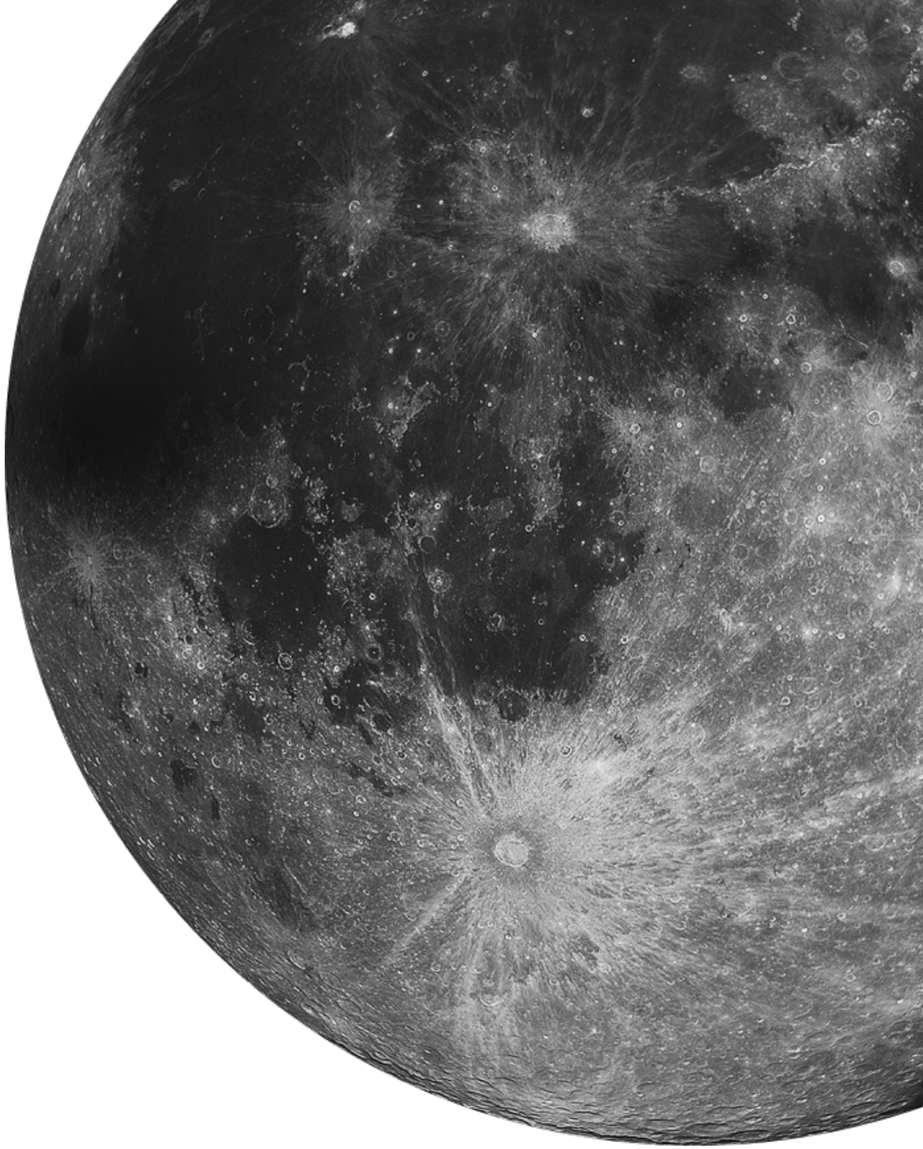


TEAM 15

Zelta Labs
Crypto Trading Challenge

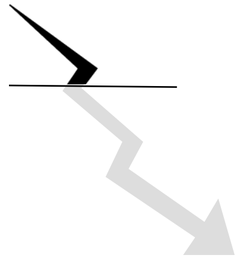
Market Dynamics

An analysis of the cryptocurrency market dynamics led to the understanding that Bitcoin market prices exhibit strong trend-based momentum, which is ideal for algorithmic trading strategies. This momentum particularly in cryptocurrencies can be attributed to factors such as:

- **Constrained attention of investors**
  As cryptocurrency markets operate 24/7, the continuous trading environment may cause retail investors to miss important developments. Their trading activities typically lag with respect to market news headlines and price changes, allowing momentum-based strategies to exploit this delay.

- **Network Effects**
  The value and utility of the crypto tokens increases as more users join and develop the blockchain ecosystem. The compounded user growth for these blockchains inherently promotes momentum.

Proposition



A **long-short** strategy which aims to capture **strong uptrends** and make profits in a bullish market.

The strategy makes use of:

- **technical indicators** which identify the strength of trends and
- **momentum** in the market by considering price movements and traded volume.

Risk management measures are also incorporated in the strategy including **stop-losses** and **time-based stops** to:

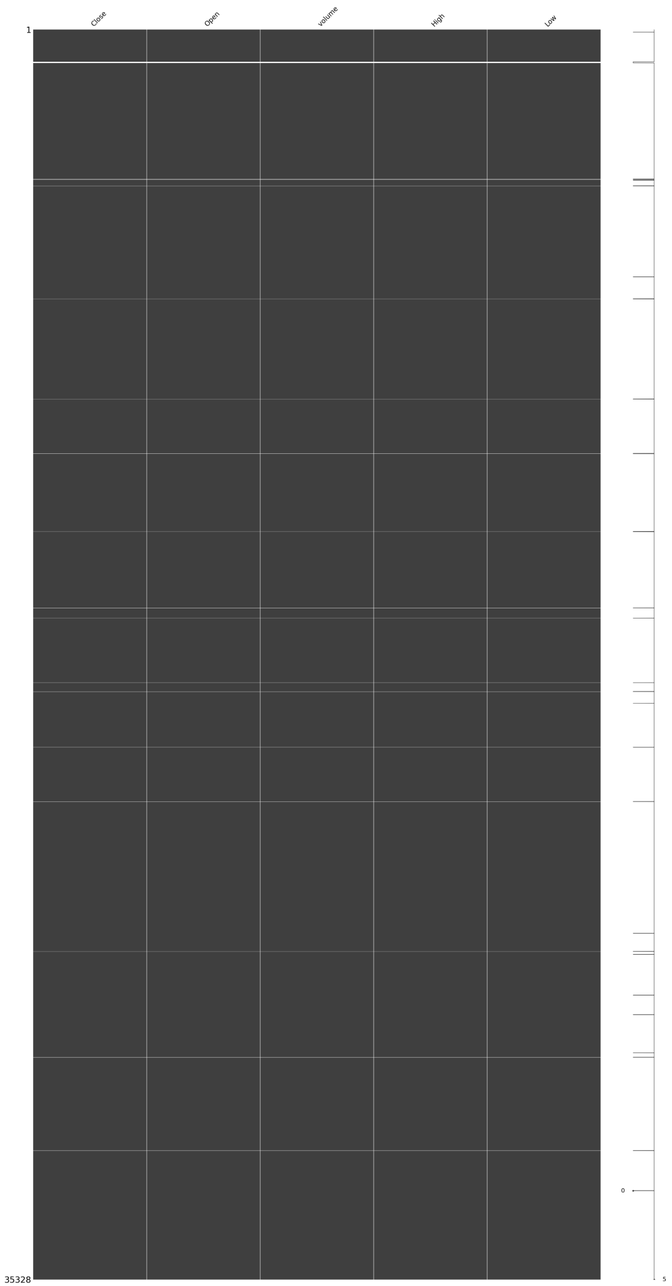
- mitigate **position risk** and
- **reduce overexposure** to market volatility with respect to time.

Data Analysis – Missing Values

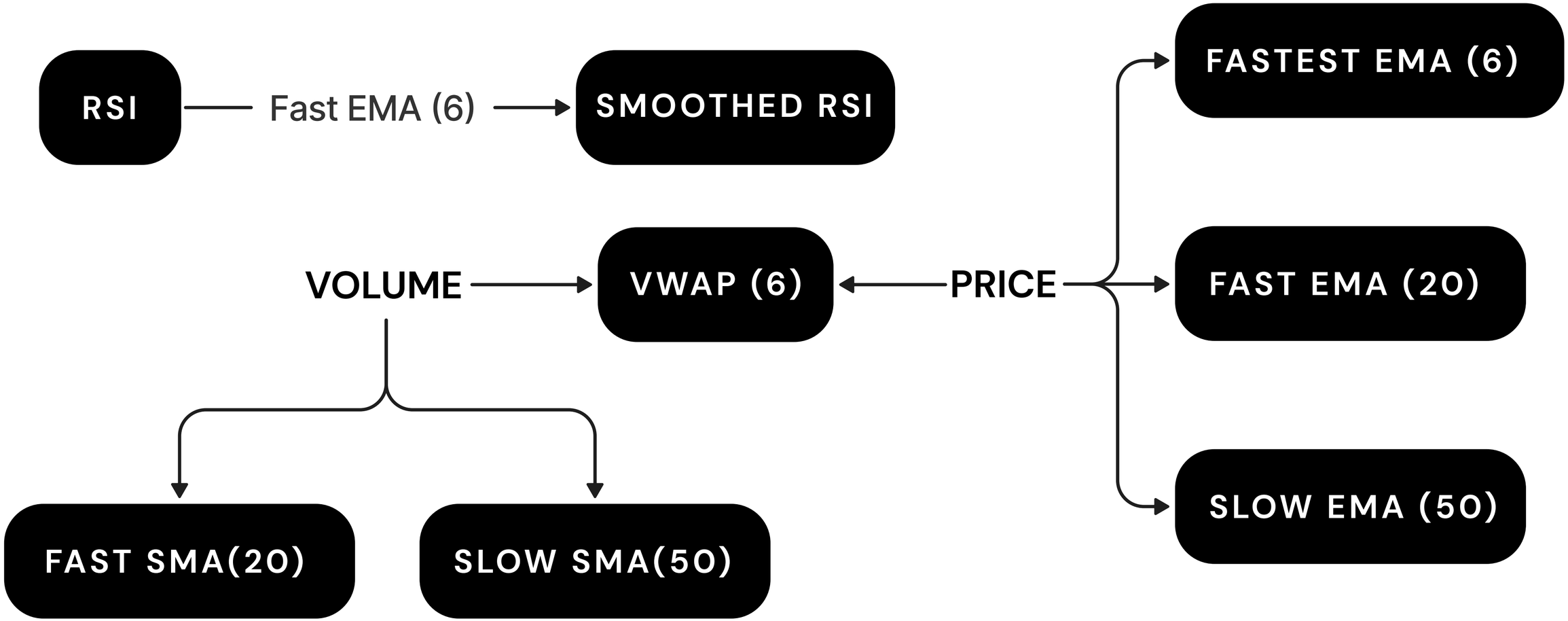
- Initial analysis of the data revealed that there are certain missing entries in the hourly data provided, shown as follows:

```
Missing Values
From: 2018-01-04 08:30:00 To: 2018-01-04 10:30:00 Values missing:  1.0
From: 2018-02-08 05:30:00 To: 2018-02-09 15:30:00 Values missing:  33.0
From: 2018-06-26 06:30:00 To: 2018-06-26 17:30:00 Values missing:  10.0
From: 2018-06-27 17:30:00 To: 2018-06-27 19:30:00 Values missing:  1.0
From: 2018-07-04 05:30:00 To: 2018-07-04 13:30:00 Values missing:  7.0
From: 2018-10-19 10:30:00 To: 2018-10-19 14:30:00 Values missing:  3.0
From: 2018-11-14 06:30:00 To: 2018-11-14 14:30:00 Values missing:  7.0
From: 2019-03-12 06:30:00 To: 2019-03-12 13:30:00 Values missing:  6.0
From: 2019-05-15 07:30:00 To: 2019-05-15 18:30:00 Values missing:  10.0
From: 2019-08-15 06:30:00 To: 2019-08-15 15:30:00 Values missing:  8.0
From: 2019-11-13 06:30:00 To: 2019-11-13 09:30:00 Values missing:  2.0
From: 2019-11-25 06:30:00 To: 2019-11-25 09:30:00 Values missing:  2.0
From: 2020-02-09 06:30:00 To: 2020-02-09 08:30:00 Values missing:  1.0
From: 2020-02-19 16:30:00 To: 2020-02-19 22:30:00 Values missing:  5.0
From: 2020-03-04 14:30:00 To: 2020-03-04 16:30:00 Values missing:  1.0
From: 2020-04-25 06:30:00 To: 2020-04-25 09:30:00 Values missing:  2.0
From: 2020-06-28 06:30:00 To: 2020-06-28 10:30:00 Values missing:  3.0
From: 2020-11-30 10:30:00 To: 2020-11-30 12:30:00 Values missing:  1.0
From: 2020-12-21 18:30:00 To: 2020-12-21 23:30:00 Values missing:  4.0
From: 2020-12-25 06:30:00 To: 2020-12-25 08:30:00 Values missing:  1.0
From: 2021-02-11 08:30:00 To: 2021-02-11 10:30:00 Values missing:  1.0
From: 2021-03-06 06:30:00 To: 2021-03-06 08:30:00 Values missing:  1.0
From: 2021-04-20 06:30:00 To: 2021-04-20 09:30:00 Values missing:  2.0
From: 2021-04-25 09:30:00 To: 2021-04-25 13:30:00 Values missing:  3.0
From: 2021-08-13 06:30:00 To: 2021-08-13 11:30:00 Values missing:  4.0
From: 2021-09-29 11:30:00 To: 2021-09-29 14:30:00 Values missing:  2.0
```

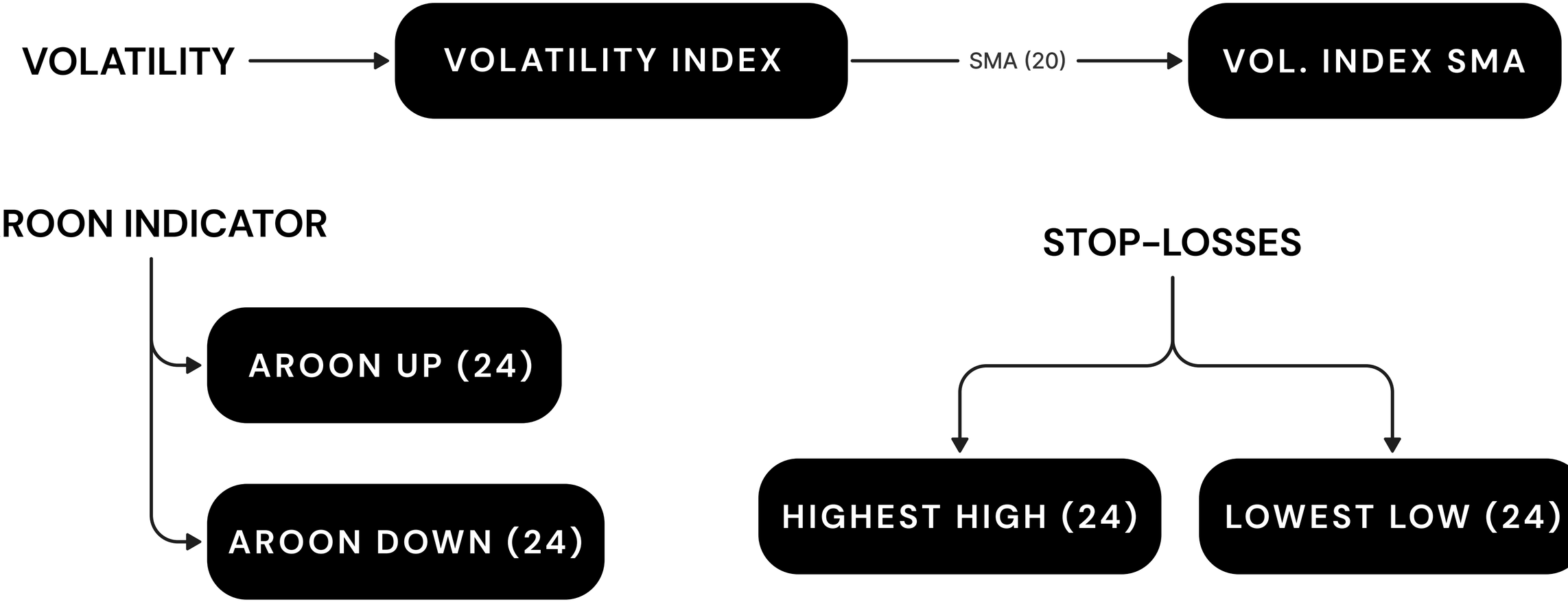
Missingno Plot



Technical Indicators



Technical Indicators



Entry and Exit Signals

Long Position Entry

The following conditions must be satisfied in conjunction to open a long position:

- **Smoothed RSI** > 75
- **Volume**: Fast SMA > Slow SMA
- **Price:** Fastest EMA > Fast EMA > Slow EMA
- **Aroon Indicator:** Aroon Up < Aroon Down

All of these signals in combination give a strong indication of an upwards moving market

```
if self.data['rsi_smooth'] > 75 and self.data['vol_sma_fast'] > self.data['vol_sma_slow']:
    if self.data['ema_fast'] > self.data['ema_slow'] and self.data['ema_fastest'] > self.data['ema_fast'] \
        and self.data['aroon_up'] < self.data['aroon_down']:
        if not self.position:
            stoploss = self.data['LL'][-1]       # Price Level Stop Loss for Exit
            self.buy(sl = stoploss)
            entry_time = datetime.strptime(str(self.data.index[-1]), datetime_format)
```

Long Position Exit

Once the trend loses strength and momentum goes down, the strategy picks up on this and squares off the long position

The following conditions must be satisfied in conjunction to close a long position:

- RSI < 30
- Volatility Index > Vol. Index Moving Average

As the RSI is now at a very low level, the trend has lost strength and momentum. Additionally since volatility is relatively higher it can indicate a oncoming dip in the price i.e price movement in the opposite direction

```
if self.data['rsi'] < 30 and self.data['vol_index'] > self.data['vol_index_ma']:
    if self.position.is_long:
        self.position.close()
        entry_time = None
```

Short Position Entry

While the market is bullish there are brief periods of pullbacks and price corrections.
These movements are also captured by the strategy by entering short positions

The following conditions must be satisfied in conjunction to open a short position:

- **Smoothed RSI < 30**
- **Price:** Fastest EMA < Fast EMA < Slow EMA
- **VWAP:** Crosses below Fastest EMA of Price
- **Aroon Indicator:** Aroon Down < Aroon Up

These signals indicate that the price is likely to experience pullback as the trend is weak and traded volume is also relatively lower

```
if self.data['ema_fast'] < self.data['ema_slow'] and self.data['ema_fastest'] < self.data['ema_fast']:
    if crossover(self.data['ema_fastest'], self.data['vwap']) and self.data['rsi_smooth'] < 30  and \
    self.data['aroon_down'] < self.data['aroon_up']:
        if not self.position:
            stoploss = self.data['HH'][-1]      # Price Level Stop Loss for Exit
            self.sell(sl = stoploss)
            entry_time = datetime.strptime(str(self.data.index[-1]), datetime_format)
```

Short Position Exit

The short positions are intended to be held for short periods of time and rely on relatively faster signals

The following conditions must be satisfied in conjunction to close a short position:

- VWAP > Fastest EMA of Price
- **Time-based Stop:** If position has been held for longer than 8 hours

```
if self.data['vwap'] > self.data['ema_fastest'] and self.position.is_short:
    if (datetime.strptime(str(self.data.index[-1]), datetime_format) - entry_time).total_seconds()/3600 >= 8:
        self.position.close()
```

Risk Management Measures

Price Level Stop-Losses

To limit the directional risk of the positions, price level stop-losses have been implemented using the upper channel of 24-hour Highest High (HH) and lower channel of 24-hour Lowest Low (LL)

- **Long Position** - SL of Lowest Low
- **Short Position** - SL of Highest High

Time-based Stops

To limit overexposure to the market volatility, time-based stops have been implemented

- **Long Position** - Maximum holding time is **24 days**
- **Short Position** - If position is held for more than **8 hours** and VWAP > Fastest EMA, then the position is squared off

Backtesting

- Created class BacktestResults to take in the **signal logs** and **compute metrics**
- **Object-oriented implementation** promotes code modularity
- Separate methods for
  - viewing different results
  - data visualizations

Trade History and Metrics

Maintains a record of all the trade positions as well as entry and exit prices and timestamps

- **Maximum Trade Duration:** 24 days
- **Average Trade Duration:** 6 days 19 hours
- **Number of Trades:** 59
- **Winning Trades:** 43
- **Losing Trades:** 16
- **Win Rate:** 72.881%
- **Number of Long Trades:** 23
- **Number of Short Trades:** 36

```
SHORT POSITION
2019-09-25 02:30:00 : ENTRY - SELL @ 8562.05
2019-09-25 15:30:00 : EXIT - BUY @ 8392.57

SHORT POSITION
2019-10-17 02:30:00 : ENTRY - SELL @ 7987.83
2019-10-17 10:30:00 : EXIT - BUY @ 7933.34

SHORT POSITION
2019-10-24 02:30:00 : ENTRY - SELL @ 7486.06
2019-10-24 10:30:00 : EXIT - BUY @ 7416.57

LONG POSITION
2019-10-26 00:30:00 : ENTRY - BUY @ 8622.0
2019-11-08 16:30:00 : EXIT - SELL @ 9026.62

SHORT POSITION
2019-11-09 02:30:00 : ENTRY - SELL @ 8810.97
2019-11-09 22:30:00 : EXIT - BUY @ 8752.3

SHORT POSITION
2019-11-22 02:30:00 : ENTRY - SELL @ 7600.0
2019-11-22 11:30:00 : EXIT - BUY @ 7559.38

SHORT POSITION
2019-12-18 02:30:00 : ENTRY - SELL @ 6584.69
2019-12-18 18:30:00 : EXIT - BUY @ 6541.47
```

Snapshot of the trade history generated in the Python notebook

Strategy Results

STATIC

Capital per Trade	$1000
Net Profit	$4242.374
Gross Profit	$4422.967
Benchmark Return	$1879.555

Sharpe Ratio	Sortino Ratio
7.335	56.999

COMPOUNDING

Initial Balance	$1000
Final Balance	$37742.562
Peak Balance	$38811.063
Lowest Balance	$1000
Net Return	3574.256%
Annualized Return	143.771%
Maximum Drawdown	-6.464%

Equity Curves

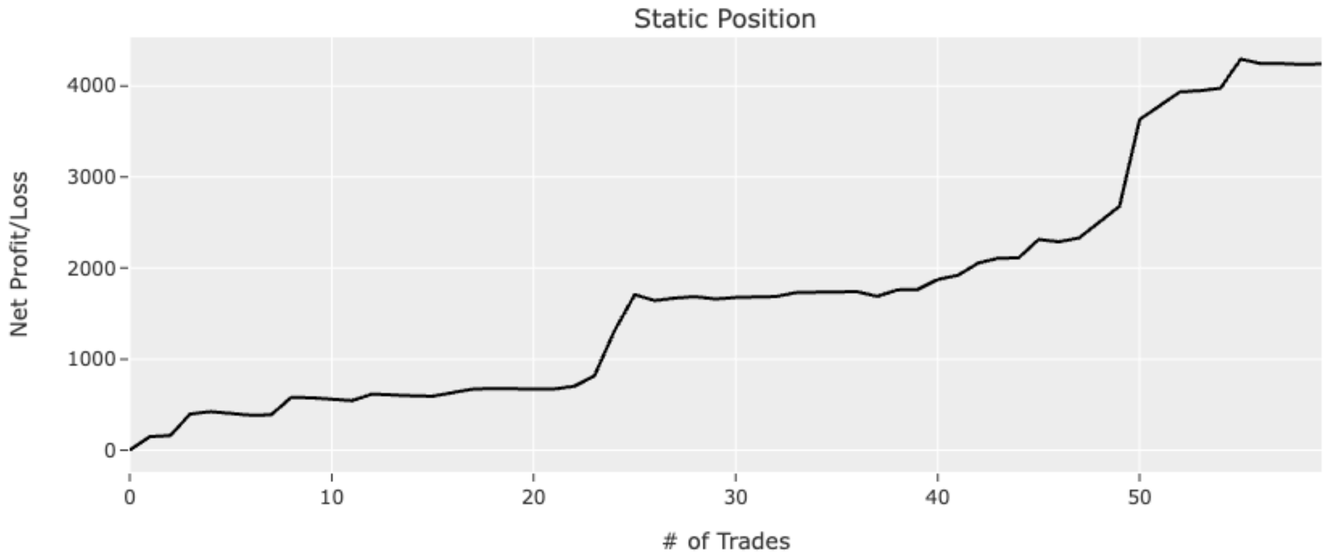
Evolution of the portfolio balance or net profit/loss made by the strategy

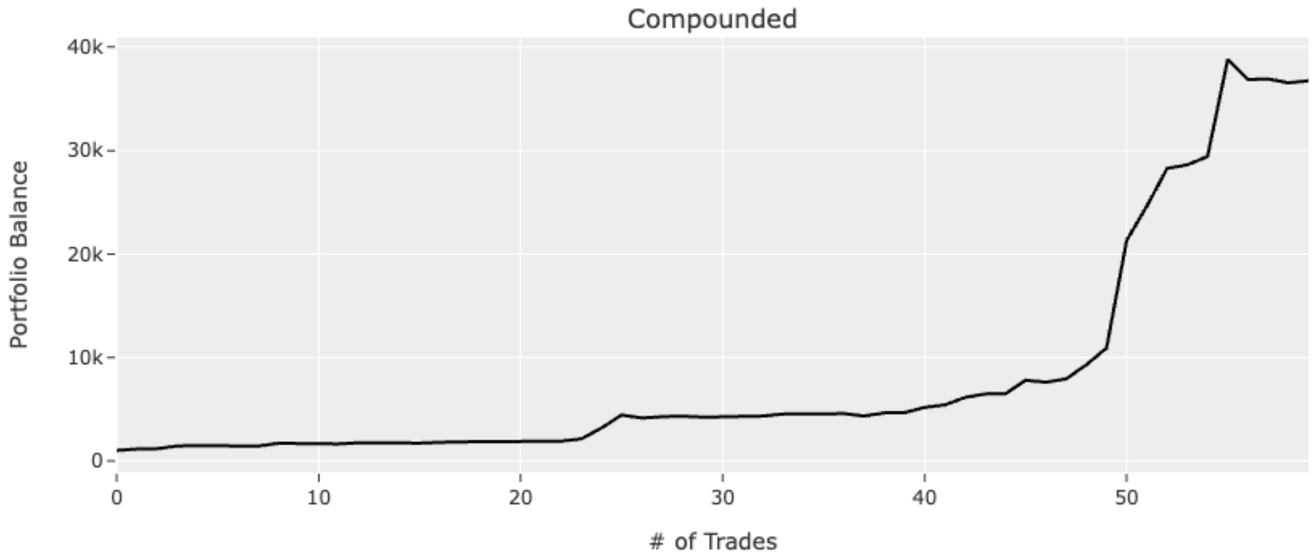
Static Position Sizing:

Net profit/loss made by the strategy upon investment of $1,000 in each trade

Compounding:

Impact of the strategy on the portfolio when the entire balance at each entry time is invested in the trade (starting balance is $1,000)



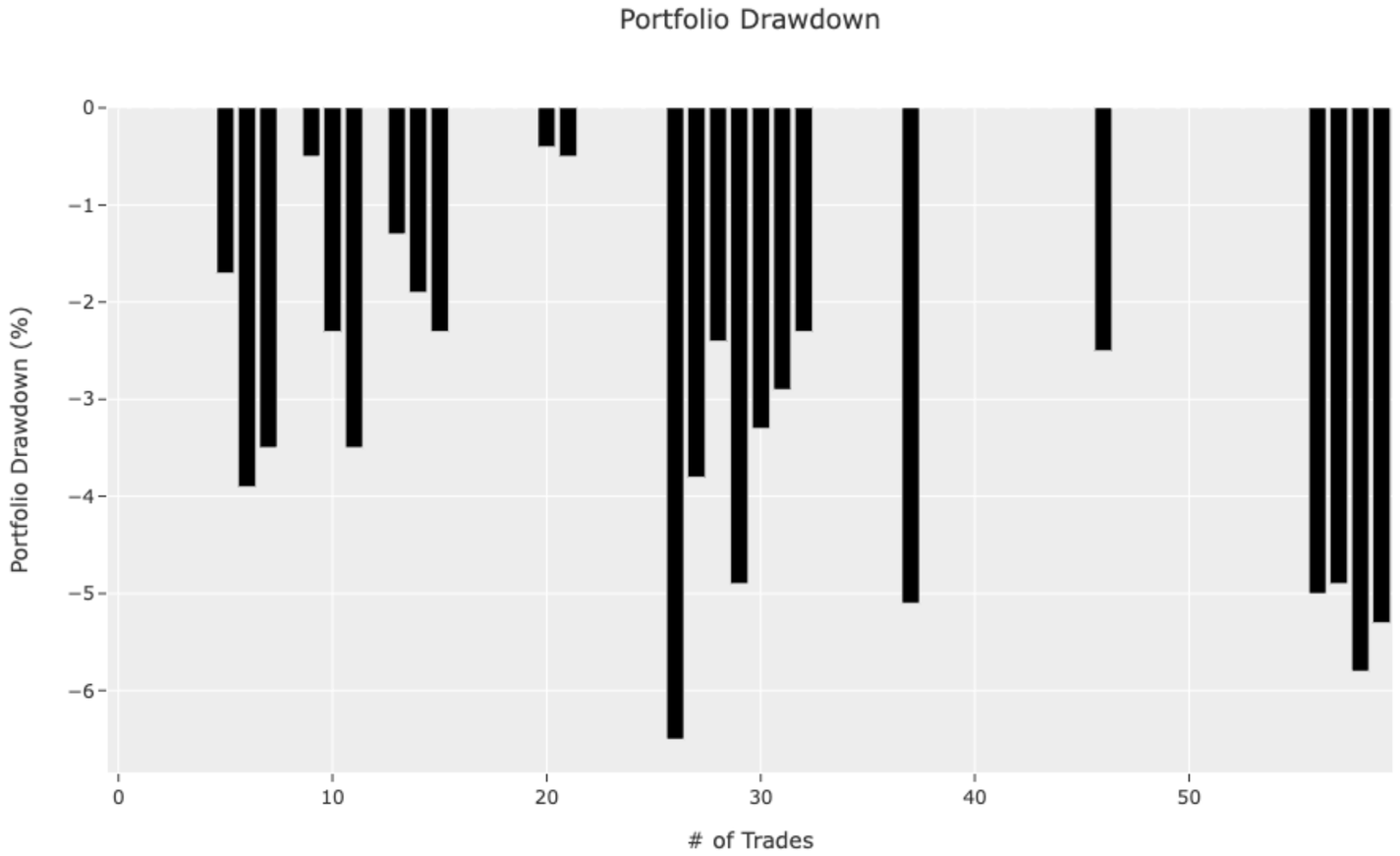


Drawdowns

Decline of the portfolio value from a historical peak

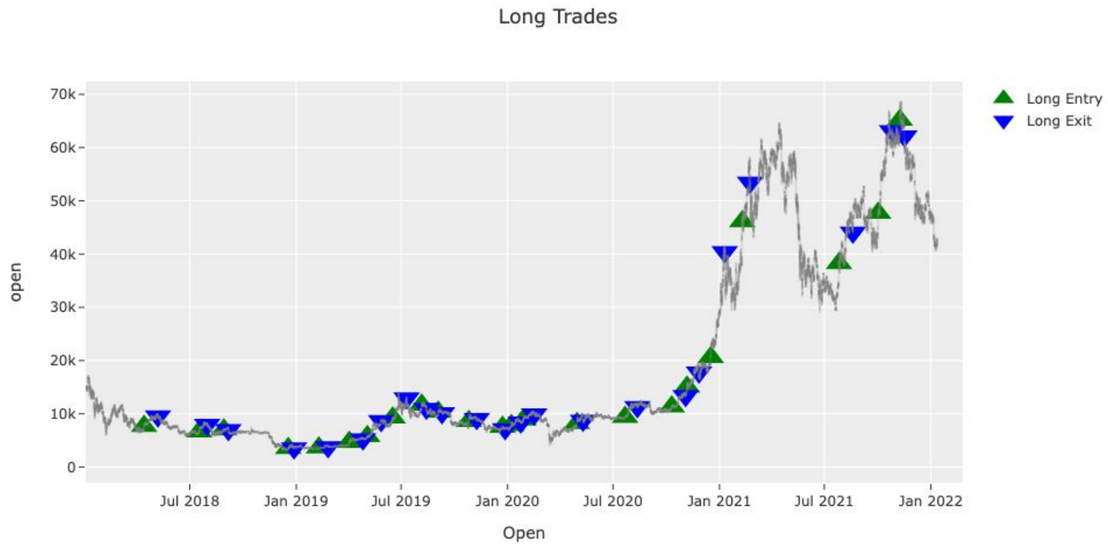
Max Drawdown: -6.46%

Benchmark Drawdown : -81.4%



Trade Positions

Indicates the entry and exit positions for both long and short trades on an interactive plot which is available in the Python notebook



TEAM 15

Thank You!