AlgoTrading

Takeaways from Version 1...

Important Points

- Plot correlation between 10 tickers
- 60% stocks/ 30% bonds/ 10% gold
- Equal weightage
- MACD (12, 26, 9)
- Weigh recent data higher
- Daily resolution
- No shorting

```
self.equities = ["AAPL", "PG", "AMGN", "EXC",
                 "LULU",   "MNST", "TLT", "LQD",
                 "BNDX", "GLD"]

self.weight = 1.0/len(self.equities)

self.MACD(symbol, 12, 26, 9,
          MovingAverageType.Exponential,
          Resolution.Daily)
```

Correlation Table

Stocks	AAPL	PG	AMGN	EXC	LULU	MNST	TLT	LQD	BNDX	GLD
AAPL	1									
PG	0.428281	1								
AMGN	0.490143	0.45775	1							
EXC	0.389153	0.548459	0.364004	1						
LULU	0.39427	0.222064	0.278597	0.304655	1					
MNST	0.428159	0.446115	0.365216	0.433684	0.309002	1				
TLT	-0.29341	-0.17932	-0.28636	-0.18298	-0.14181	-0.17929	1			
LQD	0.165152	0.175405	0.085664	0.238831	0.167088	0.181116	0.46424	1		
BNDX	0.042449	0.129161	-0.02353	0.21625	0.083448	0.095015	0.538644	0.537164	1	
GLD	-0.00938	0.049377	-0.0325	0.124397	0.00339	0.05597	0.35139	0.338778	0.337529	1

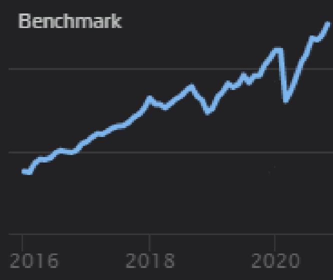
95.737%	$-79.06	-$411.14	$79,456.83	78.97 %	$178,969.71	$54,221.68	$4,494,0
PSR	Unrealized	Fees	Net Profit	Return	Equity	Holdings	Volume

Strategy Equity

1m 3m 1y All

Benchmark

1m 3m



Overview– Version 1

Overview | Report | Orders | Insights | Logs | Code | Share

Overview

Overall Statistics

Total Trades	345	Average Win	0.84%
Average Loss	-0.43%	Compounding Annual Return	12.594%
Drawdown	6.300%	Expectancy	0.804
Net Profit	78.970%	Sharpe Ratio	1.775
PSR	95.737%	Loss Rate	39%
Win Rate	61%	Profit-Loss Ratio	1.97
Alpha	0.106	Beta	-0.01
Annual Standard Deviation	0.059	Annual Variance	0.003
Information Ratio	-0.169	Tracking Error	0.184
Treynor Ratio	-10.228	Total Fees	$411.14

Revised Strategy

1. Identify...
   or rather
   Re-identify

Re-identification of Potential Markets

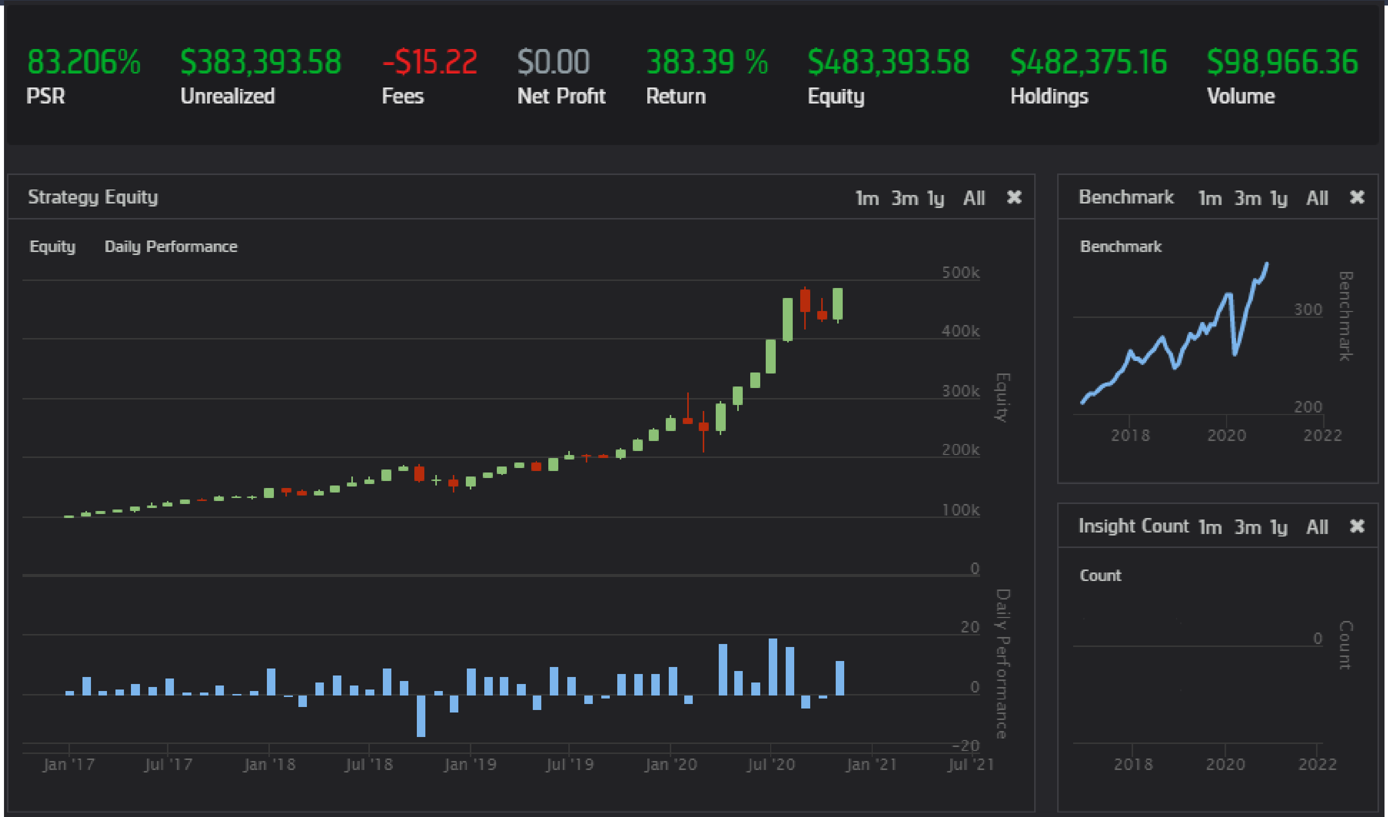
- Shift towards tech-focused portfolio;
  - "ADBE", "PG", "AMD", "NVDA", "LULU", "MSFT", "TSLA", "CDNS", "VGLT", "NEM"

What's Next?

Try out the following strategies...

1) Simulate equal weightage (Cases 1 & 2)
2) Buy and hold strategy
3) MACD strategy (w/ liquidation)
4) Test MPT weightage (Case 3)
   a) https://www.portfoliovisualizer.com/optimize-portfolio
   b) Years 2017 - 2020
   c) Maximum Sharpe Ratio
   d) Monte Carlo Simulation

Case 1: Buy and Hold from Day 1



Case 1: Results

Overview | Report | Orders | Insights | Logs | Code | Share

Overview

Overall Statistics

Total Trades	10	Average Win	0%
Average Loss	0%	Compounding Annual Return	49.719%
Drawdown	32.600%	Expectancy	0
Net Profit	383.394%	Sharpe Ratio	1.759
PSR	83.206%	Loss Rate	0%
Win Rate	0%	Profit-Loss Ratio	0
Alpha	0.467	Beta	-0.211
Annual Standard Deviation	0.248	Annual Variance	0.062
Information Ratio	0.887	Tracking Error	0.331
Treynor Ratio	-2.066	Total Fees	$15.22

Case 2: MACD Strategy (with Liquidation)

Case 2: Results

Overview | Report | Orders | Insights | Logs | Code | Share

Overview

Overall Statistics

Total Trades	427	Average Win	1.29%
Average Loss	-0.62%	Compounding Annual Return	21.581%
Drawdown	15.400%	Expectancy	0.587
Net Profit	114.451%	Sharpe Ratio	1.396
PSR	72.885%	Loss Rate	48%
Win Rate	52%	Profit-Loss Ratio	2.07
Alpha	0.188	Beta	-0.03
Annual Standard Deviation	0.132	Annual Variance	0.017
Information Ratio	0.179	Tracking Error	0.23
Treynor Ratio	-6.197	Total Fees	$573.76

Case 3: Portfolio Optimisation

Maximum Sharpe Ratio

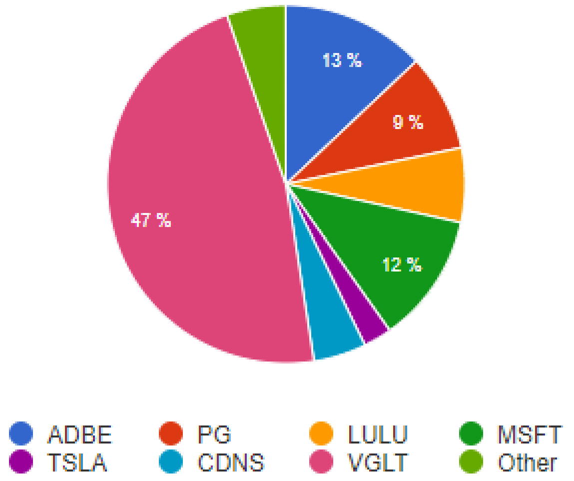
Ticker	Name	Allocation
ADBE	Adobe Systems Incorporated	12.97%
PG	Procter & Gamble Company	8.78%
AMD	Advanced Micro Devices, Inc.	1.53%
NVDA	NVIDIA Corporation	2.00%
LULU	lululemon athletica inc.	6.72%
MSFT	Microsoft Corporation	11.72%
TSLA	Tesla Inc	2.56%
CDNS	Cadence Design Systems, Inc.	4.77%
VGLT	Vanguard Long-Term Treasury ETF	47.17%
NEM	Newmont Goldcorp Corp	1.79%

```
self.__weight = dict()
self.__weight["ADBE"] = 0.12
self.__weight["PG"] = 0.08
self.__weight["AMD"] = 0.02
self.__weight["NVDA"] = 0.02
self.__weight["LULU"] = 0.06
self.__weight["MSFT"] = 0.11
self.__weight["TSLA"] = 0.03
self.__weight["CDNS"] = 0.05
self.__weight["VGLT"] = 0.47
self.__weight["NEM"] = 0.02
```

Data obtained from: https://www.portfoliovisualizer.com/optimize-portfolio#analysisResults

Case 3: Portfolio Performance Summary

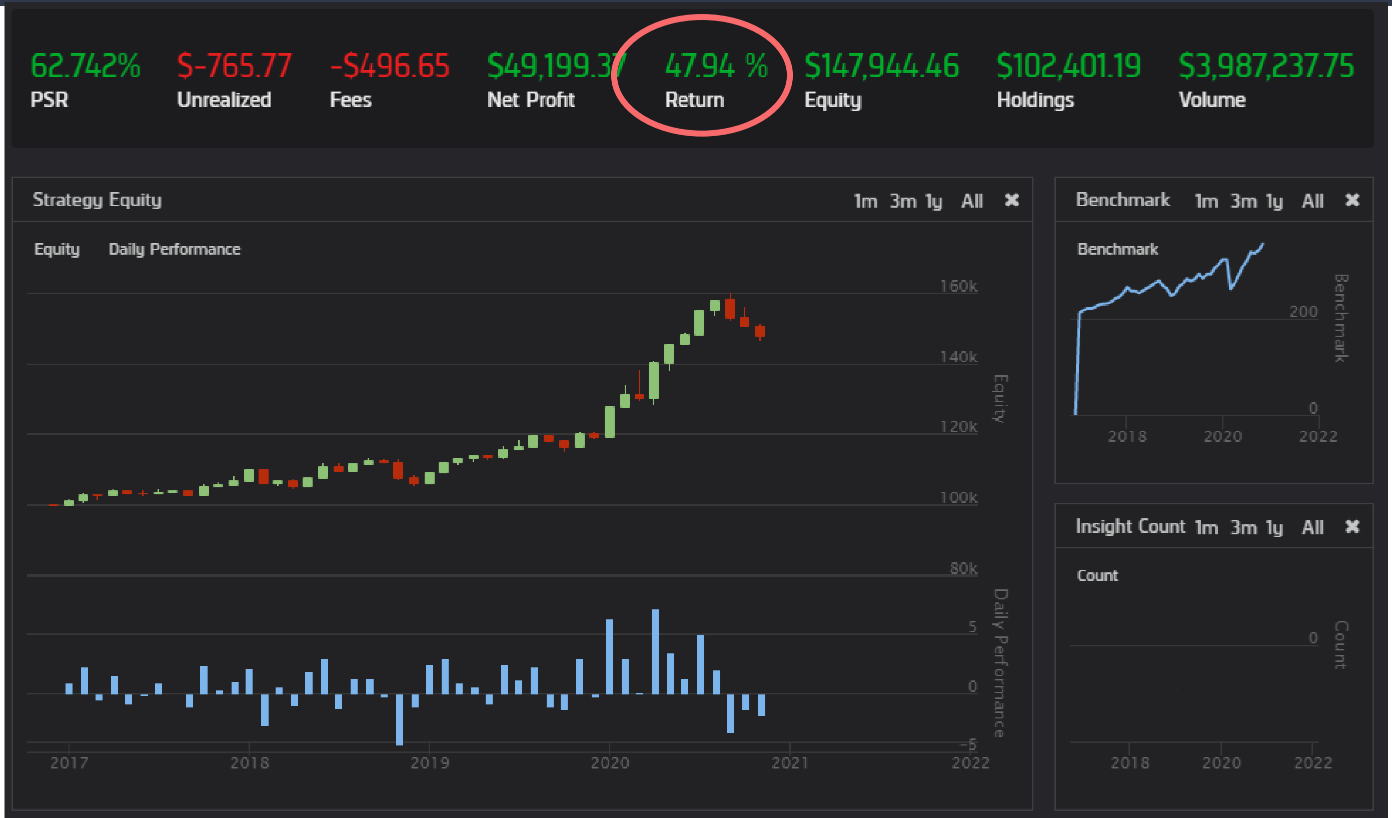
Metric	Maximum Sharpe Ratio
Start Balance	$10,000
End Balance	$25,828
CAGR	28.09%
Expected Return	28.64%
Stdev	9.55%
Best Year	36.87%
Worst Year	11.40%
Max. Drawdown	-6.27%
Sharpe Ratio (ex-ante)	2.85
Sharpe Ratio (ex-post)	2.51
Sortino Ratio	6.59
US Stock Market Correlation	0.66



VaR = -2.36%, CVaR = -3.91%

Data obtained from: https://www.portfoliovisualizer.com/optimize-portfolio#analysisResults

Case 3: MPT Weightage (Static)



Case 3: Results

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Overview

Overall Statistics

Total Trades	431	Average Win	0.71%
Average Loss	-0.33%	Compounding Annual Return	10.545%
Drawdown	8.700%	Expectancy	0.584
Net Profit	47.944%	Sharpe Ratio	1.202
PSR	62.742%	Loss Rate	50%
Win Rate	50%	Profit-Loss Ratio	2.18
Alpha	0.086	Beta	0.019
Annual Standard Deviation	0.074	Annual Variance	0.005
Information Ratio	-0.278	Tracking Error	0.194
Treynor Ratio	4.668	Total Fees	$496.65

Observations for Case 3

	Buy n Hold (Equal Weightage)	MACD (Equal Weightage)	MACD (MPT Weightage)
Returns	383.39	114.45	47.94
Sharpe Ratio	1.759	1.396	1.202
Beta	-0.211	-0.03	0.019
Drawdown	32.6	15.4	8.7

Profit-loss for MPT actually increased.

Net Profits: ↓ as average win ↓

Win Rate: Unchanged

Sharpe Ratio: ↓ but still > 1

Beta: ≈ 0

Drawdown: reduced by ≈ 50%

Overall:

- MPT win smaller, lose smaller but no. of trades stayed the same
- Notable difference between portfoliovisualizer.com results & backtest results

Other Commentary

Buying

When we tried to short the stock when the algo says to buy it perform exactly as we expected: the portfolio kept on losing money.

Thus, when the algo says to buy it, we set holdings according to the portfolio weightage (unchanged).

Selling

However, when we tried to short the stock when the algo says to sell it (currently it is liquidating), the portfolio returns are lower.

This indicates that we need to refine the criteria for liquidating or shorting.

We suspect that it is because the stocks are generally bullish and the current selling signals are false positives.

Our Strategy

2. Decide

Moving Forward With Case 3

Decide

Moving Average Convergence Divergence (MACD):

- a trend-following momentum indicator that shows the relationship between two moving averages of a security's price
- calculated by subtracting the 26-period Exponential Moving Average (EMA) from the 12-period EMA.

Confirm

Exponential Moving Average:

- Calculated using past 200-day data
- Familiarise with general movement of stocks
- Act as a strong support/resistance

Confirming for Liquidation

Before:

```
# of our macd is less than our signal, then let's liquidate
elif holdings > 0 and signalDeltaPercent < -tolerance:

        self.Liquidate(symbol)
```

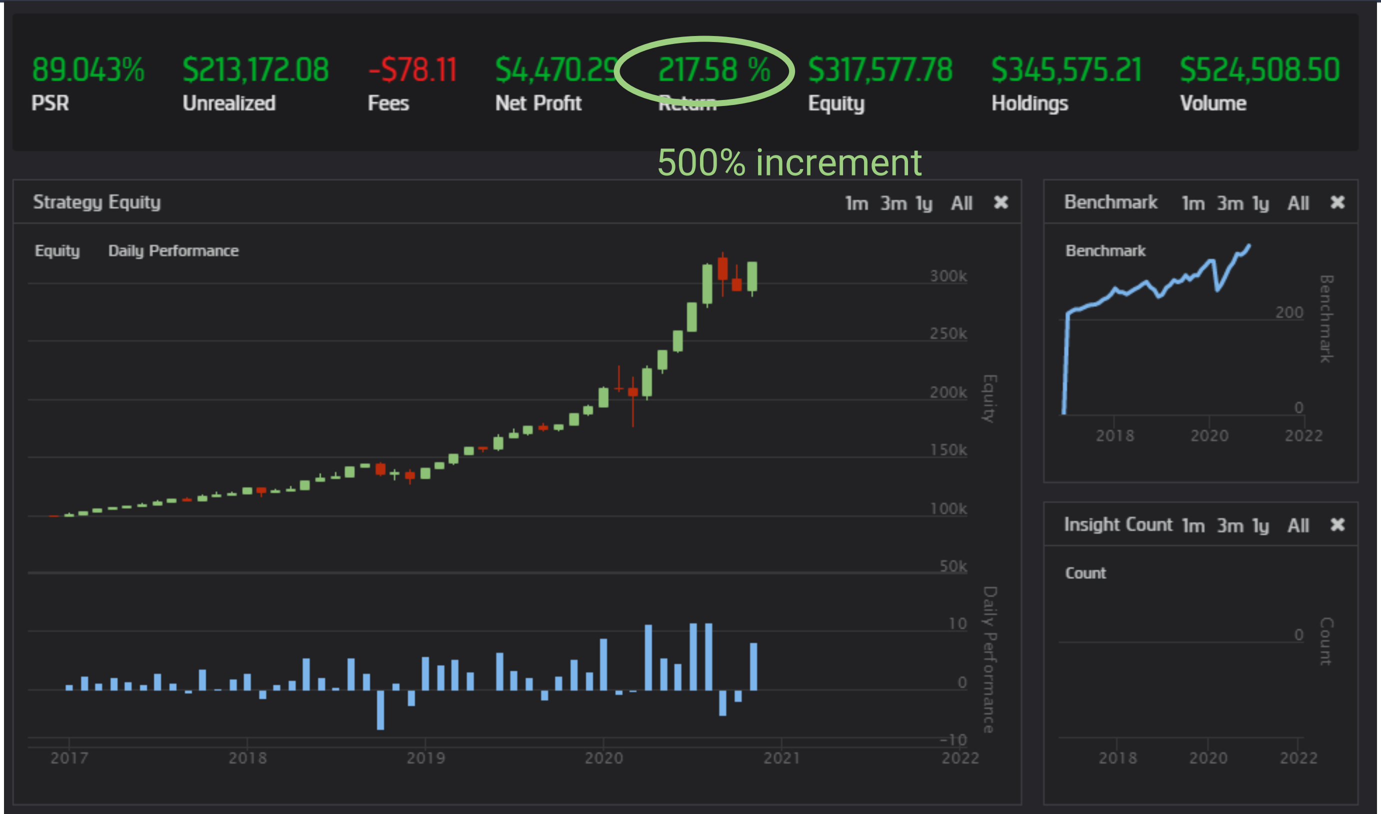
After:

```
# of our macd is less than our signal, then let's liquidate
elif holdings > 0 and signalDeltaPercent < -tolerance:

    if self.__macd[symbol].Current.Value > tolerance and self.Securities[symbol].Price < self.__ema[symbol].Current.Value:

        self.Liquidate(symbol)
```

After Confirmation



Results with Updated Selling Confirmation

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Overview

Overall Statistics

Total Trades	64	Average Win	0.82%
Average Loss	-0.44%	Compounding Annual Return	34.417%
Drawdown	23.300%	Expectancy	0.375
Net Profit	217.578%	Sharpe Ratio	1.817
PSR	89.043%	Loss Rate	52%
Win Rate	48%	Profit-Loss Ratio	1.86
Alpha	0.307	Beta	-0.108
Annual Standard Deviation	0.16	Annual Variance	0.026
Information Ratio	0.575	Tracking Error	0.258
Treynor Ratio	-2.696	Total Fees	$78.11

Lower trades; likely due to less false signals

Drawdown increased to ride out temporary dip

Highest Sharpe Ratio in discussion so far

Beta bigger but remains low volatility (<1)

Revised Strategy

3. Manage

Trailing Stop Loss:

- Tracks the highest peak
- Sets stop loss according to that peak
- Exit when price falls below stop loss

Diversify Portfolio:

- Distribute the risks
- More diversification across different sectors
- Adjust the weightages according to individual performance

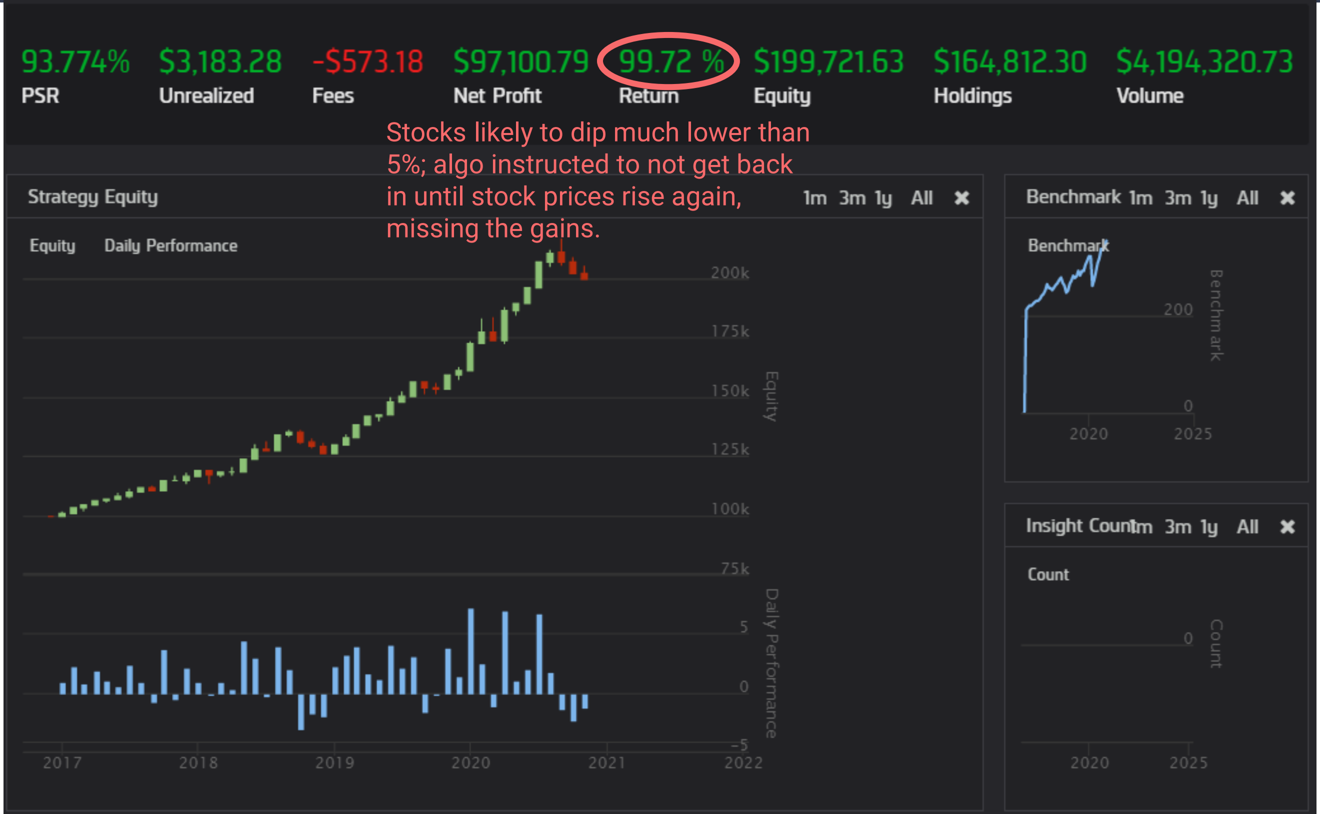
Stop Loss @ -5% from Previous Peak

```
for symbol in self.equities:
    self.AddEquity(symbol, Resolution.Daily)
    self.__highestPrice[symbol] = 0
    self.__stopPrice[symbol] = 0
    self.__macd[symbol] = self.MACD(symbol, 12, 26, 9, MovingAverageType.Exponential, Resolution.Daily)
    self.__ema[symbol] = self.EMA(symbol, 200, Resolution.Daily)
```

```
elif self.Securities[symbol].Close < self.__stopPrice[symbol]:
    self.__highestPrice[symbol] = self.__stopPrice[symbol]
    self.__stopPrice[symbol] = self.__highestPrice[symbol] * 0.95
    self.Liquidate(symbol)

if self.Securities[symbol].Close > self.__highestPrice[symbol]:
    self.__highestPrice[symbol] = self.Securities[symbol].Close
    self.__stopPrice[symbol] = self.__highestPrice[symbol] * 0.95
```

Trailing Stop Loss Effects



Results with Stop Loss Implemented

Overview | Report | Orders | Insights | Logs | Code | Share

Overview

Overall Statistics

Total Trades	525	Average Win	0.86%
Average Loss	-0.21%	Compounding Annual Return	19.371%
Drawdown	8.100%	Expectancy	1.254
Net Profit	99.722%	Sharpe Ratio	1.86
PSR	93.774%	Loss Rate	55%
Win Rate	45%	Profit-Loss Ratio	4.03
Alpha	0.166	Beta	-0.037
Annual Standard Deviation	0.086	Annual Variance	0.007
Information Ratio	0.086	Tracking Error	0.209
Treynor Ratio	-4.348	Total Fees	$573.18

More trades from stop loss

Almost a quarter of previous drawdown

Lower win rates due to increased frequency of stop loss

Even higher Sharpe Ratio

>100% increase in Profit-Loss Ratio

Smaller beta

Buying at the Dip

Before:

```
elif self.Securities[symbol].Close < self.__stopPrice[symbol]:
    self.__highestPrice[symbol] = self.__stopPrice[symbol]
    self.__stopPrice[symbol] = self.__highestPrice[symbol] * 0.95
    self.Liquidate(symbol)

if self.Securities[symbol].Close > self.__highestPrice[symbol]:
    self.__highestPrice[symbol] = self.Securities[symbol].Close
    self.__stopPrice[symbol] = self.__highestPrice[symbol] * 0.95
```

After:

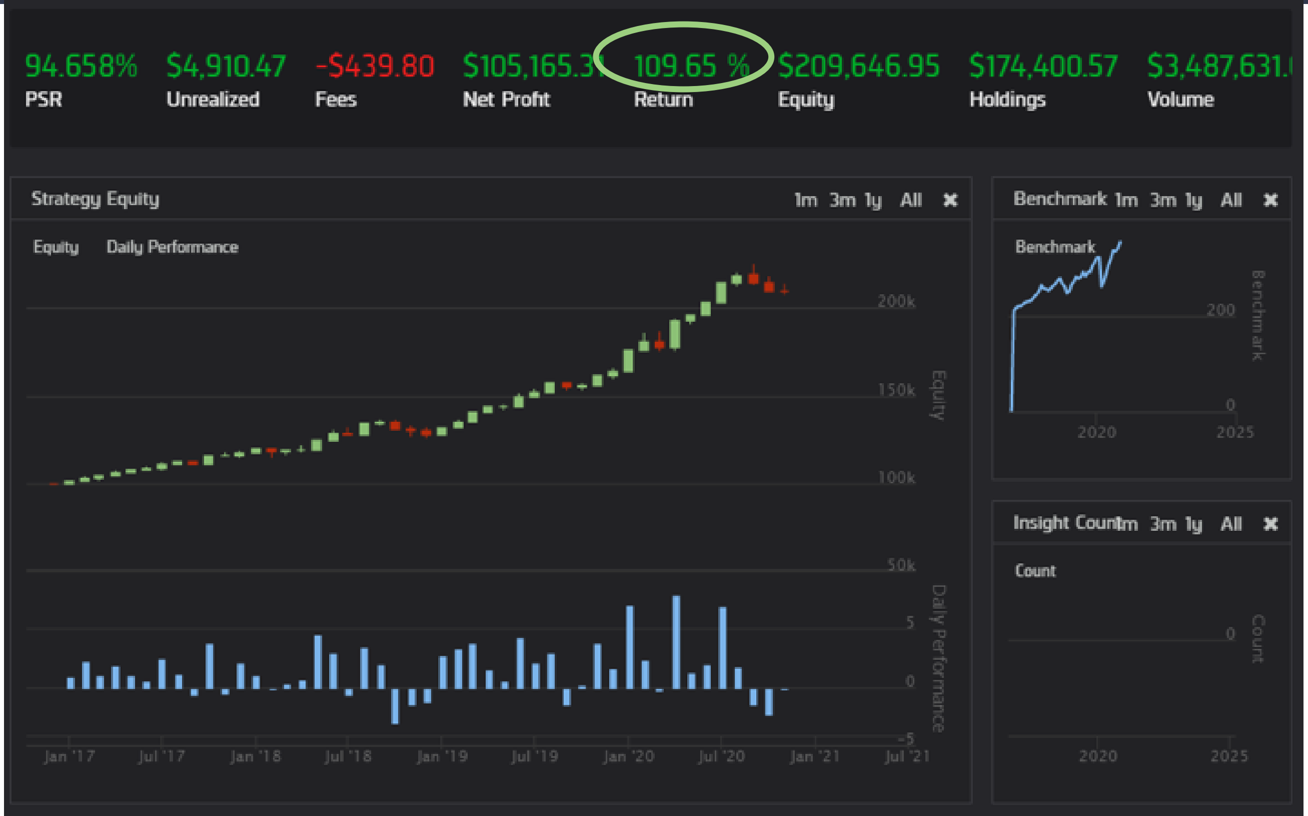
```
elif self.Securities[symbol].Close < self.__stopPrice[symbol]:
    self.__highestPrice[symbol] = self.__stopPrice[symbol]
    self.__stopPrice[symbol] = self.__highestPrice[symbol] * 0.8
    self.Liquidate(symbol)

if self.Securities[symbol].Close > self.__highestPrice[symbol]:
    self.__highestPrice[symbol] = self.Securities[symbol].Close
    self.__stopPrice[symbol] = self.__highestPrice[symbol] * 0.95
```

Idea

Experimented with this value to allow the algo to come back into the market earlier after the initial dip. (Next entry price is lower after liquidating)

Re-entering the Market



Results

Overview | Report | Orders | Insights | Logs | Code | Share

Overview

Overall Statistics

Total Trades	391	Average Win	0.92%
Average Loss	-0.29%	Compounding Annual Return	20.862%
Drawdown	7.600%	Expectancy	1.326
Net Profit	109.647%	Sharpe Ratio	1.91
PSR	94.658%	Loss Rate	44%
Win Rate	56%	Profit-Loss Ratio	3.17
Alpha	0.179	Beta	-0.041
Annual Standard Deviation	0.091	Annual Variance	0.008
Information Ratio	0.143	Tracking Error	0.211
Treynor Ratio	-4.257	Total Fees	$439.80

Higher Sharpe Ratio

Comparison

	Case 3: MACD (MPT Weightage)	MACD w/ EMA(200) & Stop Loss (MPT Weightage)
Returns	47.94	109.65
Sharpe Ratio	1.202	1.91
Alpha	0.086	0.179
Beta	0.019	-0.041
Drawdown	8.1	7.6

Revised Strategy

4. Rebalance

Rebalancing of Portfolio

- Stop all trades upon a maximum of 15% loss
- Liquidate at 85000
- Reassess market conditions and reevaluate algorithms before entering the market again
- Option for Automated or Manual depending on preference

Rebalancing

Automate

When the entire value of the portfolio falls below a certain threshold, it automatically stops all trading.

Sends a notification to the investor.

```
def OnData(self, data):
    if self.stop: return

    # if prices fall due to algo fault or case of possible black swan, then stop trading
    if self.Portfolio.TotalPortfolioValue < 0.85 * 100000:
        self.stop = True
        self.Liquidate()
        self.Notify.Email("lauyuda@gmail.com", "Investment Balance Alert",
                          "Trading has been stopped. Please look into issue.")
```

Rebalancing

Manual

Triggers a notification for investor to look out for possible issues and to stop trade if necessary.

Portfolio can be rebalanced using MPT accordingly by removing or adding other ticker(s).

```
# if price falls way below, then automate message for investor to check portfolio
if self.Securities[symbol].Price < 0.9 * self.__stopPrice[symbol]:
    self.Notify.Email("lauyuda@gmail.com", "Securities Warning",
                      "Possible changing market conditions. Monitor market and re-evaluate your portfolio.")
```