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Motivation

We see the daily up and downs of the market and imagine there must be patterns, through this project we wanted to collect data from the markets and analyze a myriad of different dates/times and examine the current prices, and based on the data collected/analyzed to forecast the future prices of selected stocks (Microsoft, Apple, Tesla, Johnson & Johnson, Nvidia, Facebook). Based on our predictions, we use our paper trading account to buy/sell our stocks at a price which we deem will give us the best results. Through this experiment, we will be able to analyze our predictions by evaluating our short term trades to see how effective technical analysis is.

Background

Technical analysis is one of the most widely used trading tools on Wall Street, but it is also one of the most controversial. Technical traders swear by it, while fundamental traders often look down on it as ineffective. Technical analysis attempts to capture market psychology and sentiment by analyzing price trends and chart patterns for possible trading opportunities. Contrary to fundamental analysis, technical analysts do not necessarily care much about the companies behind the stocks they trade or their profitability.

Technical analysis can be split into 3 distinct categories:

- I. Chart Patterns and Visualizations (head and shoulders, ascending triangle, etc)
- II. Support/Resistance zones
- III. Technical Indicators (EMA, MACD, RSI etc)

In a nutshell, technical analysis argues that you can identify the right time to buy and sell a stock using technical indicators that are based on the stock's historical price and volume movements. On the other hand, fundamental analysis argues that you can measure the actual intrinsic value of a stock based on the fundamental information found in a company's financial statements.

Dataset and Representation

In order to visualize our data, one of the categories in technical Analysis; we needed to collect the most up to date stock information for our companies (Microsoft, Apple, Tesla, Johnson & Johnson, Nvidia, Facebook). In order to do this, we collected our data via Yahoo Finance by using the pandas datareader, which assisted us in data storage and analysis. Once the data was grabbed, we were able to specify the time periods we wanted to analyze at first, so we took the past 5 years worth of stock data from our companies.

```
MSFT = dr.data.get_data_yahoo('msft',start='2015-01-01', end='2020-11-27')
AAPL = dr.data.get_data_yahoo('aapl',start='2015-01-01', end='2020-11-27')
TSLA = dr.data.get_data_yahoo('tsla',start='2015-01-01', end='2020-11-27')
JNJ  = dr.data.get_data_yahoo('jnj',start='2015-01-01', end='2020-11-27')
FB   = dr.data.get_data_yahoo('fb',start='2015-01-01', end='2020-11-27')
NVDA = dr.data.get_data_yahoo('nvda',start='2015-01-01', end='2020-11-27')
```

```
start = datetime(2015, 1, 1)
end = datetime(2020, 11, 27)
```

```
#Import Stocks Data from Yahoo Finance|
AAPL = web.DataReader("AAPL", 'yahoo', start, end)
FB    = web.DataReader("FB", 'yahoo', start, end)
NVDA  = web.DataReader("NVDA", 'yahoo', start, end)
MSFT  = web.DataReader("MSFT", 'yahoo', start, end)
JNJ   = web.DataReader("JNJ", 'yahoo', start, end)
TSLA  = web.DataReader("TSLA", 'yahoo', start, end)
```

Once the data was collected, we now have access to a bunch of features in our dataset that allow us to extract and visualize different aspects of our dataset.

The Features in our dataset include:

High price:

The peak in price of a stock during that specific date

Low price:

The trough in price of a stock during a specific date

Open price:

The price presented when the market opens on a specific date

Volume:

Is the amount of an asset or security that changes hands on a specific date

Close price:

The price of a stock when the market closed on a specific date

Adjusted close price:

The closing price of a stock after accounting for any corporate actions

	High	Low	Open	Close	Volume	Adj Close
Date						
2020-11-16	120.989998	118.150002	118.919998	120.300003	91183000.0	120.300003
2020-11-17	120.669998	118.959999	119.550003	119.389999	74271000.0	119.389999
2020-11-18	119.820000	118.000000	118.610001	118.029999	76322100.0	118.029999
2020-11-19	119.059998	116.809998	117.589996	118.639999	74113000.0	118.639999
2020-11-20	118.769997	117.290001	118.639999	117.339996	73391400.0	117.339996

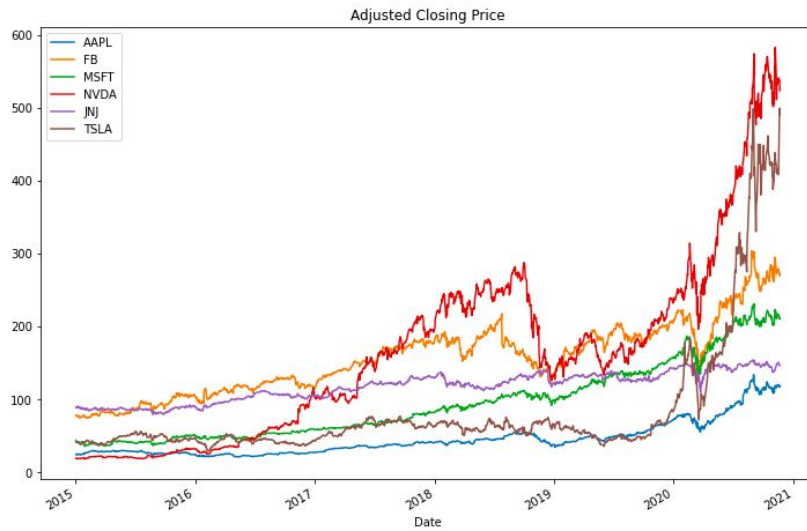
	AAPL	FB	NVDA	MSFT	JNJ	TSLA
Date						
2020-11-20	117.339996	269.700012	523.510010	210.389999	145.350006	489.609985
2020-11-23	113.849998	268.429993	525.599976	210.110001	143.869995	521.849976
2020-11-24	115.169998	276.920013	518.309998	213.860001	143.869995	555.380005
2020-11-25	116.029999	275.589996	529.390015	213.869995	143.679993	574.000000
2020-11-27	116.589996	277.809998	530.450012	215.229996	144.000000	585.760010

Visualizations that allowed us to analyze the charts and patterns:

Adjusted Closing Price of each stock:

```
#plot stocks and their Adjusted Closing Price during start and end dates
AAPL['Adj Close'].plot(label='AAPL',figsize=(12,8), title = 'Adjusted Closing Price')
FB['Adj Close'].plot(label='FB')
MSFT['Adj Close'].plot(label='MSFT')
NVDA['Adj Close'].plot(label='NVDA')
JNJ['Adj Close'].plot(label='JNJ')
TSLA['Adj Close'].plot(label = 'TSLA')
plt.legend()
```

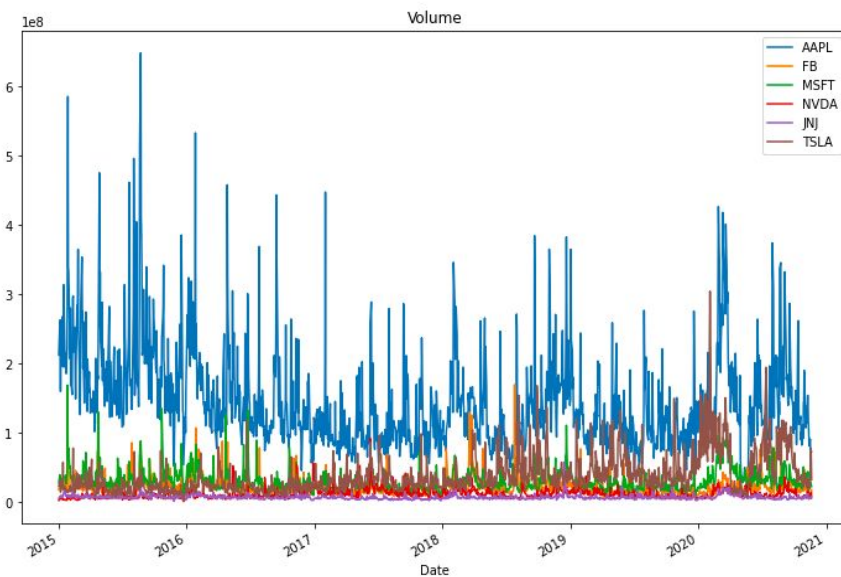
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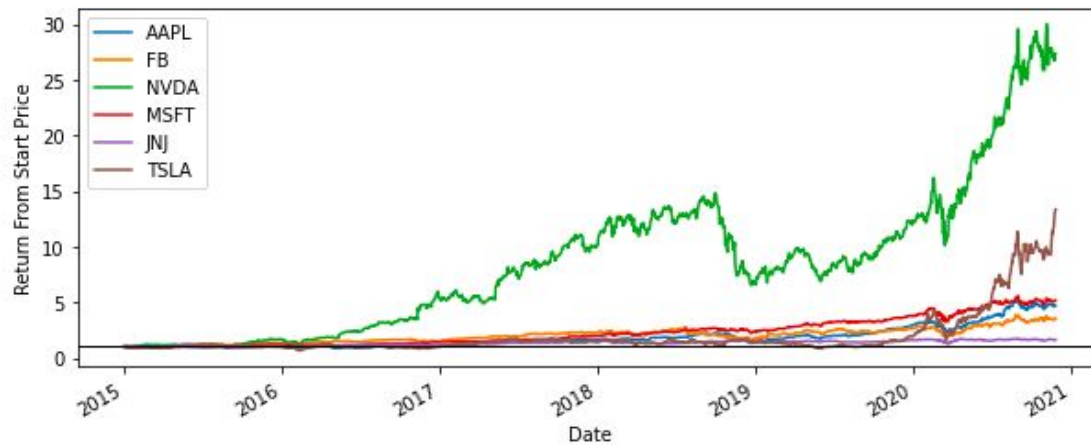
Volume traded for each stock:

```
#plot stocks and their volume traded during start and end dates
AAPL['Volume'].plot(label='AAPL',figsize=(12,8), title = 'Volume')
FB['Volume'].plot(label='FB')
MSFT['Volume'].plot(label='MSFT')
NVDA['Volume'].plot(label='NVDA')
JNJ['Volume'].plot(label='JNJ')
TSLA['Volume'].plot(label='TSLA')
plt.legend()
```

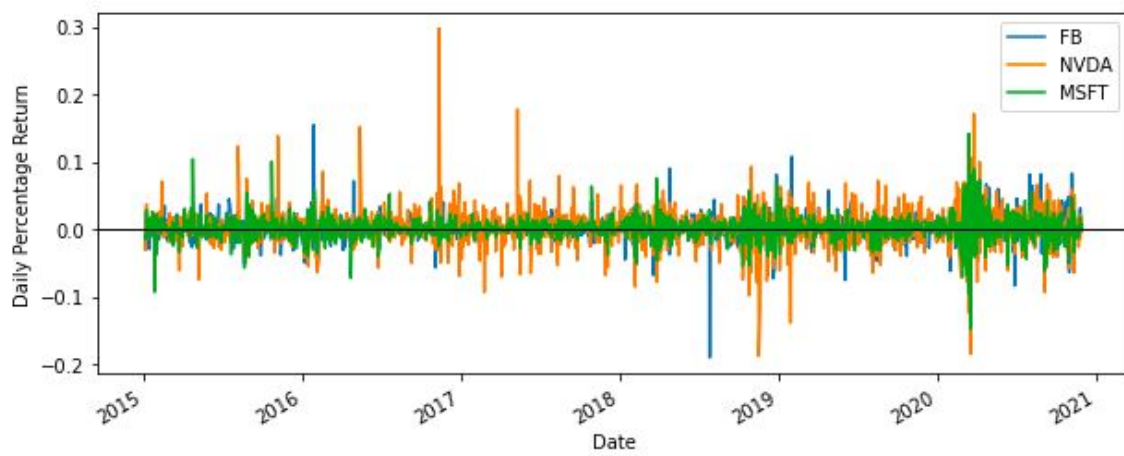
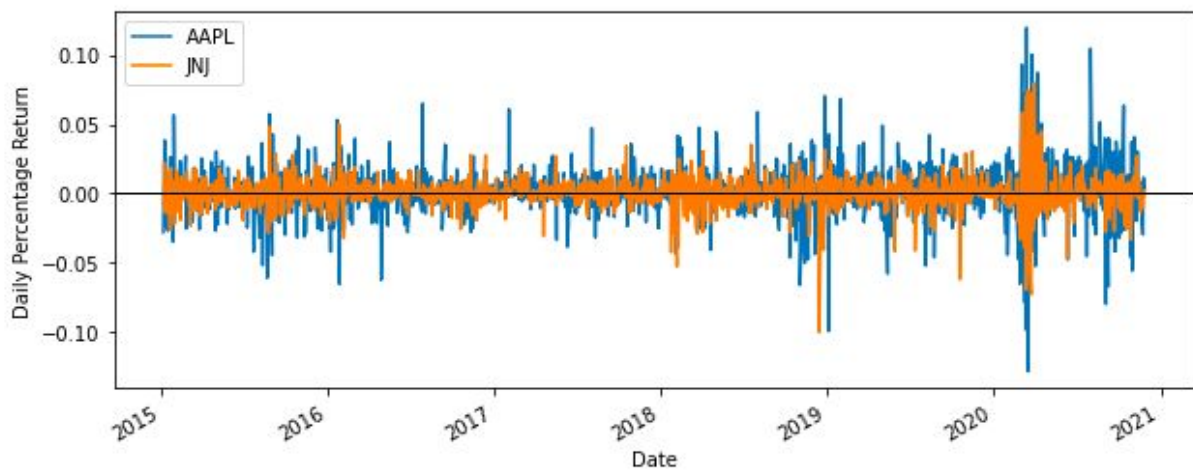
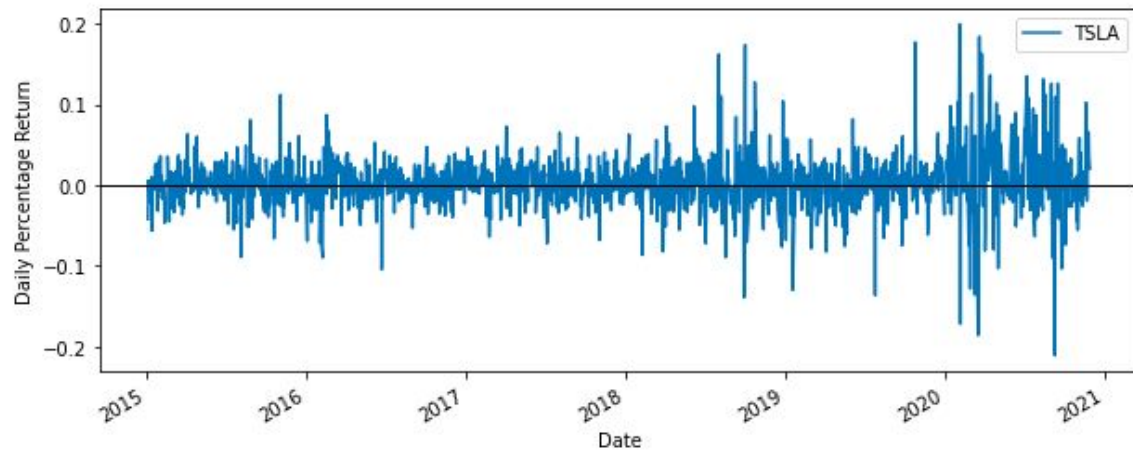
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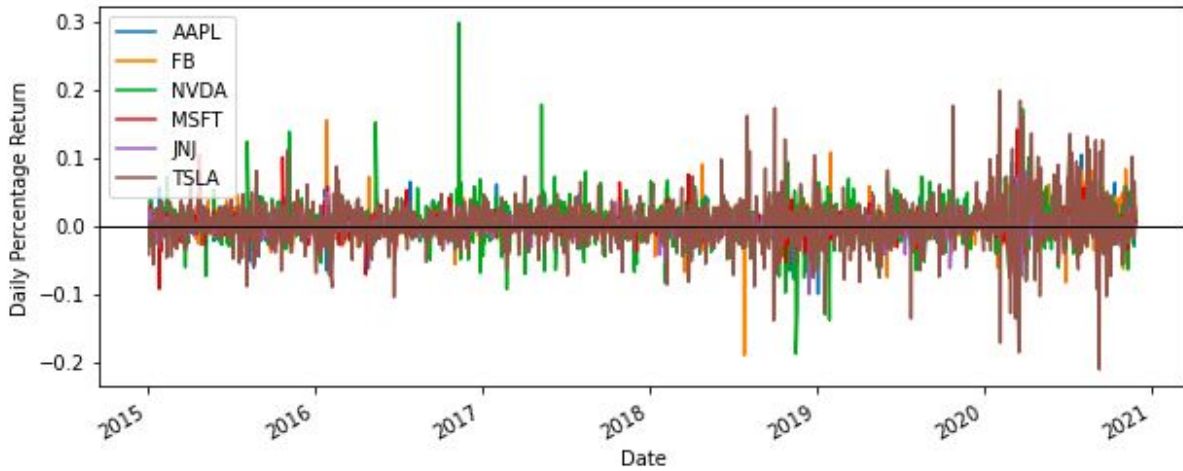


Normalise the stocks to identify best return from start price:

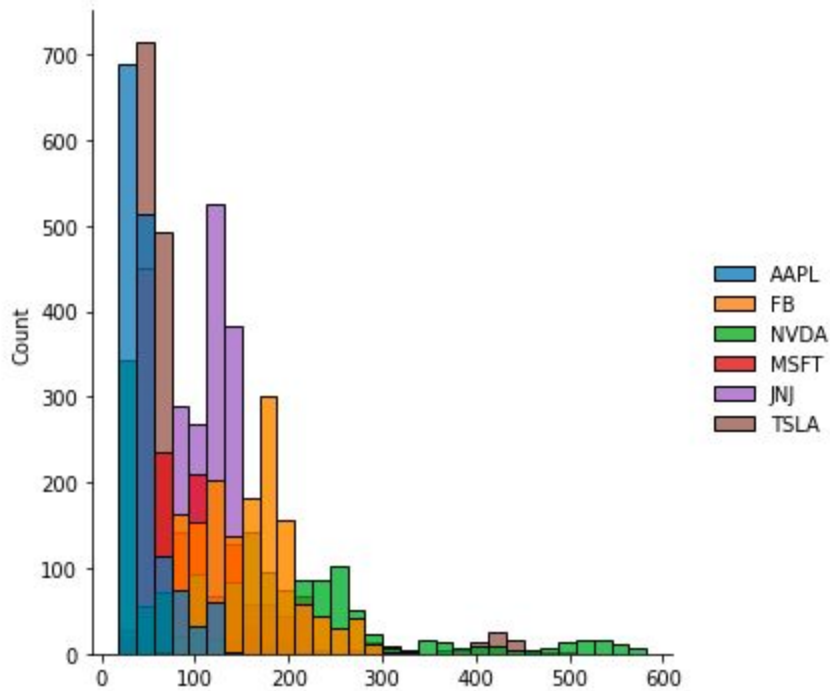


Daily percent change for each stock:





Histogram to see the spread and distribution type:



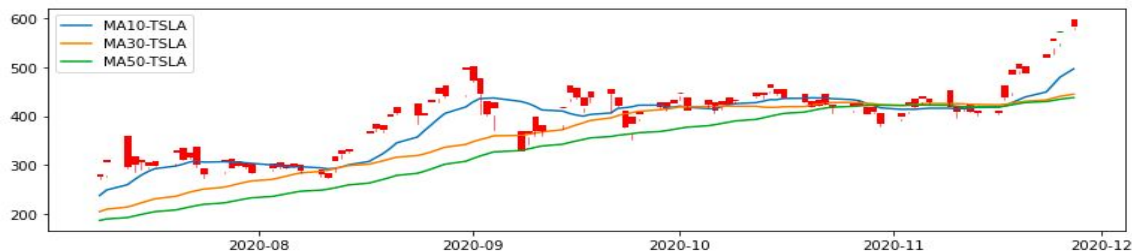
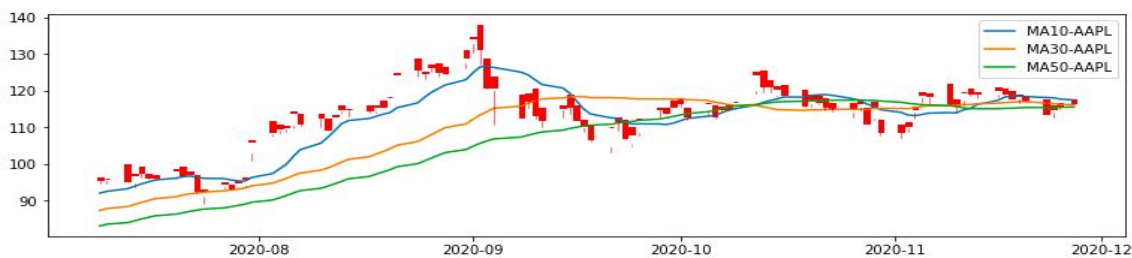
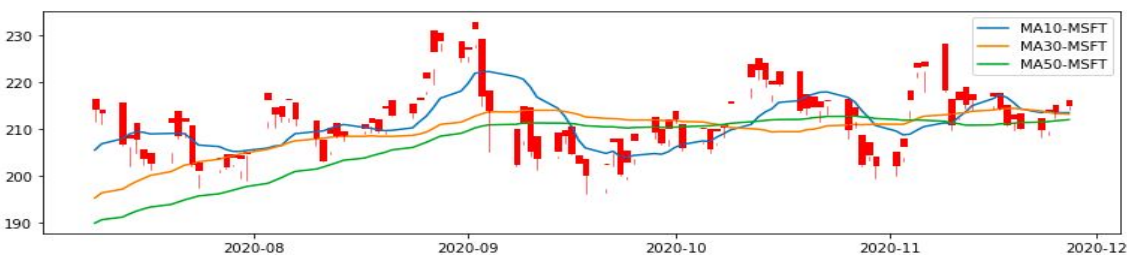
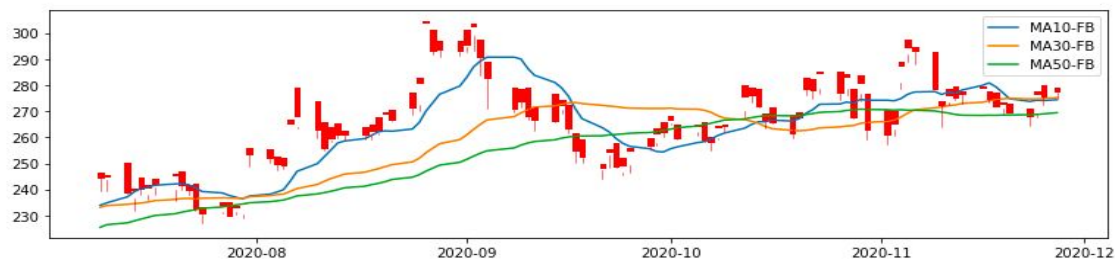
In addition to analyzing the chart patterns with our visualizations, we used technical indicators though the TA-Library (TA-lib) available to us in python which includes 150 + indicators to help us predict stock direction.

The indicators we used to help us make predictions were Moving Averages, Exponential Moving Averages, Moving Average Convergence Divergence, Relative Strength Index, and Volume traded.

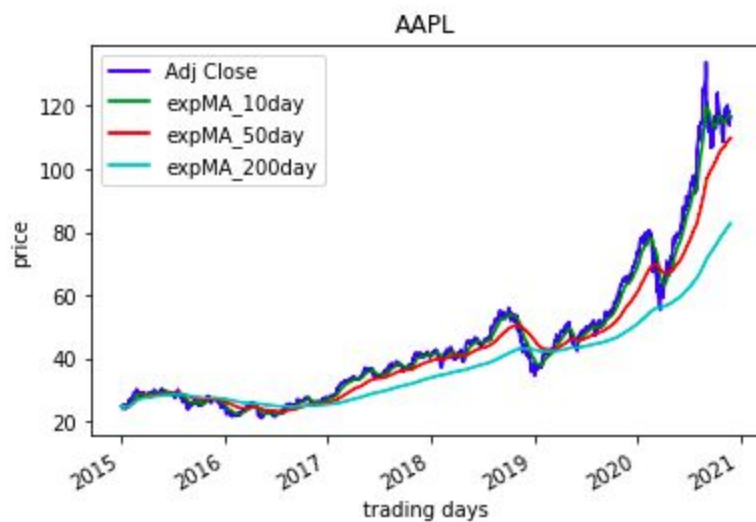
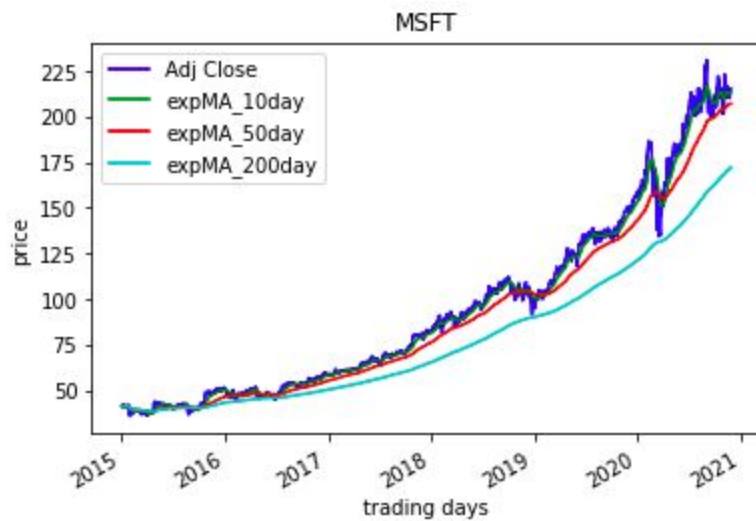
Each one of these indicators on their own can help predict stock direction but they each do it in their own unique way.

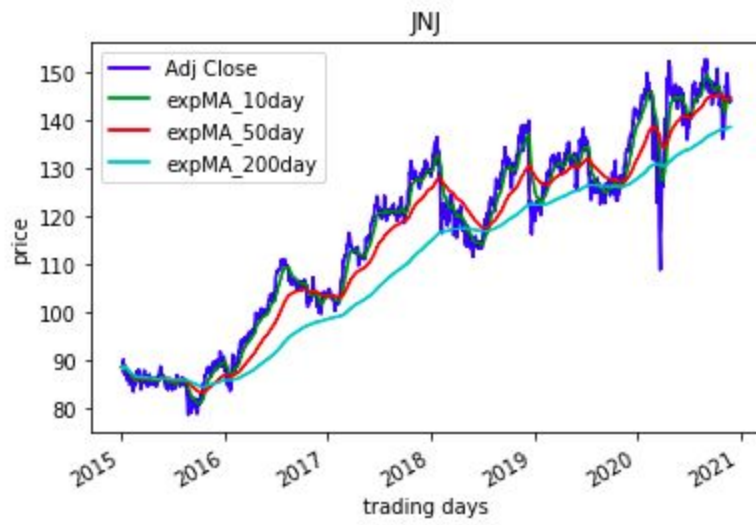
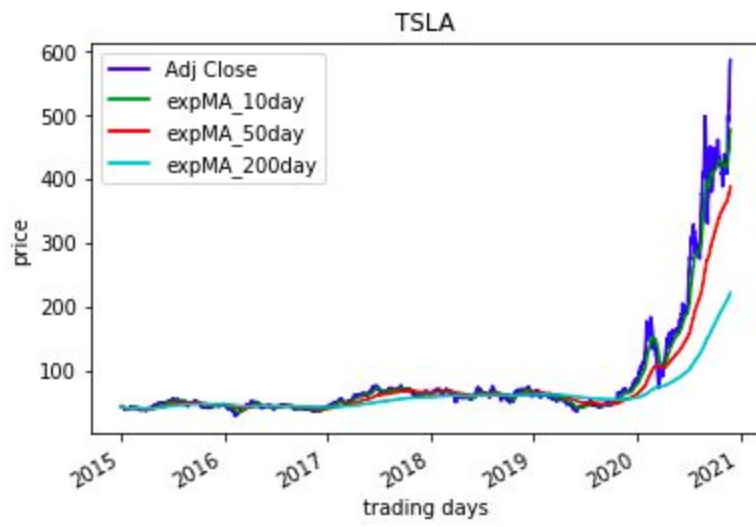
Moving Averages:

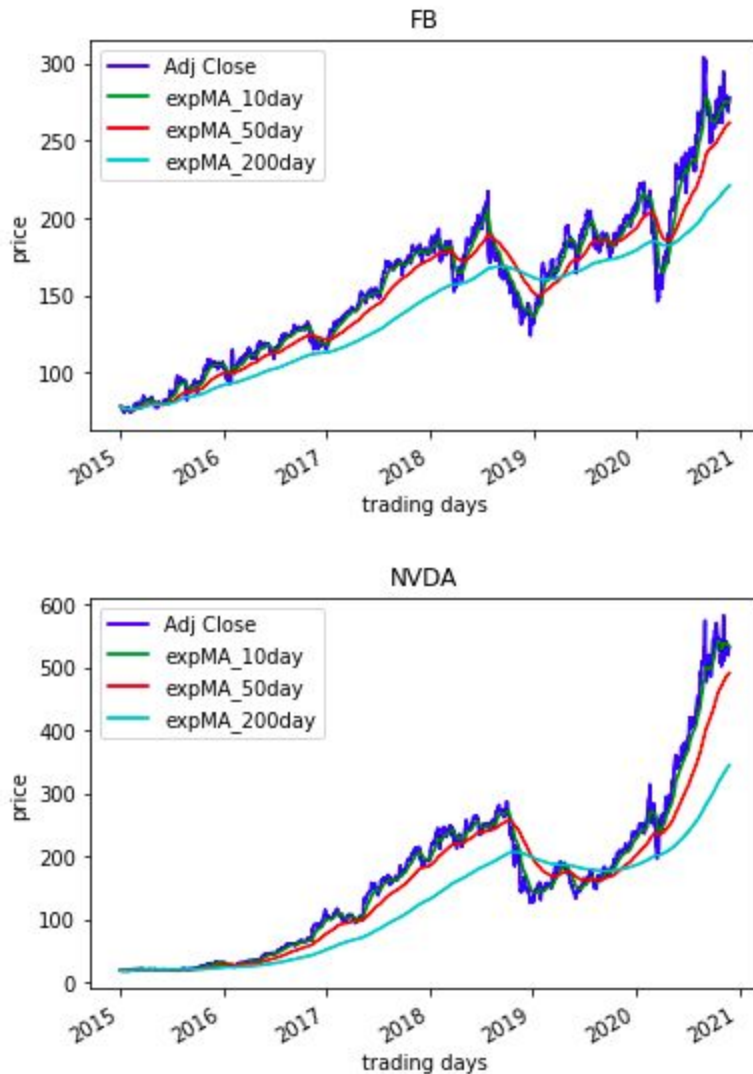
Moving averages is a simple technical analysis tool that smooths out price data by creating a constantly updated average price. Furthermore, moving averages are usually calculated to identify the trend direction of a stock or to determine its support and resistance levels. It is a lagging indicator because it is based on past prices over a specific time period, i.e, the past 10 days, 10 months, or 10 years etc. When a short-term moving average crosses below a longer-term moving average it indicates a sell/bearish crossover, and when a short-term moving average crosses above a longer-term moving average it indicates a buy/bullish crossover. For this project we utilize two different moving average tools: Simple Moving Average and Exponential Moving Average. Furthermore, we used 10, 30, and 50 day as our specific time periods for simple moving averages. The first method we used is the simple moving average. The SMA is simply calculated by summing the daily closing prices and divided by the specific time periods. With each average connected to the next, it creates singular flow lines. For SMA we simply assign equal weight to all values, which differs from EMA.



Exponential moving averages is a type of moving average that places a greater significance on the most recent data points/recent prices. Exponential moving averages follow more closely than the simple moving average above, we also interpret EMA similar to SMA in terms of crossover indication. We used 10, 50, and 200 days as our specific time periods for EMA.







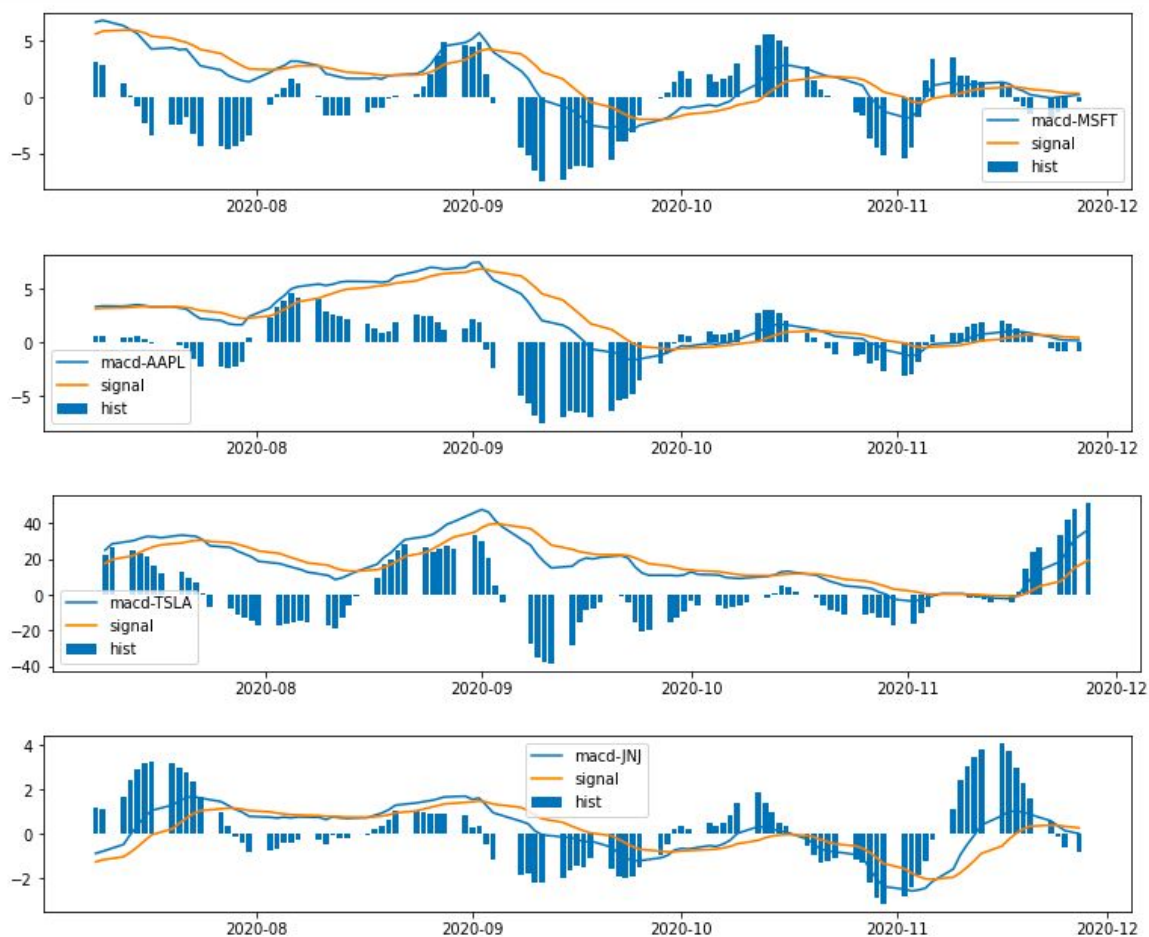
Given that moving averages are more based on historical data, it does not give us a good prediction of the future state of a stock, which means results gathered from simple moving averages can be random. In some cases, when price action becomes choppy, the price may swing back and forth, generating multiple trade signals that are potentially false alarms. On the other hand, if the price action follows more of a trend, then moving averages are a good indicator to see when to buy/sell a particular stock. In general, just by looking at moving averages won't

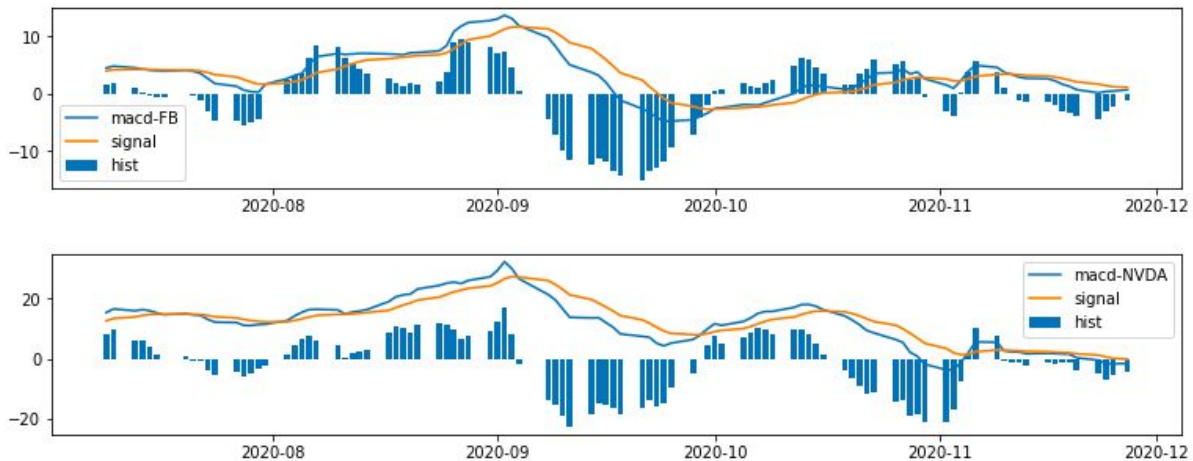
guarantee success, we also need to utilize other tools in order to maximize our ability to buy/sell stocks at the right time.

Moving Average Convergence Divergence(MACD):

In addition to simply looking at moving averages on the surface, we decided to look more in depth into the subject. Moving Average Convergence Divergence is a momentum indicator that charts two lines that provide trade signals when crossover occurs similar to moving averages.

When the MACD line crosses from below to above the signal line, this indicates a bullish signal (buy). When the MACD line crosses from above to below the signal line, this indicates a bearish signal (sell). MACD can be calculated by subtracting the value of a 26 period EMA from a 12 period EMA.



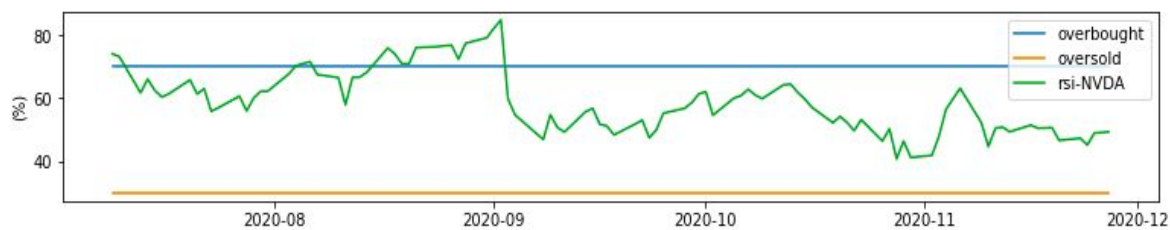
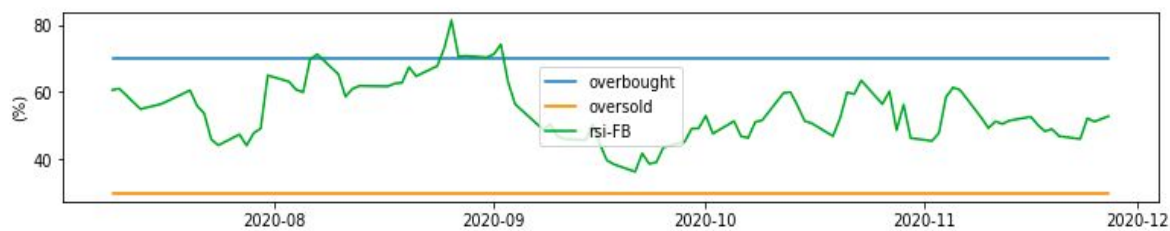
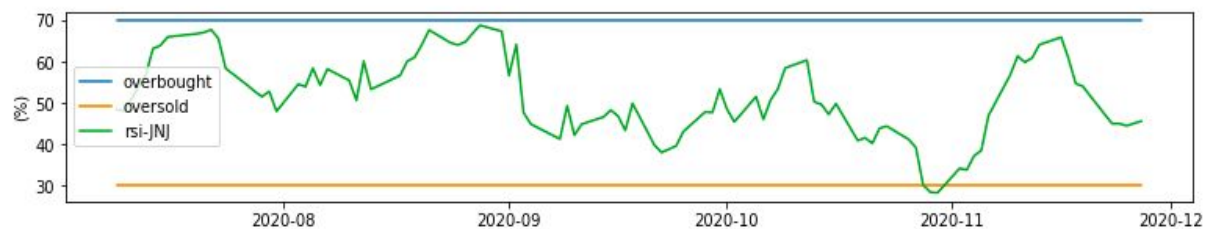
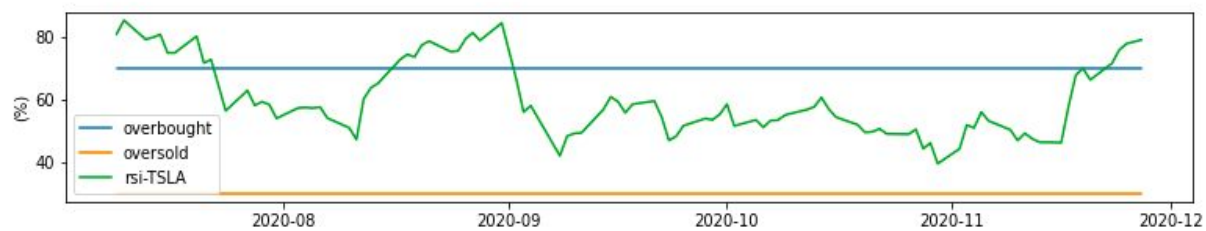
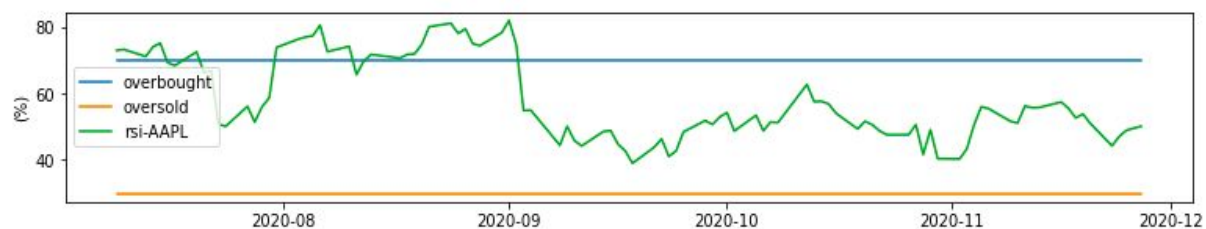
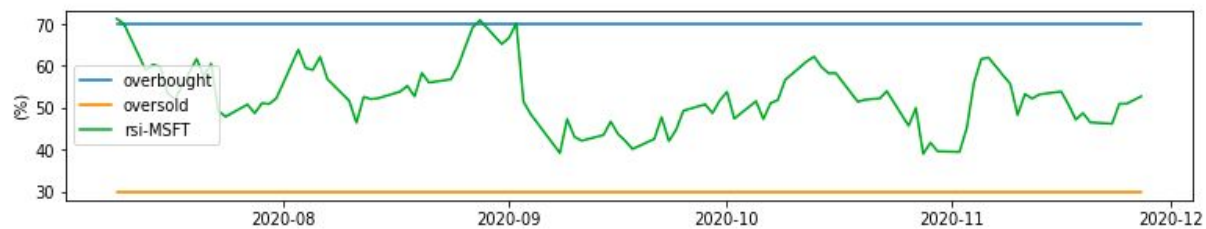


As we progressed through our research, we realized that just simply looking at moving average convergence divergence was not enough, as MACD is often used in conjunction with another tool, Relative Strength Index.

Relative Strength Index(RSI):

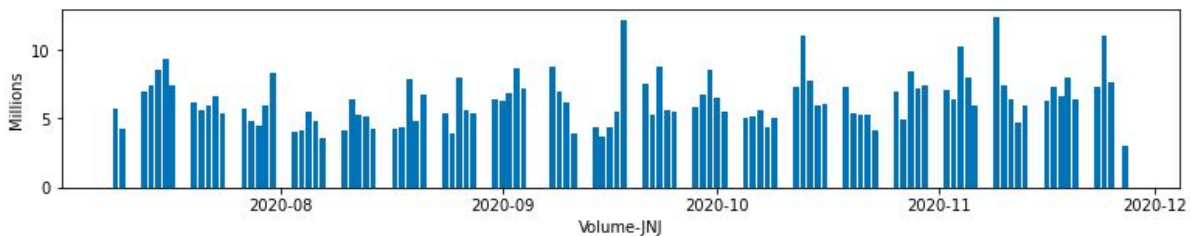
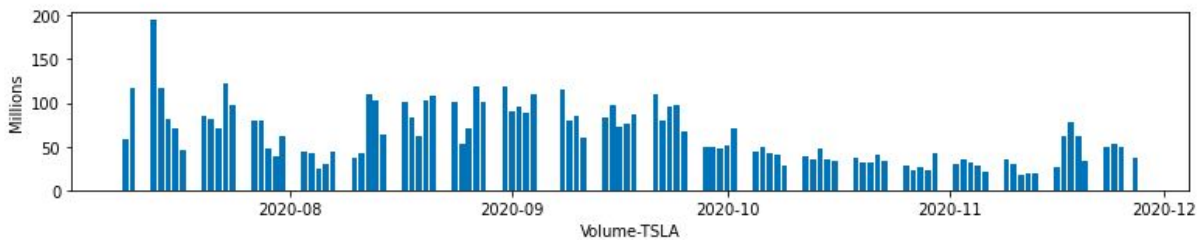
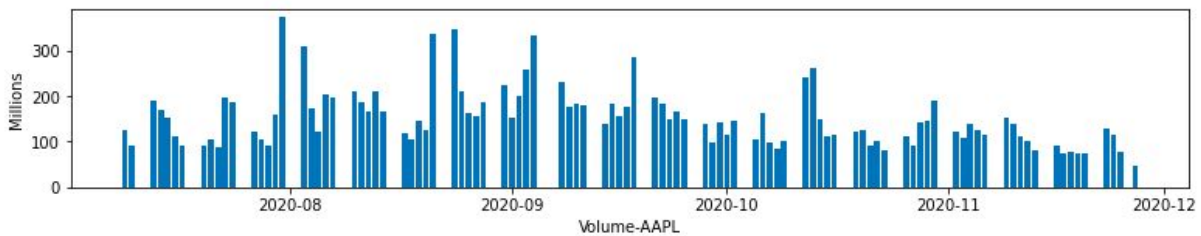
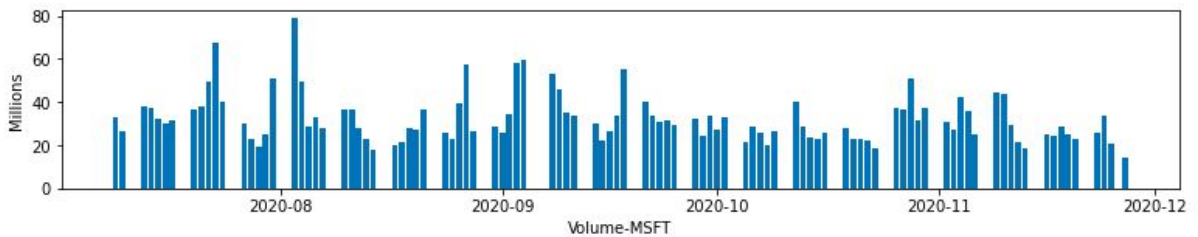
Relative Strength Index is an indicator that helps measure whether a stock is overbought or oversold, by measuring the magnitude of recent price changes. It assists in determining whether a selloff will occur or a rally to a higher stock price. The RSI oscillates between zero and 100, when the RSI is above 70 it is considered overbought and when it is below 30 it is considered oversold. The formula for RSI:

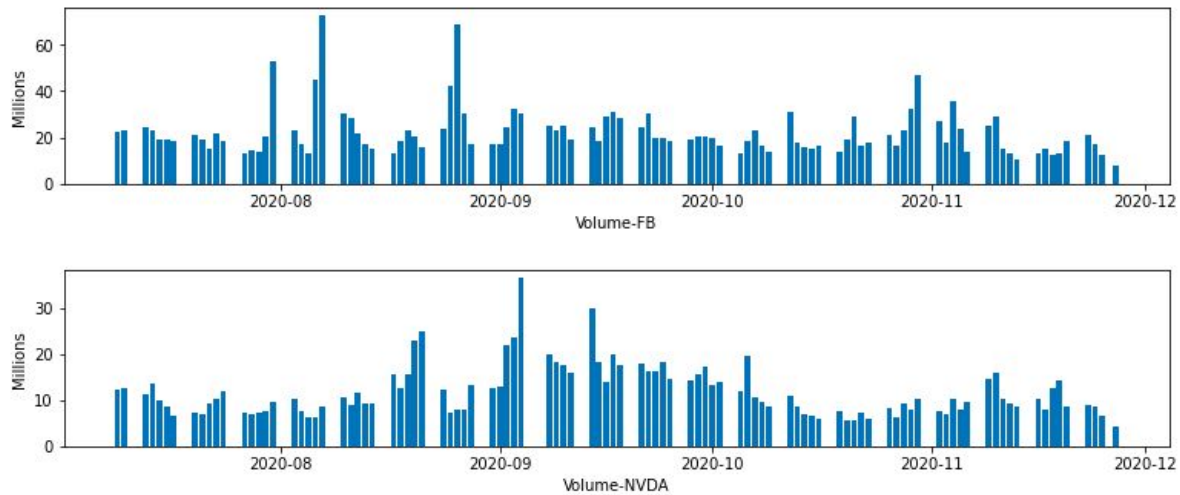
$$RSI = 100 - [100 / (1 + (\text{Average of Upward Price } \Delta / \text{Average of Downward Price } \Delta))]]$$



Volume:

Volume is an important metric and feature to track because it reflects the overall activity of the market, indicating the sheer amount of buying and selling of a specific stock. It represents the total amount of shares traded during a certain period of time. When there is more volume in a stock the demand is high and the opposite when the volume is low compared to other days.





Overall, while both indicators measure momentum in a market, the MACD measures the relationship between two EMAs, but the RSI measures price change in relation to recent price highs and lows. As for the reason why these two indicators work well in conjunction is that the two indicators act as a fail safe for each other as they might give contrary indications. For example, the RSI might indicate that right now would not be the best time to sell a specific stock while the MACD on the other hand might suggest otherwise. This is good to any potential investor as it will prompt such investors to not rush his/her decision on selling the stock by mistake if the decision was solely based on one of the aforementioned indicators.

Questions

1. Is the process of Technical Analysis beneficial in determining future stock price/performance?

Yes, technical analysis is beneficial in determining future stock price/performance. By analyzing and reading charts to identify trends in the market we were successfully able to have a positive return of close to \$5000 (3%) on our paper trading account in the first week of using our technical indicators to predict stock direction. Although technical analysis doesn't always work 100% of the time, this is evident because we used the same strategies and our account lost our initial returns and resulted in us having only 0.04% (\$70) return. There is still some time to increase the account! Update: After a few more days our profit has increased to about \$1000.

FB +200 269.80 +0.10 +0.04%	+200	\$20.00	(\$367.00)	(\$367.00)
JNJ +150 146.55 +0.19 +0.13%	+150	\$28.50	\$532.00	\$532.00
MSFT +300 210.45 +0.06 +0.03%	+300	\$18.00	(\$20.00)	(\$20.00)
NVDA +250 523.51 0.00 0.00%	+250	\$0.00	(\$4,240.00)	(\$4,240.00)
TSLA +5 490.50 +0.89 +0.18%	+5	\$4.45	\$293.50	\$293.50
Cash	—	—	—	—
Totals:	—	\$70.95	(\$3,801.50)	(\$3,801.50)

Positions								
Position ▲	⚙	Qty	P/L Day \$	P/L Open \$	P/L YTD \$	Cost	Net Liq	Trade Price
FB +200 277.60 +2.01 +0.73%		+200	\$402.00	\$1,193.00	\$1,193.00	\$54,327.00	\$55,520.00	271.64
JNJ +150 144.00 +0.32 +0.22%		+150	\$48.00	\$149.50	\$149.50	\$21,450.50	\$21,600.00	143.00
MSFT +300 215.23 +1.36 +0.64%		+300	\$408.00	\$1,414.00	\$1,414.00	\$63,155.00	\$64,569.00	210.52
NVDA +250 530.45 +1.06 +0.20%		+250	\$265.00	(\$2,505.00)	(\$2,505.00)	\$135,117.50	\$132,612.50	540.47
TSLA +5 586.80 +12.80 +2.23%		+5	\$64.00	\$775.00	\$775.00	\$2,159.00	\$2,934.00	431.80
Cash		—	—	—	—	(\$72,573.74)	(\$72,573.74)	—
Totals:		—	\$1,187.00	\$1,026.50	\$1,026.50	\$203,635.26	\$204,661.76	—

2. Does it boil down to fundamental analysis or mixture of the two?

Performing well in the market requires a mixture of both fundamental analysis and technical analysis. As fundamental analysis focuses on a lot of the real-life events that may not be

recognized from a chart. Some of these include economic data, monetary policies, management quality, and annual reports.

Technical analysis, which focuses mainly on the price trends of a stock, fundamental analysis seeks to determine the fair market value of that security and where it should be trading.

Some fundamental analysis indicators include: Book Value per Share, Cash and Cash Equivalents per Share, Debt-to-Equity Ratio, Free Cash Flow, Earnings Report. There is no right or wrong system in the markets, which is evident since there are so many different factors that determine a stock's direction on any given day. But one thing for certain is that a combination of both is needed to well equip one's self in having a proper risk tolerance and increasing probabilities, given the subjective nature of both technical and fundamental analysis. In addition, most successful traders take into consideration a wide range of technical and fundamental factors before making the decision to buy or sell a stock.

3. How effective is technical analysis?

Technical analysis is very effective depending on the person who is using it. As it is very subjective in nature, TA allows for multiple interpretations to be deduced based on the same data represented. Two people can look at a chart visualizing the adjusted closing prices for a stock and both individuals can walk away from the chart with two different predictions and analysis on what they think the stock would look like next. Technical analysis is very probabilistic, and to deem it effective requires one to associate their findings to the successes of technical analysis. A mixture of both fundamental and technical analysis is needed to best prepare oneself for proper risk and allocation management. Based on our results on just using technical analysis for our dataset, we deem it to be effective, but we believe if we mixed in fundamental analysis our predictions would be more accurate with our findings, because at times there were price

movements that we did not anticipate based on historical price data; but if we used fundamental analysis we would've been able to associate those movements with news articles that came out for that stock, or our current environment with recent covid vaccines news which was a catalyst for the market. As you can see, technical analysis is effective to an extent in which you need more economic data to justify price changes.

4. Is the history of stock prices an indicator for future stock prices/movement?

Absolutely, the history of stock prices is an indicator for future price movements as it is one of the main features used in technical analysis. By analyzing the past stock prices one can use different indicators to help quantify future price movements and justify claims. Although you can use it to anticipate the direction of a stock, it doesn't necessarily provide an accurate representation of the movement because the market can act irrationally at times disregarding the past stock prices. So the history of stock prices is definitely an indicator for future stock price movements, but to an extent; even the Security and Exchange Commission warns that past performance isn't an indicator of future performance.