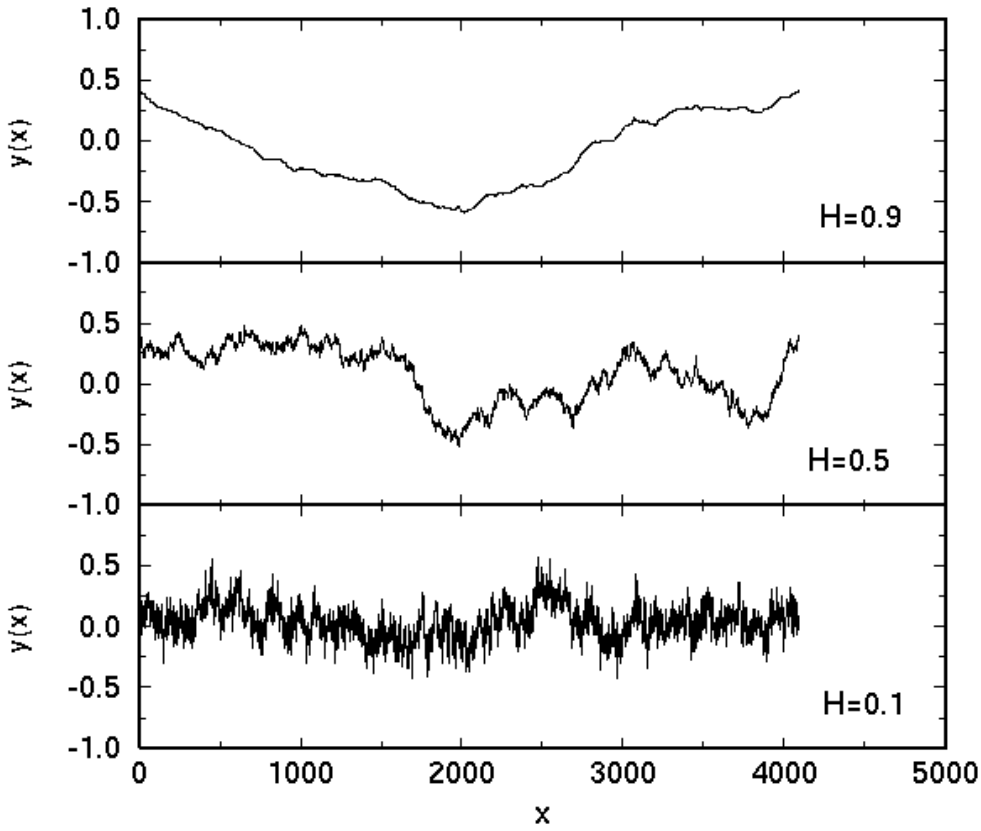


Figure 7 - Trending, Random and Mean-Reverting Time Series Movements

In a Brownian motion there is no correlation between the observations of a time series. EMH suggests that the markets exhibit random walk characteristics, where the stock prices have no correlations with the historical values.

A Hurst Exponent value close to 0.5 indicates that a series is following a Brownian motion. In this case, forecasting the market moving from the past prices is not possible.

A mean reverting movement is exhibited by anti-persistent time series where an increase is mostly followed by a decrease. A Hurst value between 0-0.5 indicates that the series tend to revert to its mean.

A Hurst exponent between 0.5-1 indicates a persistent time series and it is equivalent to trending market in financial terms. In this case an increase in the value of a time series is followed by an increase and vice versa.

Trading Strategies and The Hurst Exponent

Traders mostly utilize mean-reversion or momentum strategies to make money in the financial markets. When the return of an asset at time “t” depends on its return at time “t-1”, the returns are autocorrelated.

In a mean-reverting regime, the returns are negatively correlated as an increase in the price is most likely to be followed by a decrease in the next time step. In a momentum regime, the returns are positively collected as an increase in the price is followed by an increase in the next time step.

In both mean-reverting and trending market regimes, the current price of an asset contains information about the future price. Trading strategies can only generate profits if the prices are either trending or mean reverting, as the random walk (Hurst=0.5) process is random and unpredictable.

Efficient Markets Hypothesis (EMH) is only true when the Hurst Exponent is equal to 0.5 or is in a very narrow neighborhood of 0.5. However, Hurst is not always equal to 0.5 and it indicates that EMH which says the markets are completely unpredictable, is often violated.

By incorporating Hurst Exponent into the calculations, FinBrain Technologies adjusts the weights given to mean reversion or momentum strategies to increase predictability. AI Model input parameters are adjusted according to current market conditions in order to ensure high prediction accuracy.

A Data Driven Approach to Stock Prediction

90% of the world’s data has been created in the last two years. Huge amounts of data are generated every second, and analysts are trying to create models to extract features from data.

Data is the new commodity in the information age. The ability to collect, analyze and interpret the data determines the success of an organization in today's world.

Financial markets generate massive amounts of qualitative and quantitative data every single day, in the form of numbers, reports, news, press releases and so on. Organizing, interpreting and learning from gigabytes of data every single day, is beyond humans' capacity. However, AI models such as Machine Learning and Deep Learning are specifically designed to operate on and learn from vast amounts of data. A well-constructed model can extract the dynamics of how a stock's price is formed, by analyzing a diverse set of data.

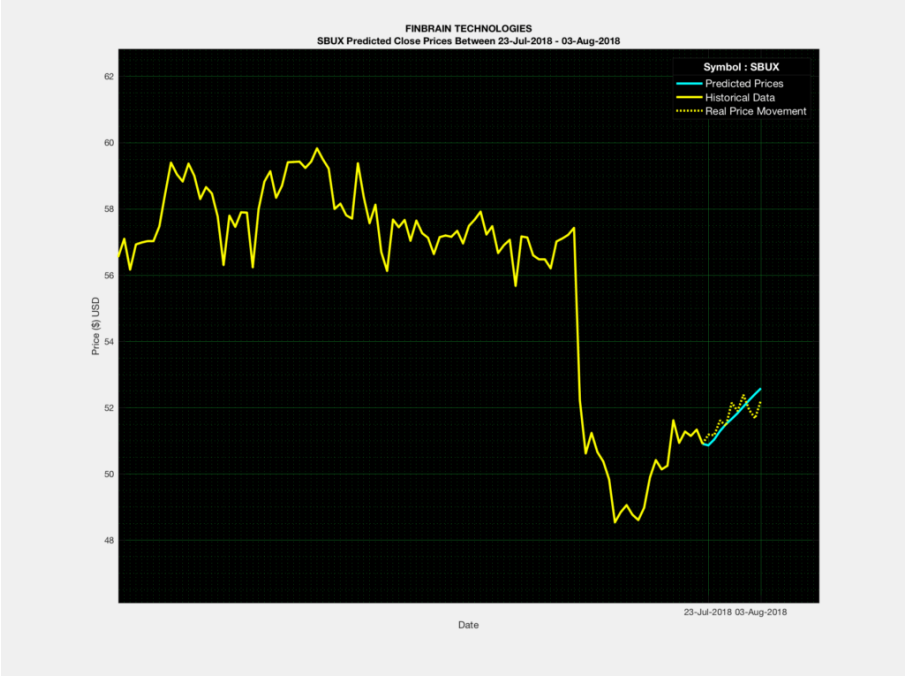


Figure 8 - Predicted and Real Price Movements of SBUX

FinBrain collects stock data: daily open, high, low, close, volume values, technical indicators, company financials and news/reports in order to build models that learn how these predictors affect the stock prices. We incorporate as much data as we can to increase the robustness and prediction accuracy of our algorithms. We train Deep Neural Network

models based on the data we collected for more than 10.000 US & World stocks, commodities, foreign currency pairs, crypto currencies and exchange traded funds on a daily basis. The trained models then predict where the asset prices will be heading to in the next 10-day period based on what it learned from the historical financial data.

Yearly Backtest Results

Backtests are important in optimizing the performance of the trading strategies. They are equally dangerous as traders and strategy developers can easily over-optimize their strategies. An over-optimized strategy usually overfits the data and perfects the algorithm's performance for the given test period. Once the backtested "perfect" algorithms are put into real trading, most of these strategies fail.

Using complicated models/strategies require lots of parameters to be optimized and testing these strategies over a short period of time eventually lead to overfitting. This is why a rather simple model can beat most of the complex strategies out there, when put into realtime trading. However, the main reason for great backtest results and poor production/real trading performance is using static models and model parameters.

The market conditions change over time, and a strategy widely optimized for a given period of time might perform worse on the unseen data. In order to overcome this problem, traders need to employ adaptive models, which change and optimize model parameters according to the market behavior.

The widely used indicator-based strategies have lost their edge because of the fact that their parameters keep constant over time and the fall short in capturing the regime changes in the market. These widely-known technicals based investing strategies also cannot factor-in different types of inputs at once such as OHLCV values, News Sentiment, other technical indicators and custom-built adaptive indicators. This is why traders who employ the old-school, technicals-based, non-adaptive methods are losing

money over the long run, eventually quit trading and believe that making money in the markets is impossible.

FinBrain Technologies has developed Digital Signal Processing algorithms and Deep Neural Network models for trading. These algorithms combine an adaptive approach to data processing and a self-learning neural network structure to factor in asset financial data to predict the future outcomes.

FinBrain's DSP and DNN based approach captures the regime changes, trends and mean reversions better than any other static, technicals based strategy out there. Our algorithms give the traders the edge they were seeking and help them achieve consistent returns in the long run.

We would like to demonstrate how our algorithms performed for the stocks listed under S&P500 over the year of 2019.

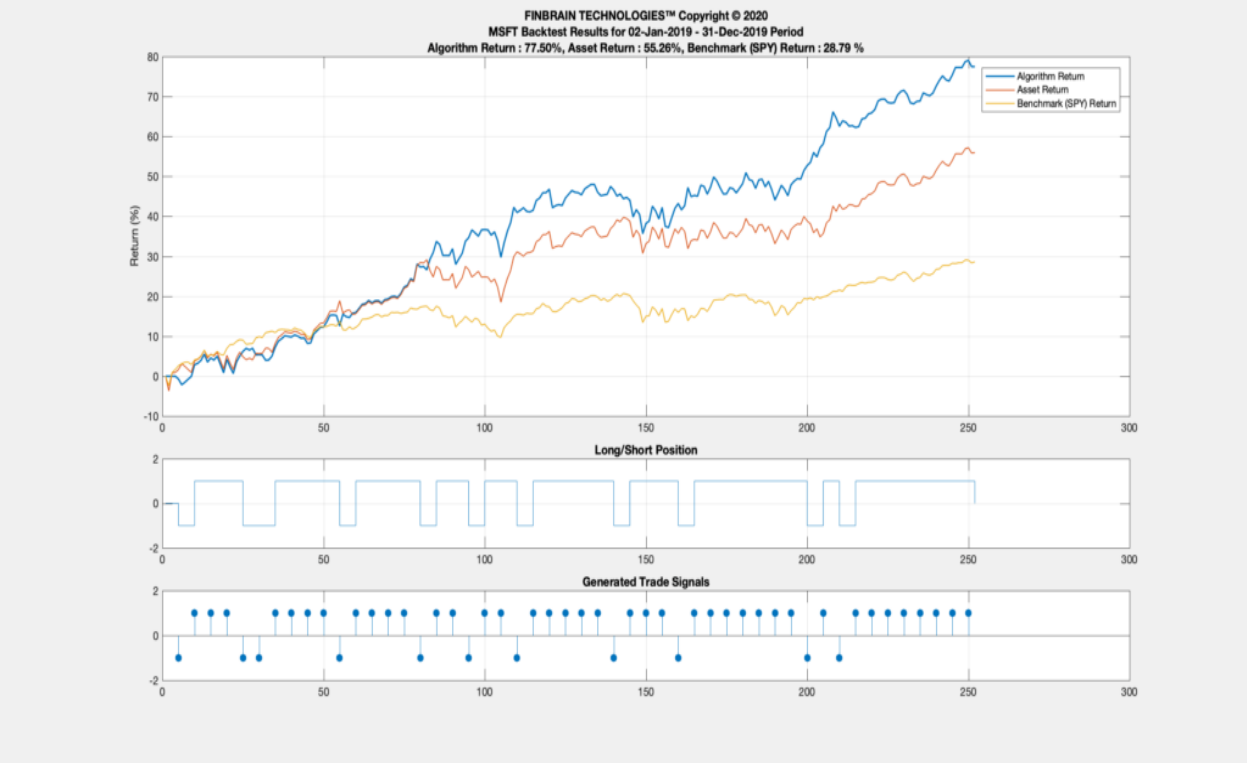
The Backtest Structure

We have backtested our algorithms for a number of widely traded S&P500 stocks between 02-Jan-2019 and 31-Dec-2019 time period.

Our algorithms have generated 5-day ahead predictions and we have generated BUY/SELL signals based on these predictions. If the predicted 5 day ahead price was higher than the last close price, we interpreted this as a BUY signal and vice versa.

A Long & Short trading strategy was used without any leverage and the strategy took Long or Short positions based on the generated signal. The algorithm kept the position for 5 trading days and re-positioned itself after 5 trading days if a new signal was generated. An arbitrary 4% stop loss is applied, as we always suggest to use stop losses on all your trades.

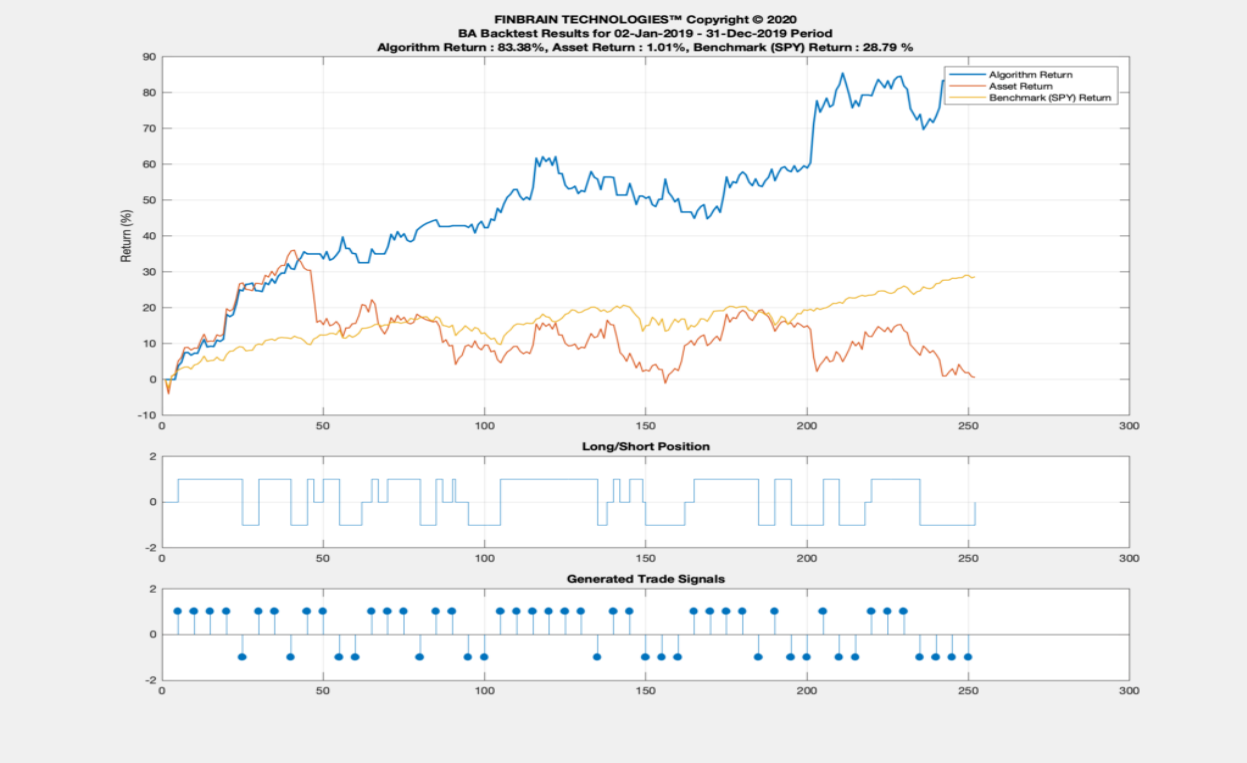
MSFT - Microsoft Corporation



MSFT buy and hold strategy has returned 55.26% between 31-Dec-2018 and 31-Dec-2019. FinBrain's algorithms have yielded 77.50% return over the given period by trading MSFT stock. The algorithm took 20 trades based on the Neural Network generated signals and 14 of them (70%) were profitable. Our strategy has beaten the buy and hold strategy by more than 22%. Maximum drawdown was 8.18% and Return-to-Drawdown ratio was 9.47.

A good strategy usually has a high Return-to-Drawdown ratio, which means that your algorithm eventually returns higher values with less decrease/drawdown in your portfolio value during the given period of time.

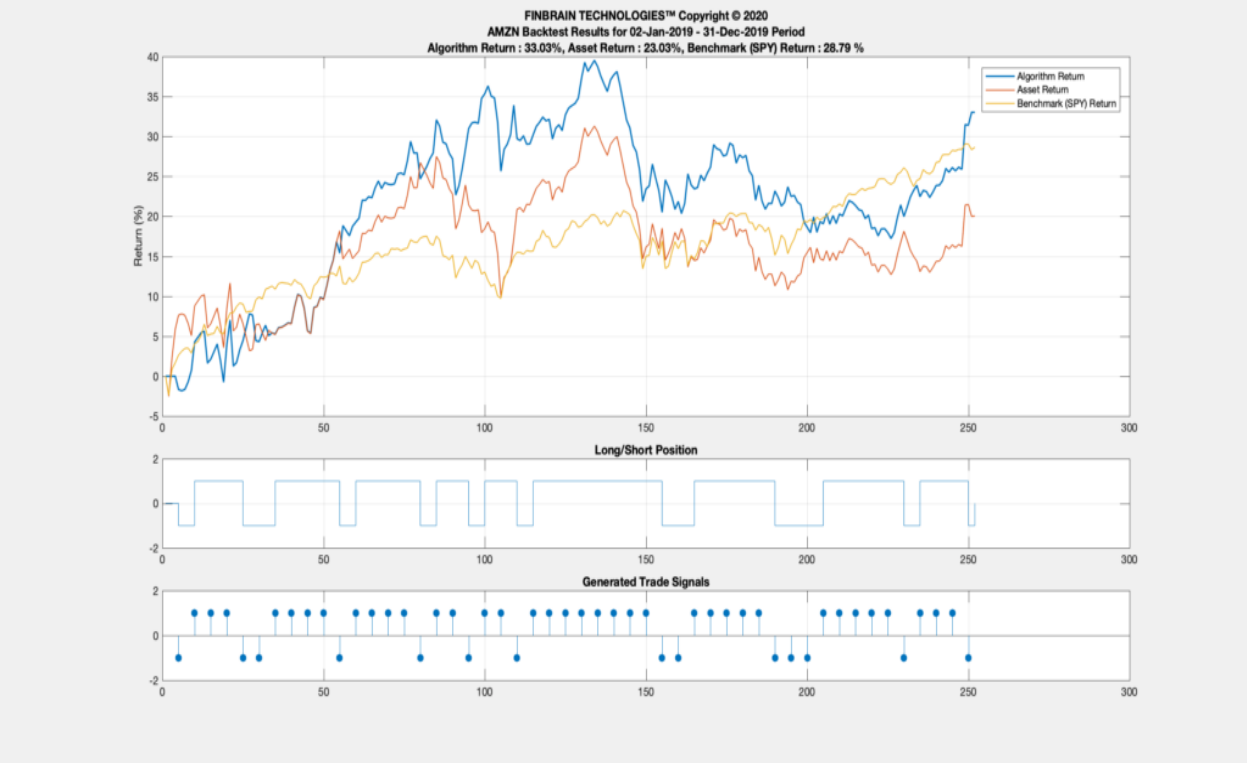
BA - Boeing Co.



BA stock has returned only 1% during the year of 2019. The stock has returned more than 30% at some point during the year, however gave back almost all of its gains throughout the year. FinBrain's algorithm has returned a massive 83.38% by trading BA where the stock price has more or less yielded random walk characteristics.

Our algorithms have kept generating profits despite the stock's price going down. Maximum drawdown of this strategy was 10.24% and the Return to Drawdown ratio was 8.14. The algorithm has beaten the Benchmark (SPY) and the asset's (BA) returns significantly during a year's time.

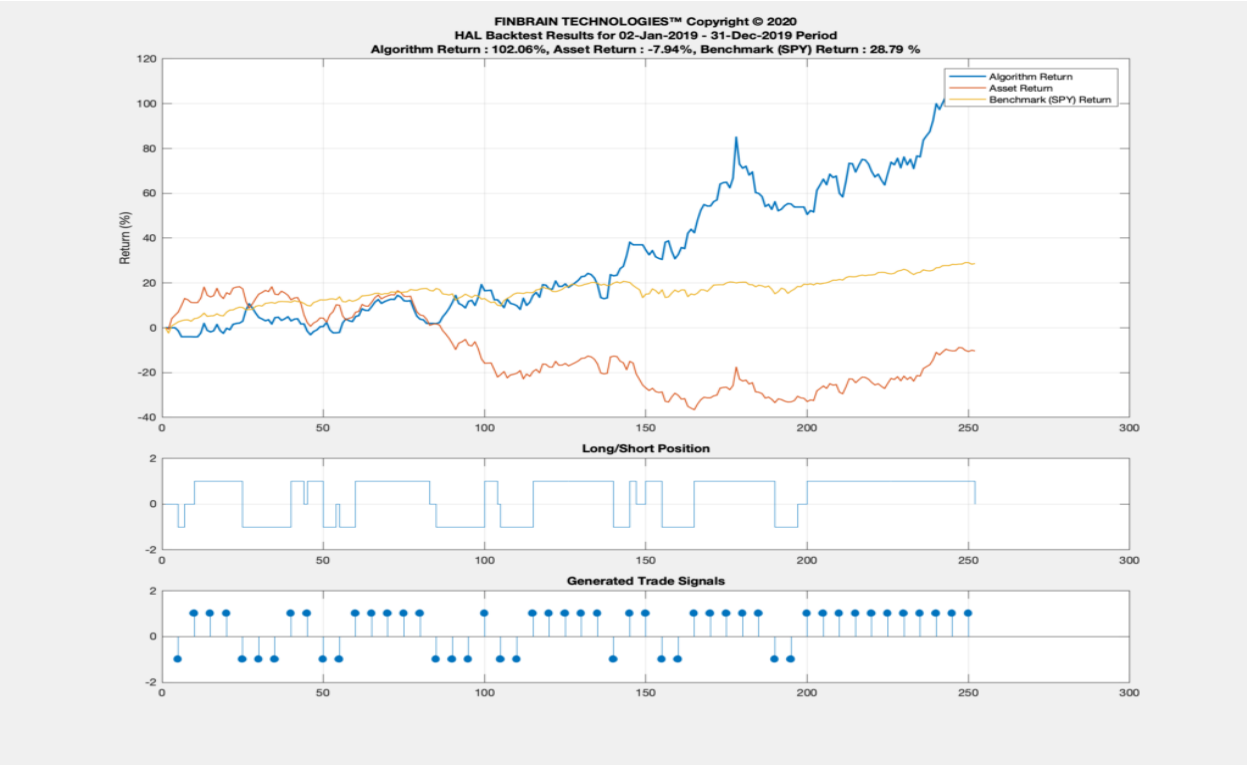
AMZN - Amazon.com, Inc.



AMZN stock has returned 23.03% during 2019, where FinBrain's algorithms have returned 33.03% trading AMZN stock. Our algorithms have beaten the buy and hold strategy for the most valuable company stock being traded in the US Stock Market: AMZN. 11 out of 19 trades taken by the algorithm were profitable and the Return-to-Drawdown ratio was 2.14.

The market is a mechanism that transfers the money from the pockets of the impatient to the patient, and that's you need to stay consistent and patient with your trades. People tend to stop trading, or close their positions especially in drawdown times and think that their strategies are not working. Traders should know that the drawdowns are expected and are natural. You just need to stay patient because only the ones who can accept the drawdowns and trade consistently are getting rewarded in the markets.

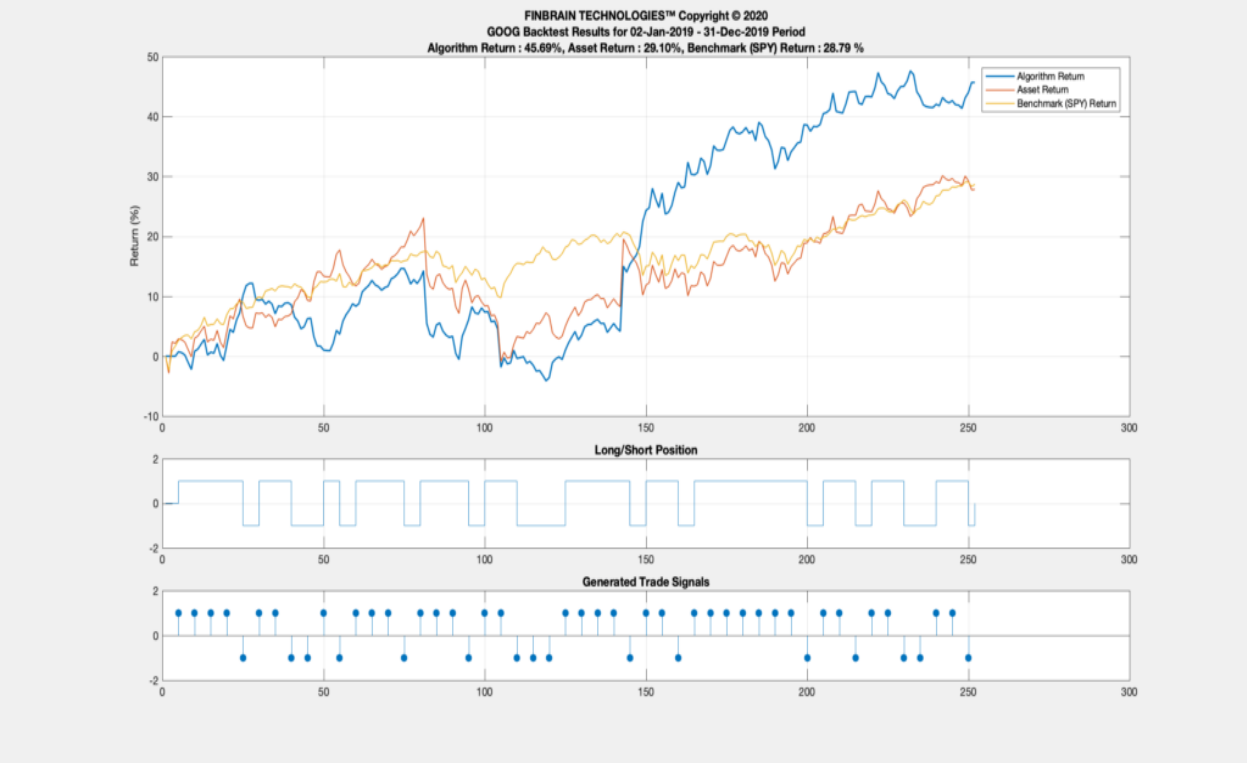
HAL - Halliburton Company



Halliburton is an oil & gas company whose stock was struggling to turn green in 2019. However, the stock has lost 7.94% of its value in a year's time. FinBrain's algorithms trading HAL stock have returned a massive 102.06% return and the percent returns curve moved with a strong upside. The maximum drawdown occurred as 18.15% and return to drawdown ratio was at 5.62.

HAL has exhibited upward and downward moves during different times of the year, however closed the year with a loss. Our algorithms have taken advantage of both up and down movements and generated massive returns once again, trading HAL stock.

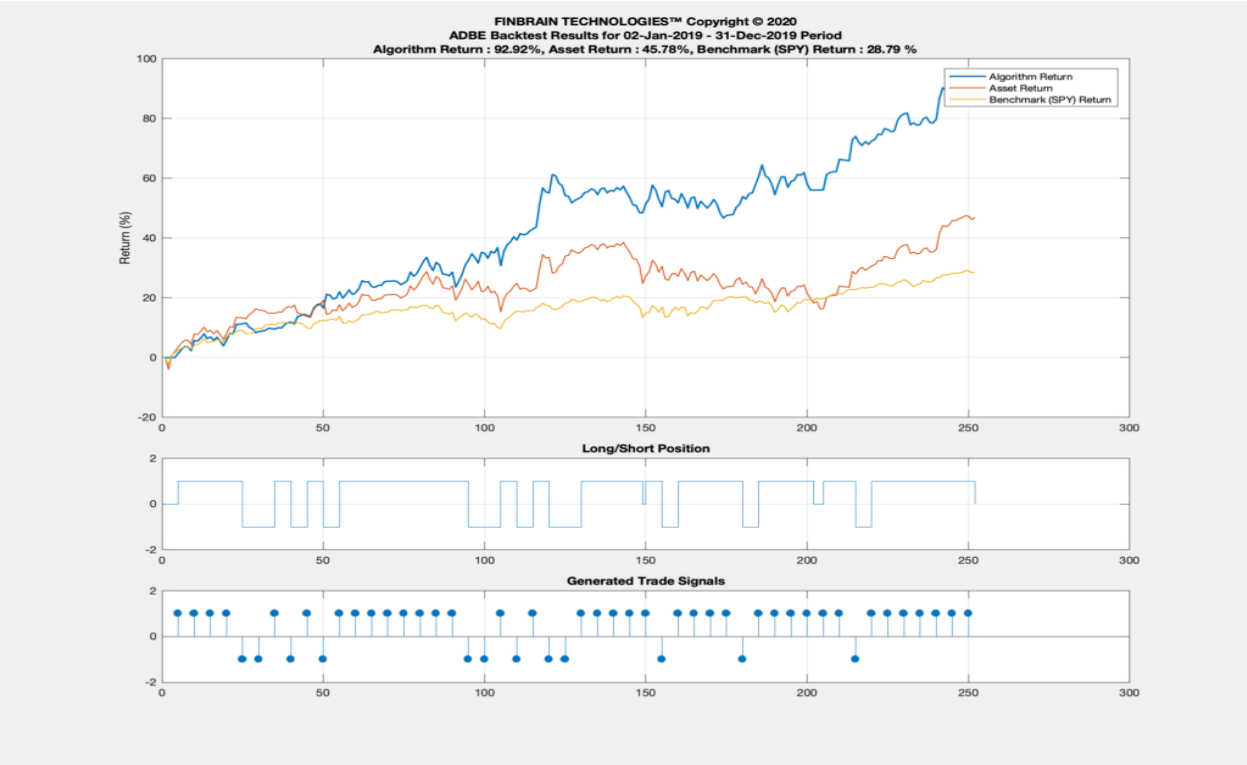
GOOG - Alphabet Inc. Class C



GOOG buy and hold strategy has returned 29.1% during the year of 2019. FinBrain's trading strategy which considers 5-day ahead predictions and interprets them as Buy or Sell signals, have returned 45.69% over the same period trading GOOG. The algorithms took 24 trades and 14 of them were profitable.

One of the most important qualities required for trading is to accept that losing trades will occur. However, your strategy needs to have more winning trades than the losing ones over the long run and you shouldn't quit trading because you had a couple of losing trades. The maximum drawdown was 15.64% and Return-to-Drawdown ratio was 2.92.

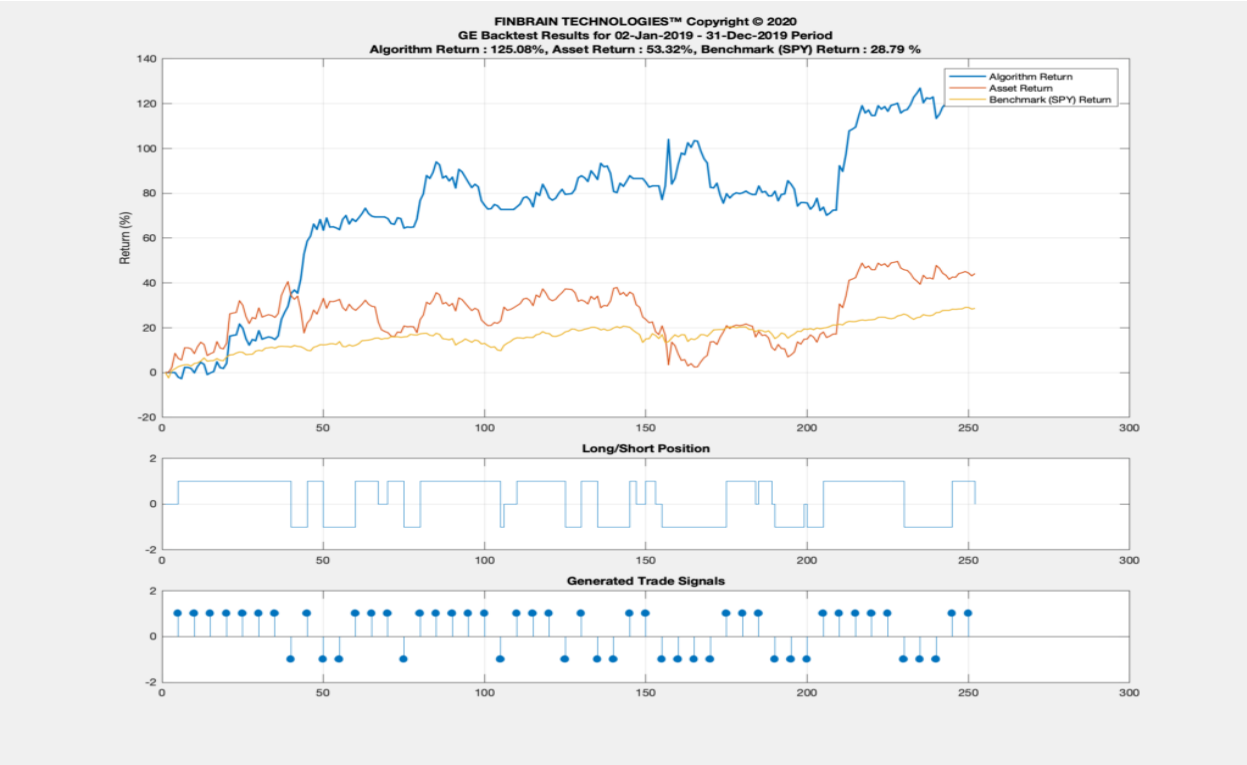
ADBE - Adobe Inc.



ADBE has gained 45.78% in value during 2019. The stock price has started to move south during the Q3 of the year and gave back almost half of its gains. The stock had a few upward and downward periods, however FinBrain's algorithms have spotted these regimes correctly and turned them into profitable periods.

Our algorithms have returned twice the asset's yearly return, which equals to 92.92%. Maximum drawdown was 8.60% and Return-to-Drawdown ratio was 10.81. The return/equity curve exhibited by our strategy backtest is very close to the ideal curve with a low drawdown and high return.

GE - General Electric Company

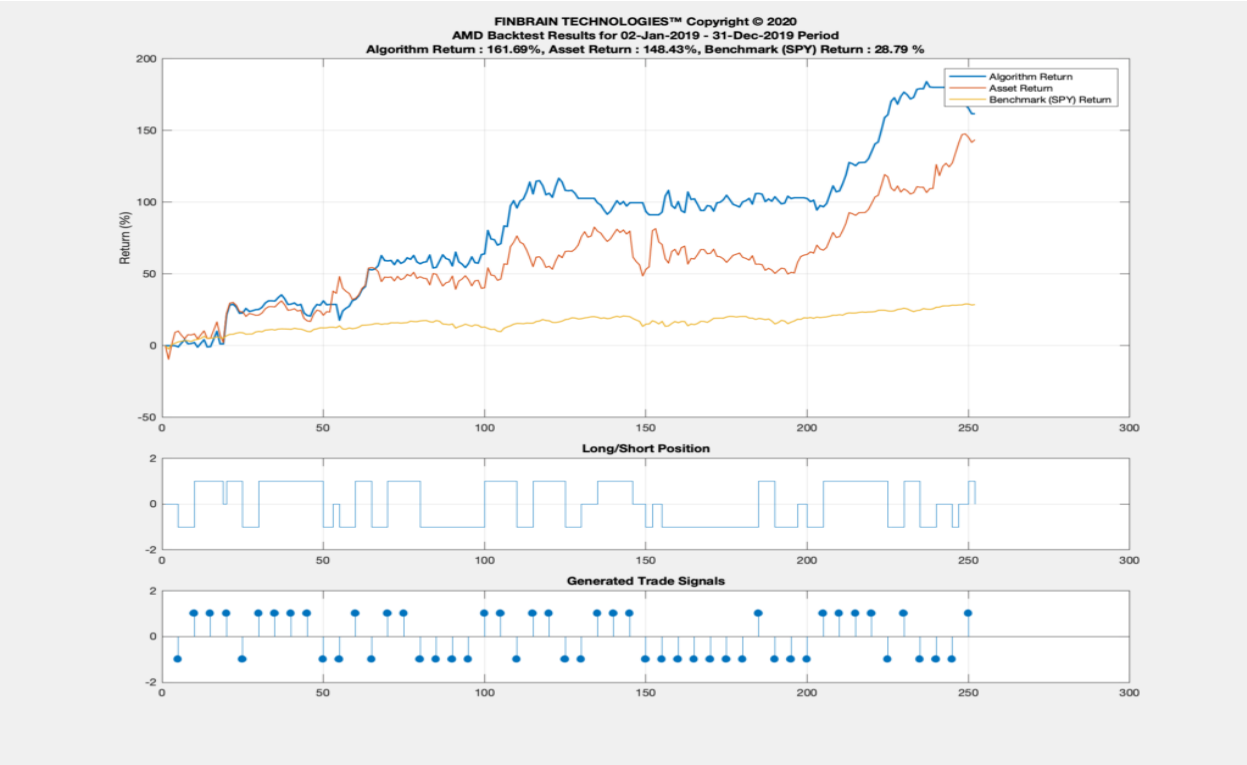


GE has gained almost 40% during the first half of 2019, then gave back almost all of its gains. The stock has again started to gain traction, and finished the year with a 53.32% increase. Despite all the ups and downs in the GE stock price, FinBrain's return curve for GE had strong upward moves and finished the year with a massive 125.08% gain.

Our strategy has beaten both buy & hold strategy for GE and the Benchmark (SPY) returns. The maximum drawdown exhibited by our strategy was 15.79% and the Return-to-Drawdown ratio was 7.92.

Static and non-adaptive indicators-based strategies have lost money during this period, as the underlying characteristics of the stock price do not stay the same over the time.

AMD - Advanced Micro Devices, Inc.



AMD is a quite popular semiconductor company that focuses on developing computer processors. The AMD stock took off like a rocket in 2019 and enjoyed its ride in 2020 as well. The stock has gained 148.43% in 2019 with a couple of strong pullbacks.

FinBrain's algorithms trading AMD based on 5-day ahead predictions have returned 161.69% in a year's time. Maximum drawdown was 12.39% and Return-to-Drawdown ratio was 13.05.

FinBrain's algorithms have captured the upward moves in the AMD stock price correctly and didn't get hit by the pullbacks during the mid-year. This indicates that the smart and adaptive Digital Signal processing techniques combined with Neural Networks exhibit a great performance in trading.

FinBrain Terminal and FinBrain API

FinBrain applies a set of Digital Signal Processing techniques to the financial data before feeding it into the neural networks and this helps the data to be analyzed much better than the majority of the models out there. Lagging, indicators-based trading will not react to the changes in the market conditions quickly and will cause many losing trades. Various markets and thousands of assets can be modeled and predicted with the combined DSP-DNN approach created by FinBrain Technologies.

Majority of the indicators-based trading strategies are lagging by their nature and would be hardly beaten by the buy & hold strategy and cutting-edge deep learning based strategies. The old school strategies are bound to lose money as more advanced technologies replace technicals based or fundamentals-based investing. FinBrain's algorithms adapt to the changes in the market behavior and help trades with spotting the best opportunities even during the market downturns.

Currently, traders from all over the world can reach out to FinBrain's AI enabled predictions for the next 10 days and 12 months, through **FinBrain Terminal**. However, if you would like to automate your trades or if you are already doing so, our brand new **FinBrain API** will help you on retrieving our AI enabled predictions for more than 10.000 assets. FinBrain API will help you on beating the markets, as seen on the backtests given above for some of the largest US companies' stocks. You'll also have the chance of removing the emotional bias from your trades, apply a proven cutting-edge strategy and become a consistent trader.

You'll be one of the select few, who employs Deep Learning technologies on their algorithmic trades by utilizing **FinBrain API**. We will release our API products in the coming weeks. FinBrain Terminal and FinBrain API will empower you on the way to become a consistently profitable trader, who beats the markets thanks to the cutting-edge AI and data analysis technologies.

FinBrain's Predictability Indicator

FinBrain's algorithms collect, organize and feed the financial datasets to the Deep Neural Networks in order to analyze and predict the stock prices. Figuring out the behavior of the stock prices and correctly involving the right predictors in the dataset is substantial when it comes to training a Deep Learning model. However, we need to come up with a value to measure how predictable the stocks are for the given time period. This is important in order to take the safest trades that maximize returns and minimize risks.

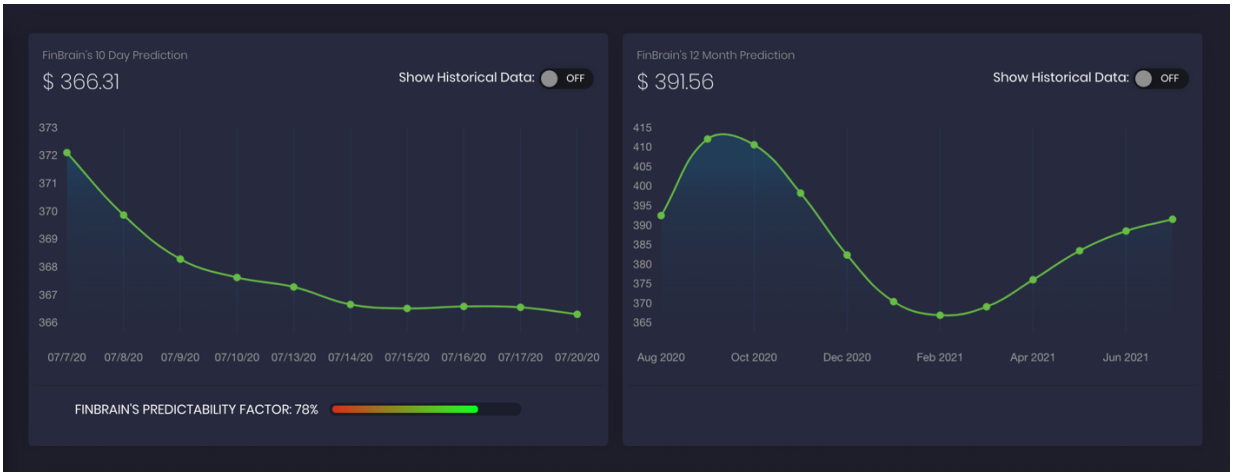
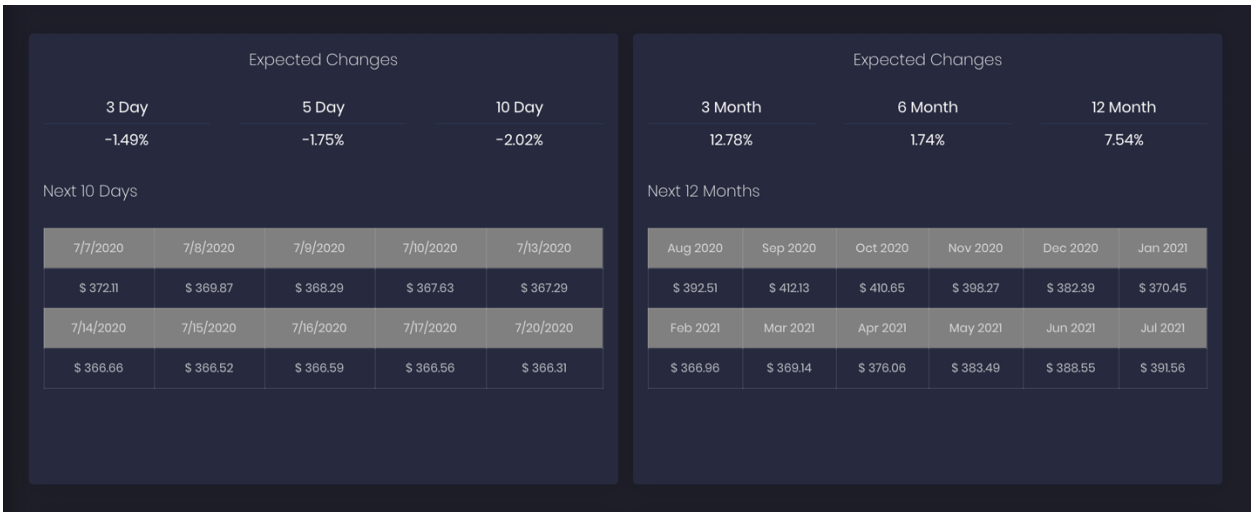


Figure 9 - FinBrain's 10-Day Ahead and 12-Month Ahead Prediction Charts

FinBrain has constructed a special predictability analysis algorithm that calculates how predictable an asset is, by incorporating Hurst Exponent, Volatility and Coefficient of Determination (R-squared). Both concepts are merged into a single algorithm in order to provide a robust predictability indicator value that helps our customers to take safe trades.



FinBrain's 10-Day Ahead and 12-Month Ahead Prediction Tables

How to Utilize the Predictability Indicator

A high predictability indicator shows that the forecasts for the asset is more likely to happen, and the risk of deviating from the forecasted values is lower. A low predictability indicator shows that the stock can make moves outside of the predicted pattern and the risk of deviation is higher.

Our customers can filter the assets listed under S&P500, NASDAQ, NYSE, DOW30, UK FTSE100, German DAX, HK Hang Seng, Canadian TSX, Australian ASX, Foreign Exchange, Commodities, Cryptocurrencies and ETFs markets based on Expected Change Values for 3-day, 5-day and 10-day periods as well as based on the Predictability Indicator.

The Daily Technical Analysis Report

We have enabled a rule-based algorithm that generates a report of the technical outlook for every single stock, commodity, foreign currency pair

and exchange traded fund available on our website. The new algorithm analyzes technical indicators such as RSI, MACD, SMA, Bollinger Bands and daily asset close prices to create a technical report for all assets listed under the available prediction packages.

The Daily Technical Analysis Reports are accessible at the Predictions Page on our website. We strongly believe that this new feature will create an edge for the traders by making the Technical Data easily accessible and understandable while combining the predictive powers of the AI algorithms and rule-based algorithms. This hybrid approach will help the traders that combine several indicators and the results of our algorithms to take trades.

Prediction Performance Results

FinBrain Technologies
DOW30 Prediction Performance
www.finbrain.tech

Top 10 Stocks Under FinBrain's LONG Portfolio			
Expected vs Real Gains In 3 Trading Days			
12-Dec-2019 - 16-Dec-2019 Period			
Max Return : 4.1105% and Average Return : 1.9427%			
Portfolio Prediction Accuracy : 90%			
Ticker	Expected % Change	Real % Change	Result
INTC	4.3137	1.1039	✔
WBA	3.3173	-0.3620	✖
CAT	2.2265	0.9444	✔
PFE	1.6900	2.4071	✔
AAPL	1.4852	3.3571	✔
UTX	1.2763	1.4871	✔
DIS	1.2100	0.5895	✔
UNH	1.2038	4.1105	✔
CVX	0.8636	2.6929	✔
GS	0.8344	3.0969	✔

Table 1 - DOW30 Past Prediction Performances for a 3-Day Period

Traders from all over the world, utilizing FinBrain's AI enabled predictions have also yielded consistent returns changing between 2-5% on a weekly basis. Our 3,5,10-day ahead predictions have modeled the future price

paths of thousands of assets under Stock, Commodity, Foreign Exchange, ETF and Cryptocurrency markets. The Deep Learning algorithms developed by FinBrain has demonstrated signal-wise prediction accuracies varying between 70-100% on a weekly basis as well.

FinBrain Technologies
Past Prediction Performances
www.finbrain.tech

Top 10 Foreign Currency Pairs Under FinBrain's LONG Portfolio			
Expected To Gain Value In 10 Days			
19-Jul-2019 - 01-Aug-2019 Period			
Max Return : 5.7995% and Average Return : 2.339%			
Portfolio Prediction Accuracy : 90%			
Ticker	Expected % Change	Real % Change	Result
TRY-ZAR	2.6909	5.7995	✔
TRY-ILS	2.6252	1.5042	✔
CHF-GBP	2.2431	2.1451	✔
TRY-RUB	2.2007	3.6934	✔
CAD-GBP	2.1847	1.7769	✔
CAD-AUD	2.0778	1.5306	✔
CHF-AUD	1.9685	1.8979	✔
TRY-CNY	1.9401	2.4644	✔
TRY-IDR	1.8733	3.4933	✔
CHF-USD	1.6731	-0.9153	✖

Table 2 - Foreign Currency Pairs Past Prediction Performances for a 10-Day Period

Our Top 10 Portfolios which we've brought together for different asset classes have yielded 70-100% signal-wise prediction accuracy on a weekly and bi-weekly basis. We have shared those results with our members on a periodical basis as well. Majority of our traders have opened Long positions based on our Top 10 Highest Return portfolios and followed the price paths for the given assets on the charts, which were also published on our website.

FinBrain's algorithms keep helping the traders from more than 150 countries from all around the world, with generating alpha and minimizing risks. FinBrain's AI algorithms successfully analyze the asset prices and market conditions to predict what's next for the stocks, commodities,

currency pairs, exchange traded funds and cryptocurrencies on a daily basis. FinBrain's AI algorithms spot the best market opportunities for many traders in beating markets significantly and generating decent profits.

FinBrain Technologies ETFs Prediction Performance www.finbrain.tech			
Top 10 ETFs Under FinBrain's LONG Portfolio			
Expected vs Real Gains In 5 Trading Days			
17-Sep-2019 - 23-Sep-2019 Period			
Max Return : 19.2706% and Average Return : 7.3486%			
Portfolio Prediction Accuracy : 90%			
Ticker	Expected % Change	Real % Change	Result
DWT	13.8084	14.3223	✔
GDXJ	12.3676	7.4926	✔
ZROZ	11.8679	4.0460	✔
GOEX	11.5941	6.6988	✔
GDX	10.8869	6.8523	✔
EDV	10.5669	3.7641	✔
VXX	9.5993	-1.4091	✖
SILJ	8.5302	9.8592	✔
TLT	7.3158	2.5890	✔
DGAZ	7.1325	19.2706	✔

Table 3 - ETFs Past Prediction Performances for a 3-Day Period

The Profit Potential of the Deep Learning Algorithms

As can be seen on the past prediction performances, our traders have the opportunity of collecting 2-5% returns easily on a weekly basis depending on the markets you choose to trade. If you choose to trade Top Stocks for the given time periods, the potential return on a single asset goes up to 8-13% on a weekly or bi-weekly basis.

The key here is, collecting consistent profits and growing your account steadily using the tools that give you an edge over the others. FinBrain's algorithms provide financial data and predictions for every single asset listed under the available markets, as well as Top Long and Top Short

stock picks. You can invest more aggressively and open the doors for yielding higher returns on your investments using our Top Stock picks.

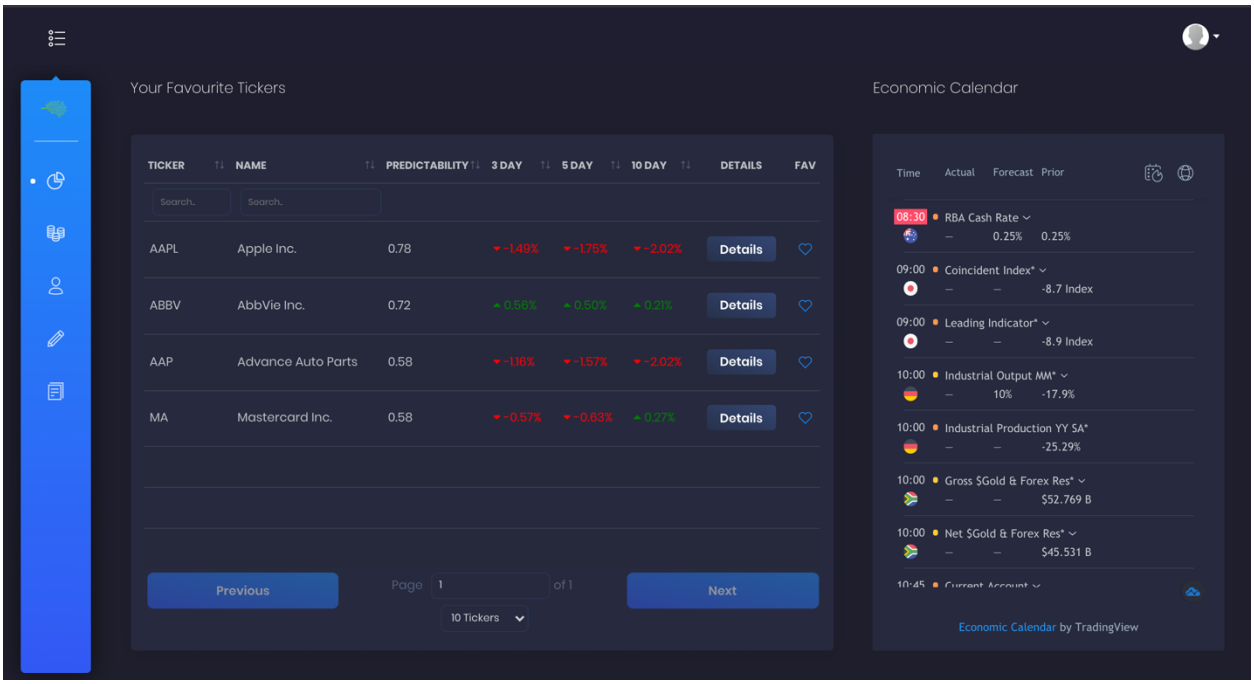
70-100% signal-wise prediction accuracies are scored and maintained by FinBrain's Top Picks for different time intervals. FinBrain supports the patient and consistent traders by giving them an extra 20% discount when they choose to subscribe to our services, instead of purchasing the one-time packages.

FinBrain Terminal Is Now at Your Fingertips

Data and Artificial Intelligence Technologies are transforming the Finance. Utilizing the right tools to analyze and understand the market movements are essential to generate alpha and beat the market significantly.

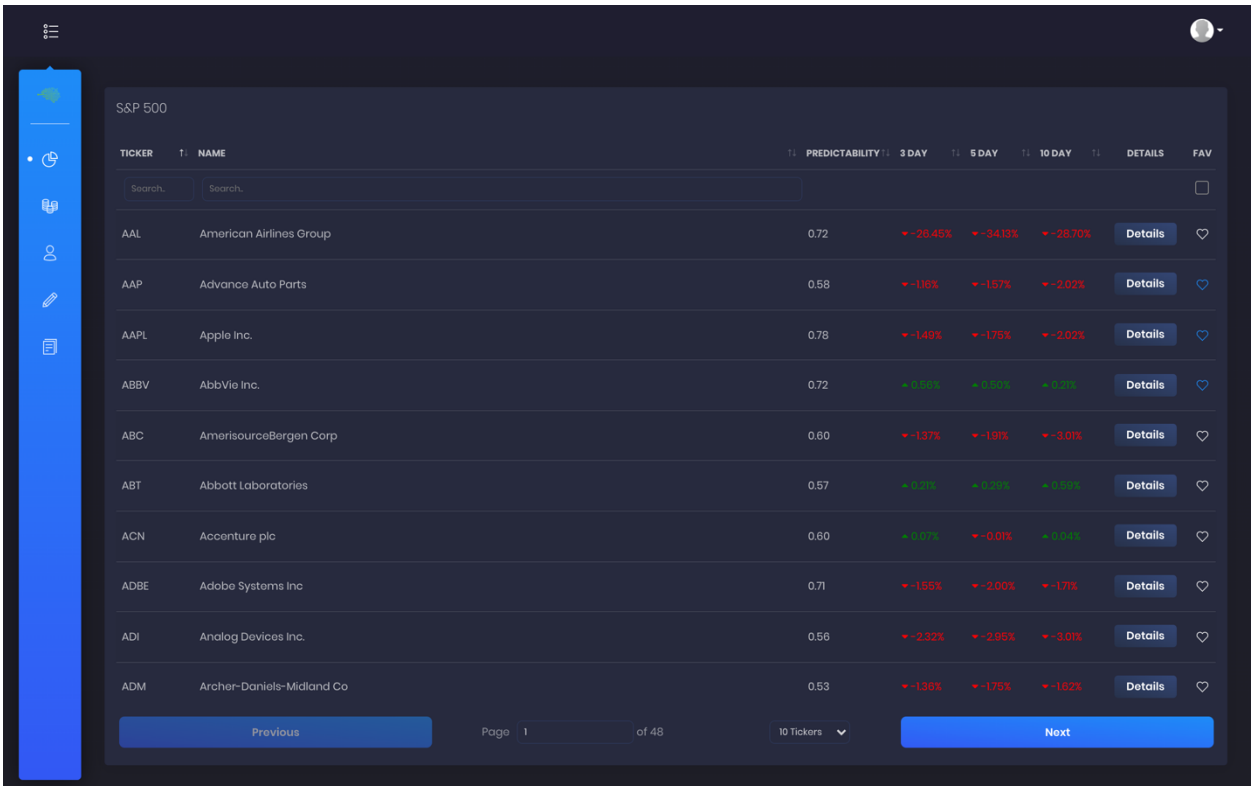
FinBrain Terminal is now available to the traders from all around the world. AI enabled 10-day ahead and 12-month ahead predictions, company financials, advanced charts and technical indicators, economic data as well as an API to retrieve the predictions to your trading platform are available within FinBrain Terminal.

We are here to help you in collecting the most profits out of your trades. The markets are moving fast and FinBrain is here to help you on spotting the best invetment opportunities and highest return stocks with its cutting edge Deep Learning Algorithms.



Favorite Tickers and Economic Calendar on FinBrain Terminal

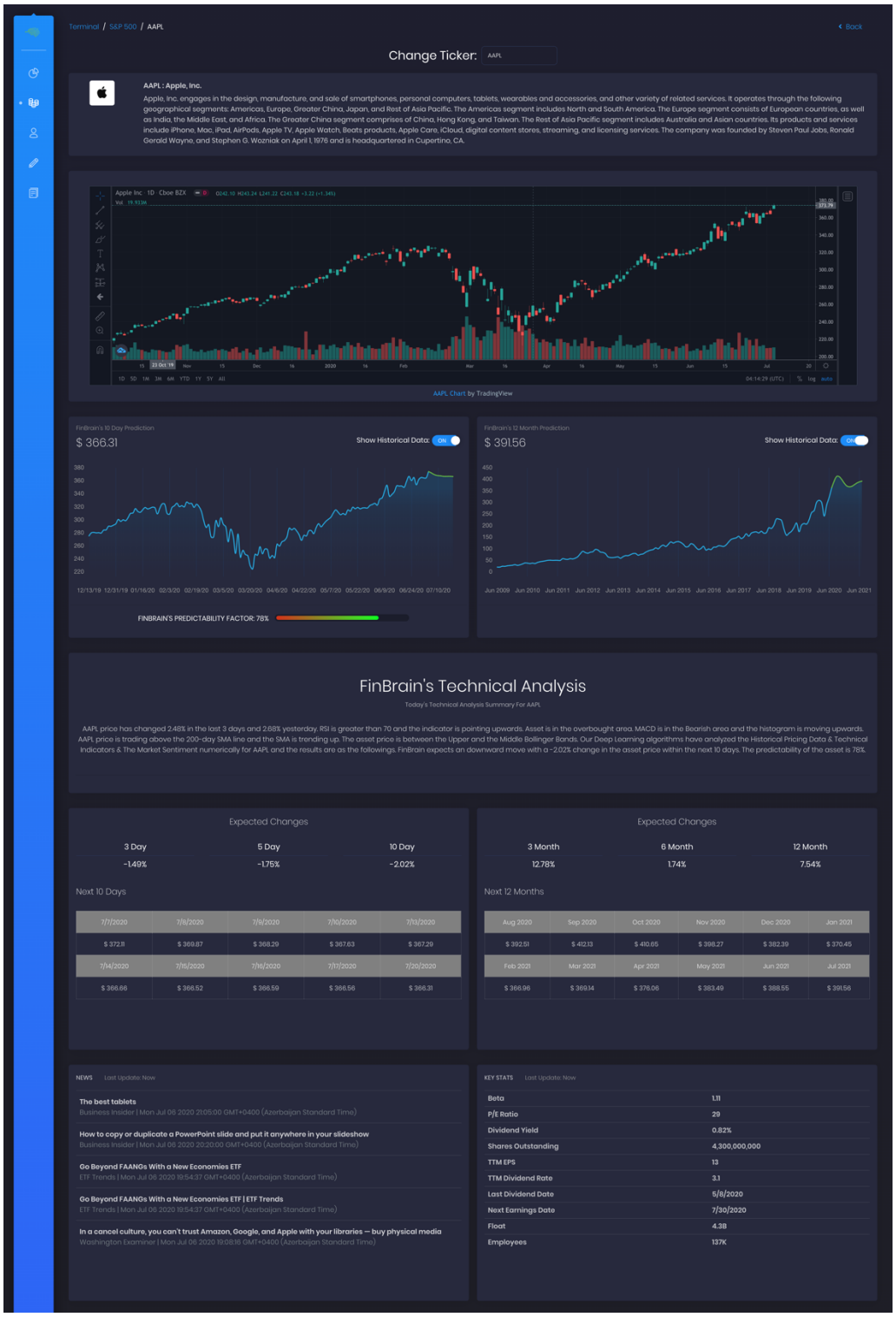
You can add and remove your favorite tickers easily on the Terminal page. A real-time economic calendar is also provided to all members, where you can access the forecasted, actual and prior values of the key financial data from different countries all around the world. This feature helps the stock, foreign exchange and commodities traders to keep up with the critical financial data that affects the markets.



List of S&P500 Stocks on FinBrain Terminal, Register and Discover More Markets on https://finbrain.tech

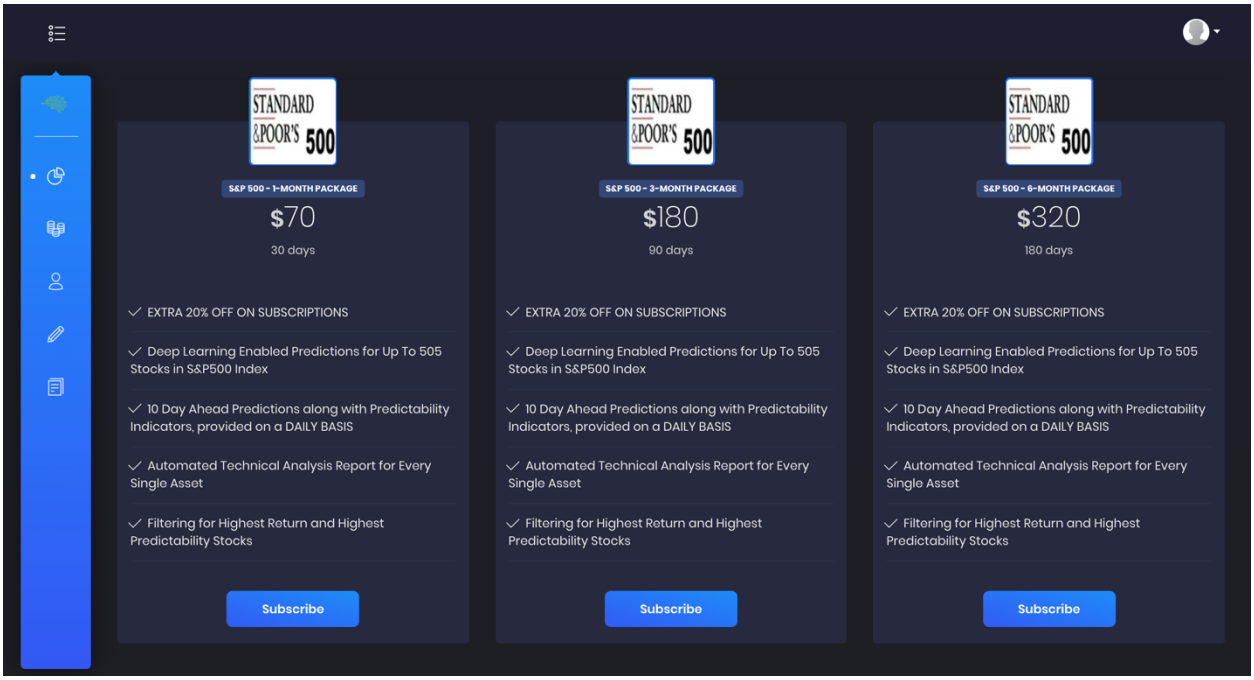
Right below the Favorite Tickers and Economic Calendar, you will be able to see the tabs where you can pick the market of your interest among 14 currently available options. On the image above, you can see the S&P500 stocks along with their Predictability Indicators and Expected 3/5/10 Day Change values.

When you click on the “Details” button for an asset, the ticker details page opens where you will be able to see the company details, interactive chart, 10-day ahead and 12-Month ahead prediction charts, tables, daily technical analysis report, company news, company key stats and a market screener.



The Asset Details Page on FinBrain Terminal, Register and Discover More Predictions on https://finbrain.tech

You can easily select the package of your interest, among the available 1-Month, 3-Month and 6-Month options for each market and complete the checkout. Please note that we are here to help the traders who seek consistency and who would like to grow their accounts steadily. That's why we provide an extra 20% discount on all subscriptions.



Available Prediction Packages for S&P500 Stocks on FinBrain Terminal

FinBrain API

We are also currently working on an API, where you can retrieve all the data provided on our website for your professional needs.

If you are programming new tools, strategies, automated traded systems using Python, JavaScript, C/C++ you can request our data just by obtaining an API key from our website.

You will also be able to reflect our data on your Meta Trader, Trade Station or TradingView screens.

The release of the new API service is planned for Q4 2020, and we strongly suggest you to register on our website in order not to miss the release notification.

Join the AI Revolution in Investing

FinBrain Technologies helps traders from more than 150 countries all around the world with the most advanced Deep Learning algorithms, developed and optimized for financial prediction. The traditional fundamental and technical analysis methods have already lost their edge over time, as they have become widely available to anyone.

The traders utilizing the tools that have capability of collecting and analyzing massive amounts of data are able to spot the trends and opportunities with better accuracy than anyone else out there in the market.

Joining the AI revolution and being an early adopter of this technology will give you an edge over all others struggling to find the opportunities in the market.

You can visit FinBrain Technologies' website and start getting AI Enabled Predictions instantly on https://finbrain.tech