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# Online Portfolio Selection Pattern Matching

# Introduction: Alex Kwon



- Researcher at Hudson & Thames Quantitative Research.
- Incoming Quantitative Trading Intern at Marshall Wace.
- Rising Senior at University of California, Berkeley.

# Overview

Online Portfolio Selection

Correlation Driven Nonparametric Learning

Universal Portfolio

Correlation Driven Nonparametric Learning - K

Market Symmetry

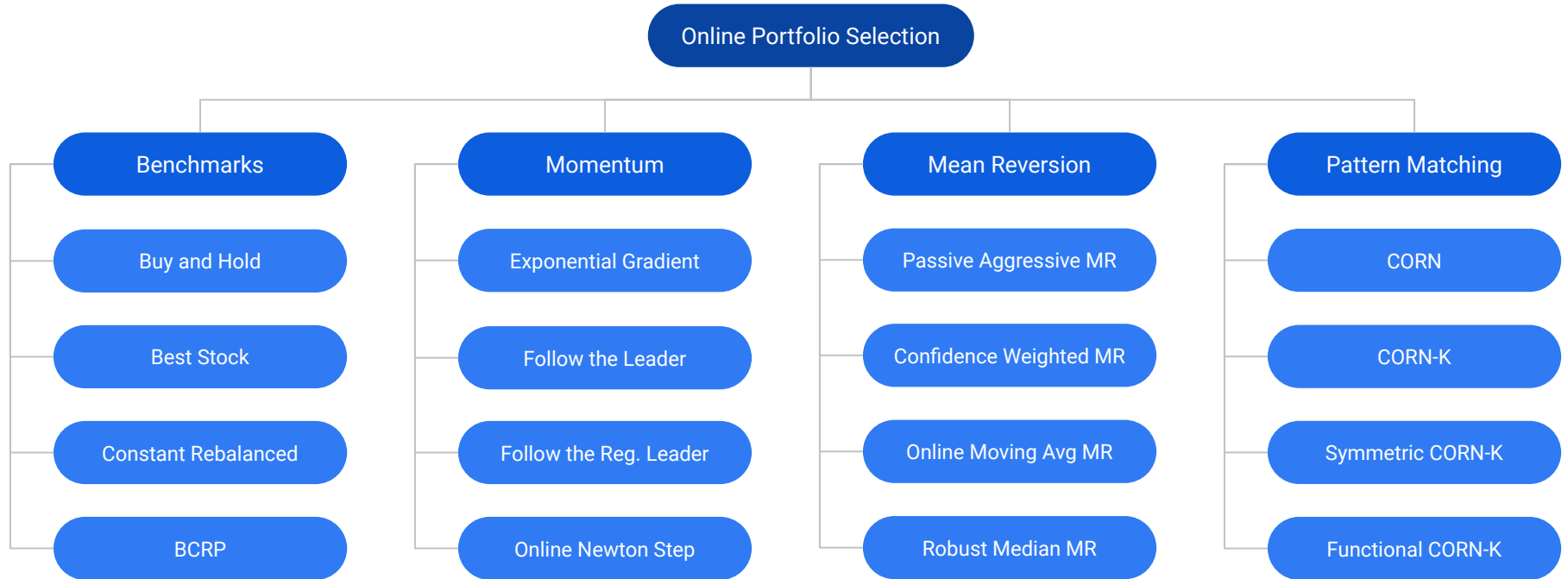
Symmetric Correlation Driven Nonparametric Learning - K

Functional Correlation Driven Nonparametric Learning - K

Results

# Online Portfolio Selection

- Portfolio Selection
  - Sequential allocation among a set of assets to maximize the final return of investment.
- Online Learning
  - Computationally efficient algorithms to handle large scale applications.

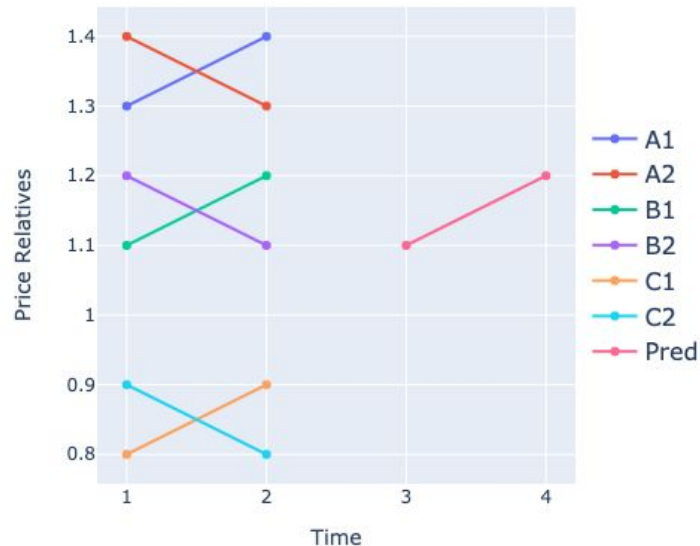
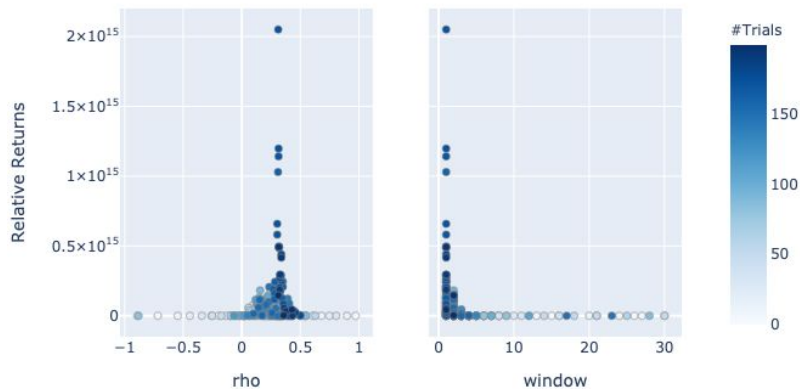




# Correlation Driven Nonparametric Learning

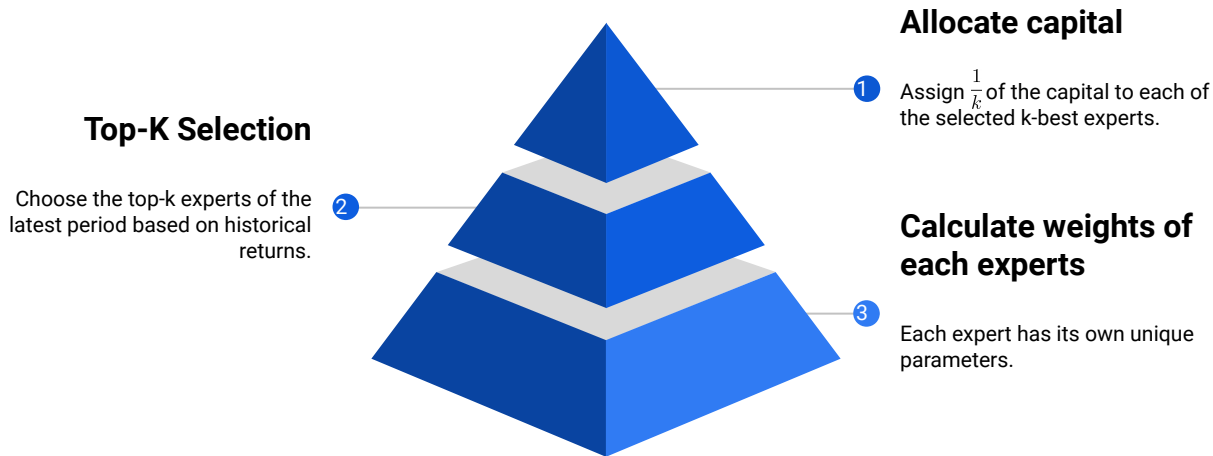
- Correlation between two different market windows.

NYSE CORN for Rho of  $[-1, 1]$  and Window of  $[1, 30]$



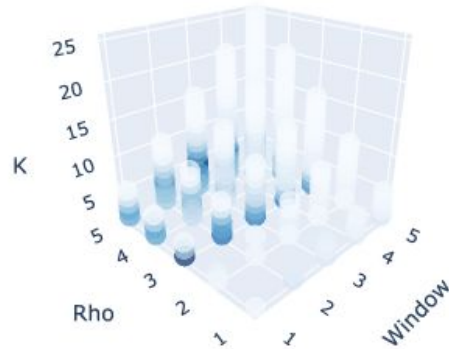
# Universal Portfolio

- Ensemble method that acts as a fund of funds.
- Top K: Allocating  $\frac{1}{k}$  of the total capital to the k best performing experts.



# Correlation Driven Nonparametric Learning - K

NYSE CORNK Window of [1, 5] and Rho of [1, 5]

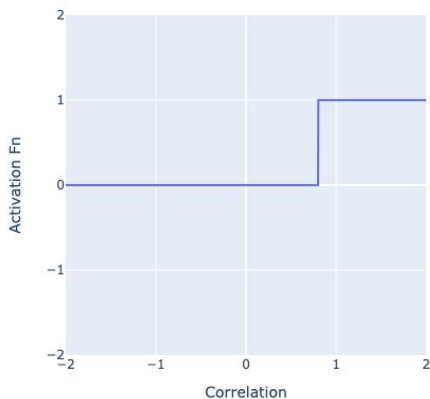




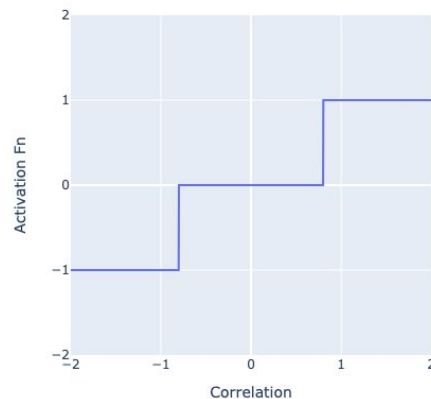
# Market Symmetry

$$b_t^*(w, \rho) = \arg \max_{b \in \Delta_m} \sum_{j \in \{1, \dots, t-1\}} v(j) \log b^\top x_j$$

CORN



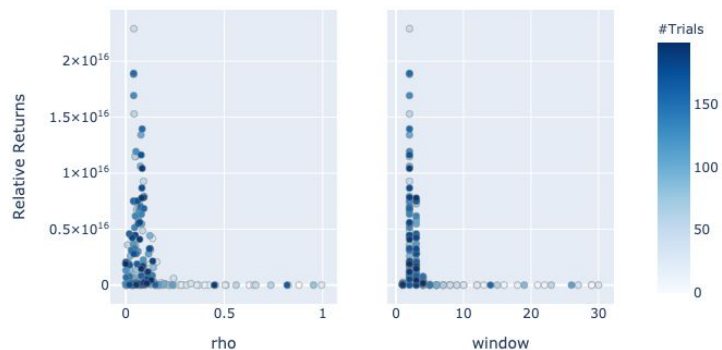
SCORN



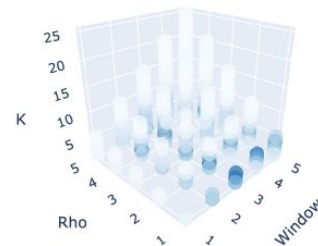
# Symmetric CORN-K

- Tracks the positive and negative correlation between market windows.

NYSE SCORN for Rho of  $[-1, 1]$  and Window of  $[1, 30]$



NYSE SCORNK Window of  $[1, 5]$  and Rho of  $[1, 5]$



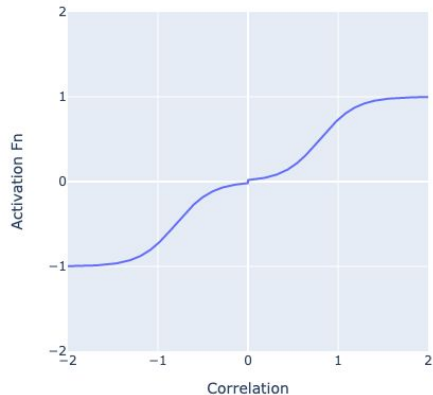


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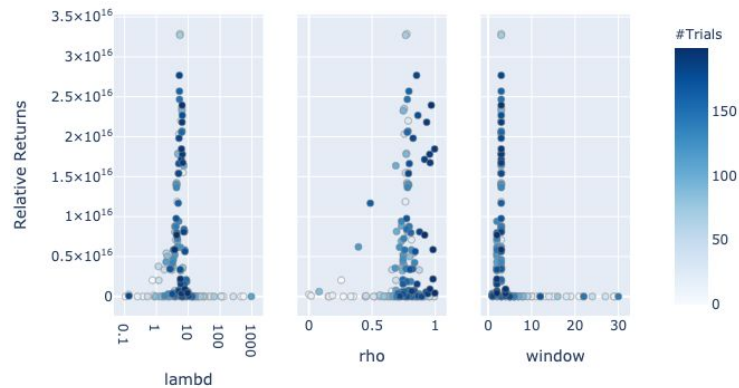
# Functional CORN-K

- Dynamically changing weights on all historical periods.

FCORN

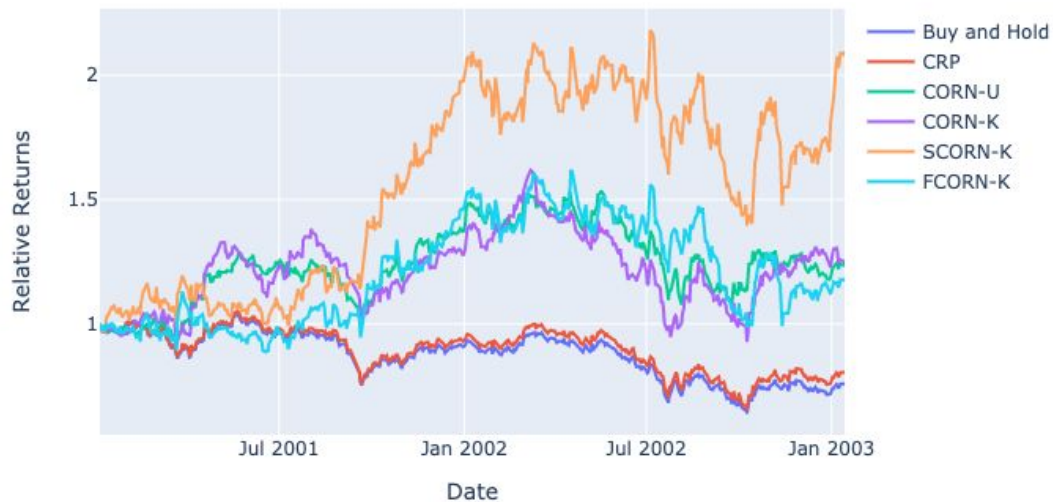


NYSE FCORN for Lambd of [0.1, 1000], Rho of [-1, 1], and Window of [1, 30]



# Results: DJIA 2001 ~ 2003

Pattern Matching Strategies on DJIA



# Results: US Equity 2011 ~ 2020

Pattern Matching Strategies on US Equity



# MLFinLab Module

```
In [301]: import mlfinlab
```

```
In [302]: model = CORN(window=2, rho=0)
```

```
In [303]: model.allocate(us_equity, verbose=True)
```

Progress:  100.0% Complete

```
In [304]: model.all_weights.tail()
```

Out[304]:

	AAPL	ABT	AMGN	AMZN	AXP	BAC	BRK-A	C	CAT	CMCSA	...	PG	PM	QCOM	SLB	T	UPS	USB	WFC	WMT	XOM
Date																					
2020-04-21	0.000000	0.0	0.0	0.000000	0.0	0.0	0.0	0.0	0.0	0.020534	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2020-04-22	0.000000	0.0	1.0	0.000000	0.0	0.0	0.0	0.0	0.0	0.000000	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2020-04-23	0.489216	0.0	0.0	0.510784	0.0	0.0	0.0	0.0	0.0	0.000000	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2020-04-24	0.000000	0.0	1.0	0.000000	0.0	0.0	0.0	0.0	0.0	0.000000	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2020-04-27	0.000000	0.0	0.0	0.000000	0.0	0.0	0.0	0.0	0.0	0.000000	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

5 rows x 44 columns


```
In [305]: model.portfolio_return
```

Out[305]:

	Returns
Date	
2011-01-03	1.000000
2011-01-04	1.002099
2011-01-05	1.007820
2011-01-06	1.014134
2011-01-07	1.016917
...	...
2020-04-21	12.518541
2020-04-22	12.439334
2020-04-23	12.512422
2020-04-24	12.716396
2020-04-27	13.050817

2344 rows x 1 columns

# Additional Resources



**Hudson and Thames Quantitative Research**

Private research group, focused on financial machine learning.

Manhattan, London, Kyiv <https://hudsonthames.org/> [research@hudsonthames.org](mailto:research@hudsonthames.org)

**Repositories** 3


**Packages**

**People** 17

**Teams** 2

**Projects** 6


## Pinned repositories



**MFinlab**

MFinlab helps portfolio managers and traders who want to leverage the power of machine learning by providing reproducible, interpretable, and easy to use tools.

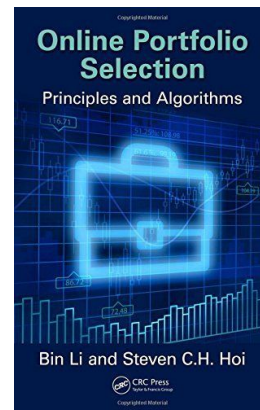
Python ★ 1.3k 📄 320



**research**

Notebooks based on financial machine learning.

Jupyter Notebook ★ 403 📄 162



## Market Symmetry and Its Application to Pattern-Matching-Based Portfolio Selection

YANG WANG AND DONG WANG

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**Abstract**  
The paper studies the problem of online portfolio selection (OPLS) in the context of market symmetry. We propose a new algorithm, called the Market Symmetry-based OPLS (MSOPLS), which can achieve a better performance than the existing OPLS algorithms. The MSOPLS algorithm is based on the market symmetry assumption, which states that the market returns are symmetric around zero. The MSOPLS algorithm is based on the market symmetry assumption, which states that the market returns are symmetric around zero. The MSOPLS algorithm is based on the market symmetry assumption, which states that the market returns are symmetric around zero.

**Keywords**  
Online portfolio selection, Market symmetry, Pattern matching, Portfolio selection.

# References

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- Wang, Y., & Wang, D. (2019). Market Symmetry and Its Application to Pattern-Matching-Based Portfolio Selection. *The Journal of Financial Data Science*, 1(2), 78–93. doi: 10.3905/jfds.2019.1.2.078





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Thank You