Application of Alternative Data and Convolutional Neural Networks for Forecasting Stock Prices

Erez Katz

CEO & Co-Founder, Lucena Research

About

Lucena Research
Predictive Analytics

About Lucena

- Leader in Machine Learning and AI

- Connect big data with investment professionals

Erez Katz, Lucena CEO

Buy Side Alternative Data Adoption

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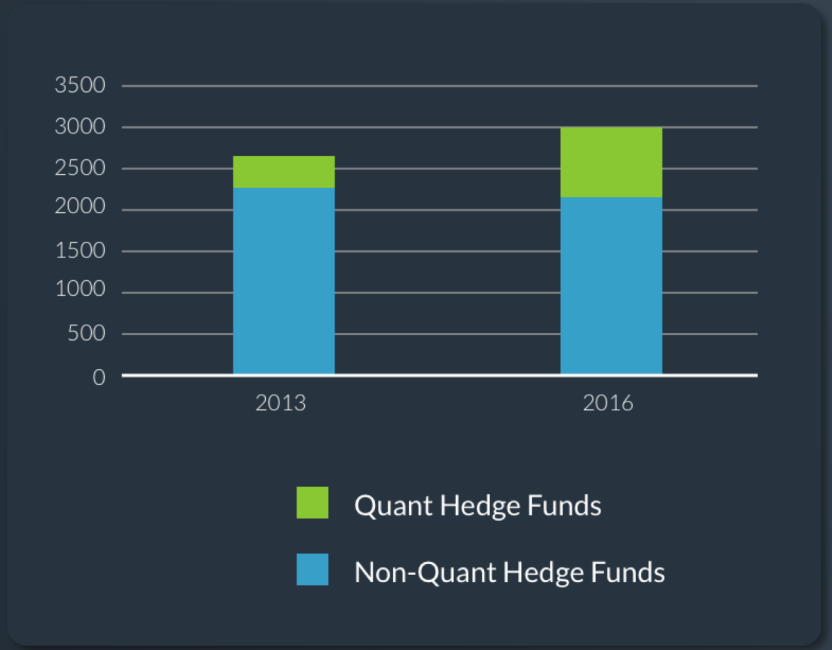

Image Source: Jefferies, Hedge Fund Research

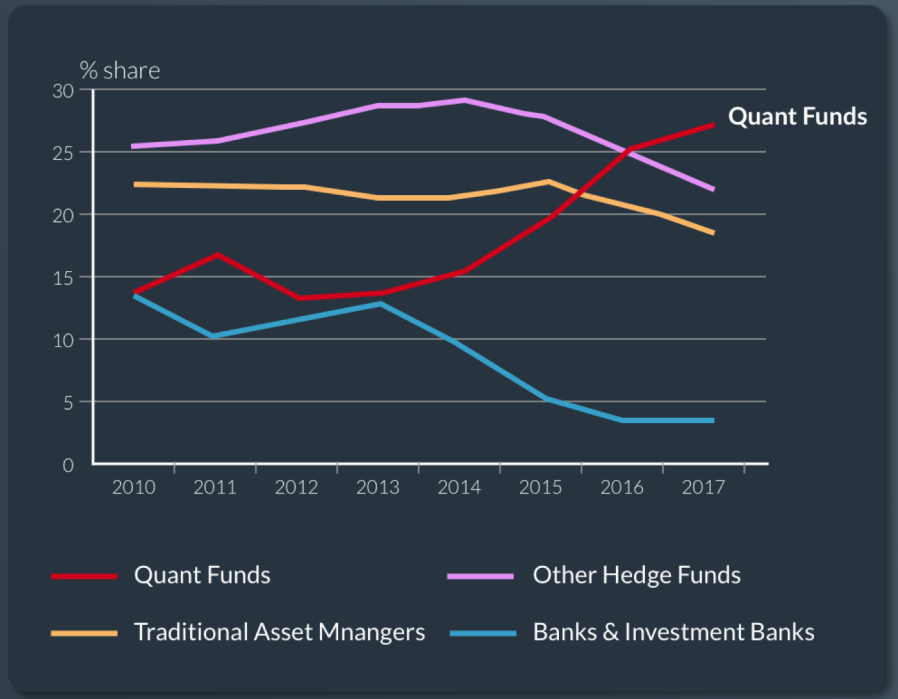

Image Source: WSJ, Tabb Group

Big Data & Alternative Data

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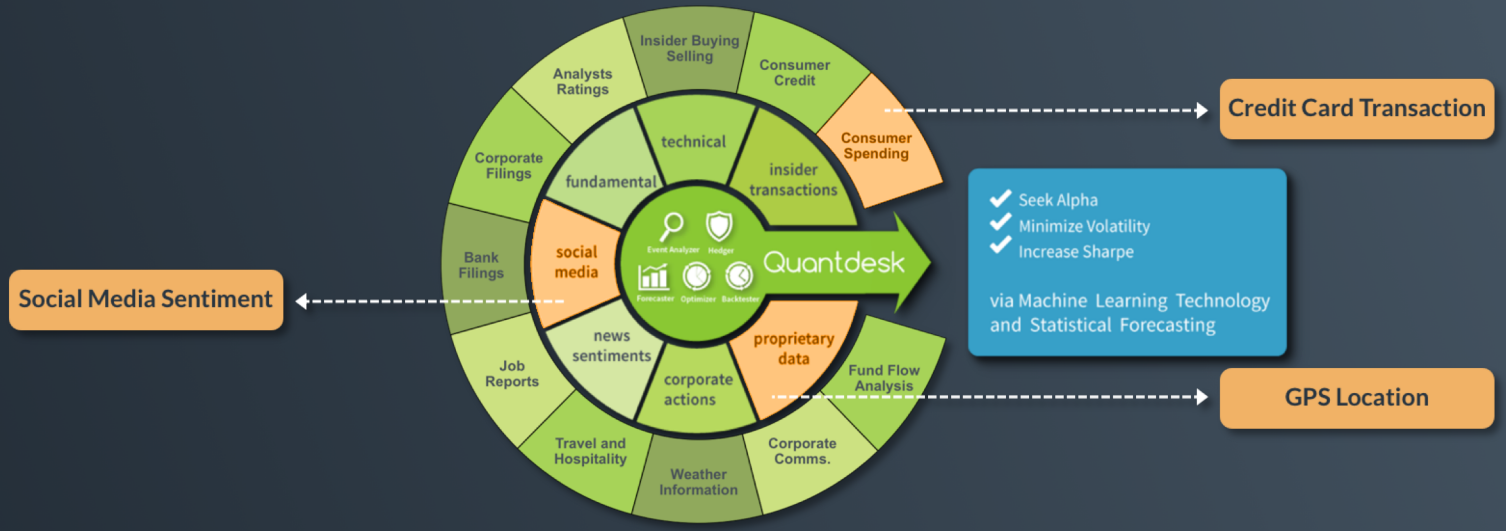
- Traditional Data Types: Mainly Technical and Fundamentals
- Equity Specific Alternative Data: Corporate Action, Insider Buying Selling
- Non Financial Data Repurposed for the financial markets: Credit Card, Weather Data
- Unstructured Data: News Feed, Social Media Feed, Speeches, Earnings Calls



Data Validation Process

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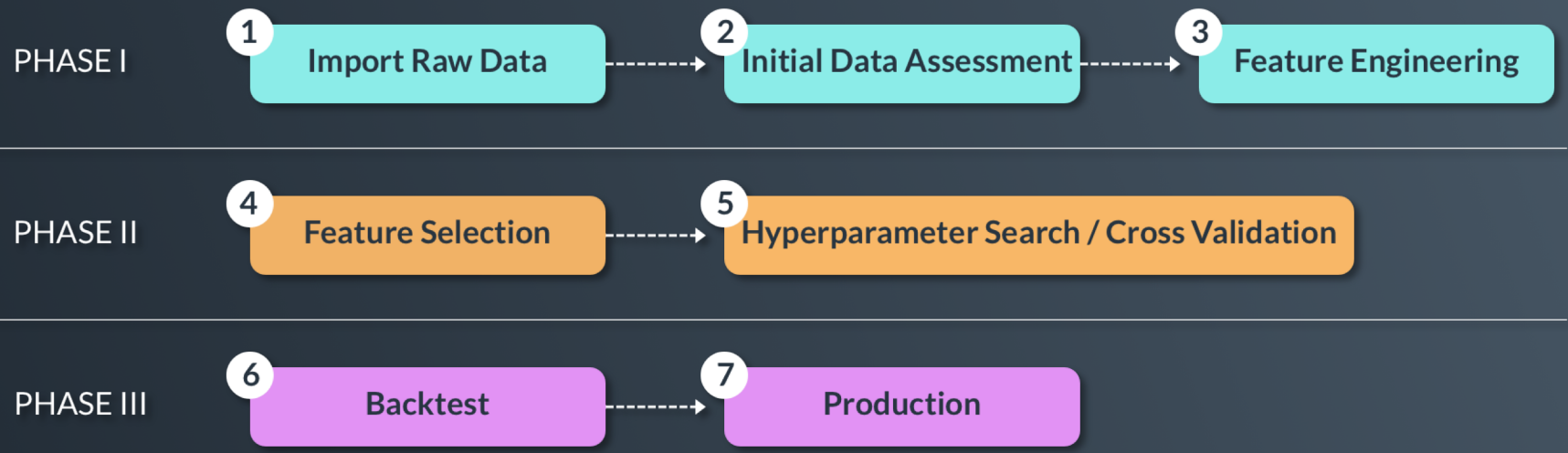
- Critical to follow a regimented process by which you can reliably consume, validate, and enhance data in order to generate predictive signals.



Data Validation Process

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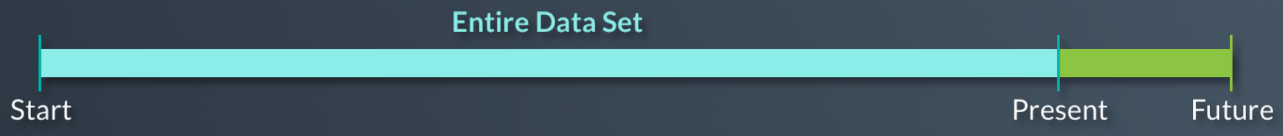
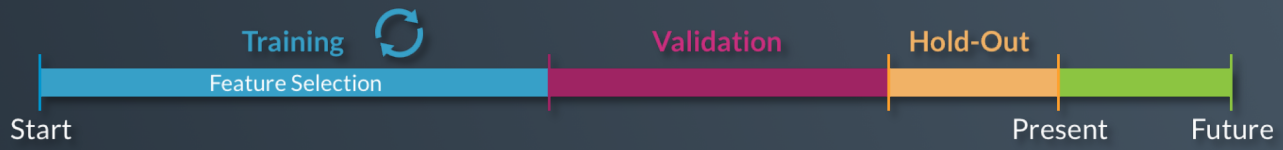
PHASE I

1. Import Raw Data
2. Initial Data Assessment
3. Feature Engineering

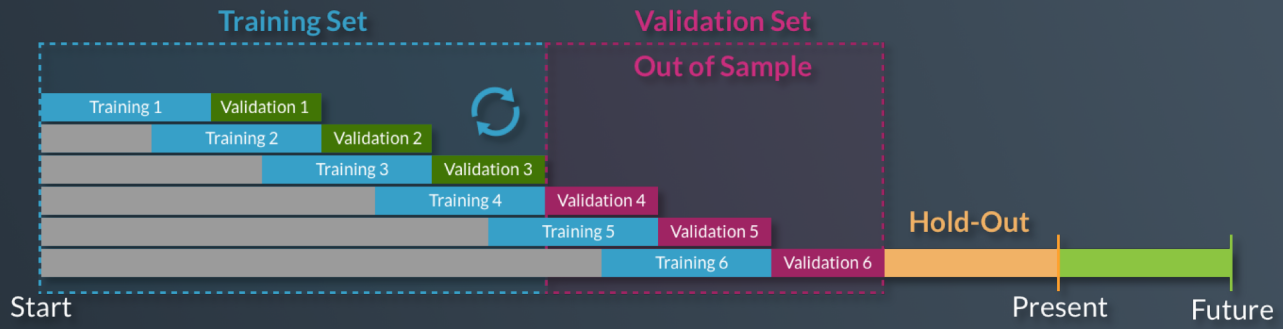


PHASE II

4. Feature Selection



5. Hyperparameter Search
Cross Validation



Data Validation Process

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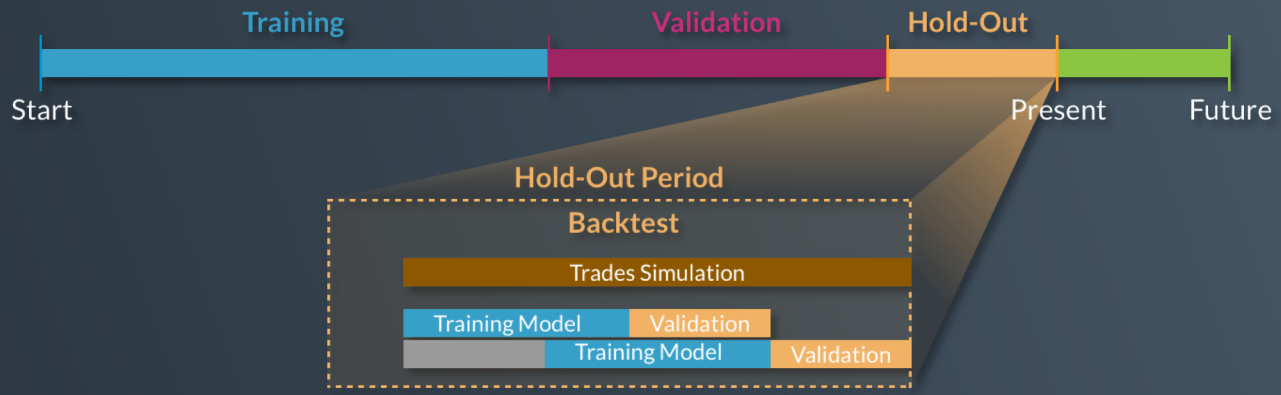
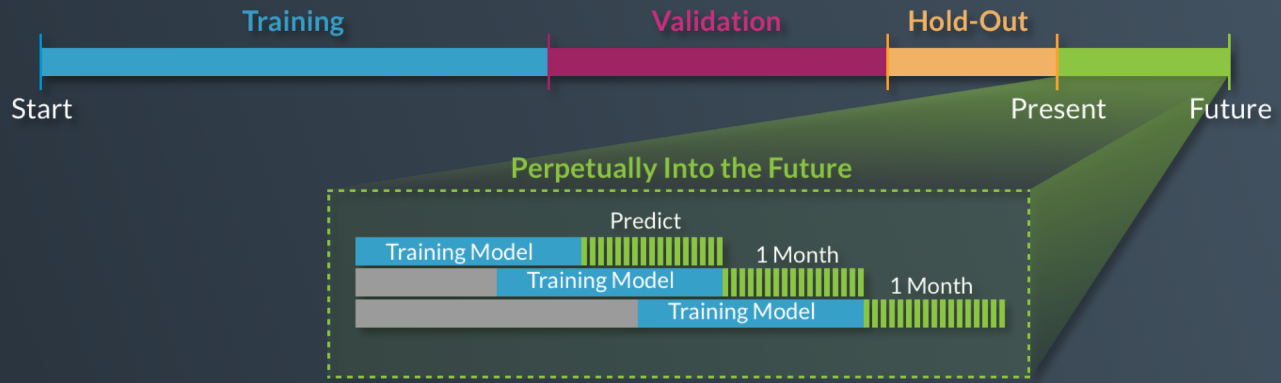
PHASE III

6 Backtest



7 Production



Automating Data Qualification? Why?

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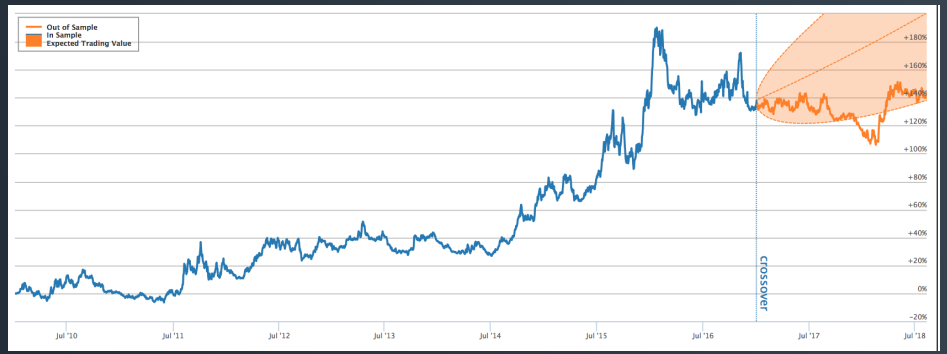
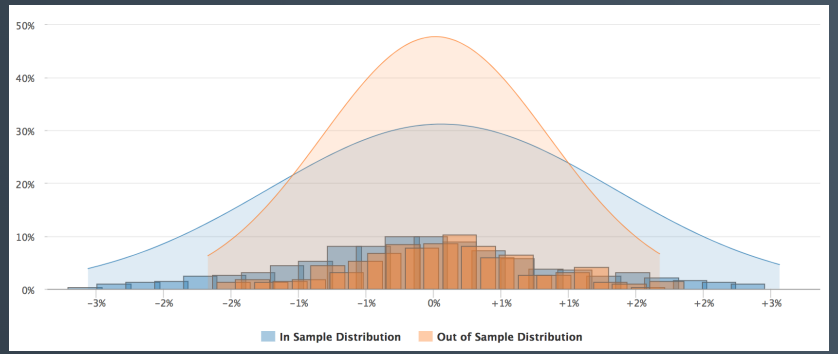
Qualification Statistics

	Value	Best	Grade
Percentage of NaNs	0.0799	Lower	✗
Percentage of Symbols Mapped	0.84	Higher	✓
Likelihood of Survivorship Bias	0.83	Lower	✗
Best Decile Sharpe	0.7353	Higher	✓
Signal Distribution Normality	0.91	Higher	✓
Percentage of Missing Trade Days	0.16	Lower	✗
Percentage of Extra Trade Days	0.01	Lower	✓
Percentage of Days with Multiple Signals per Asset	0.2037	Lower	✗
Average Data Frequency (Days)	65.8316	Closer to 1	✗
Data Type Prevelance	1.00	Higher	✗
Likelihood of Underlying Model Change	0.64	Lower	✗

- **Completeness**
- **Authenticity**
- **Consistency**
- **Survivorship Bias**

Below is an example of an inconsistent model:





Data Qualification What To Look For?

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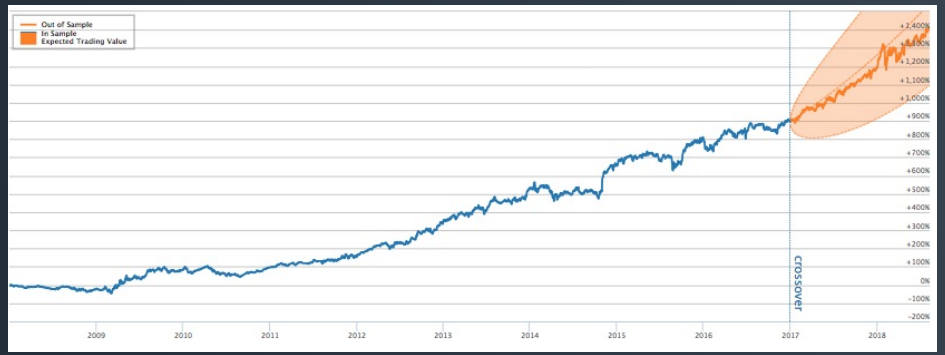

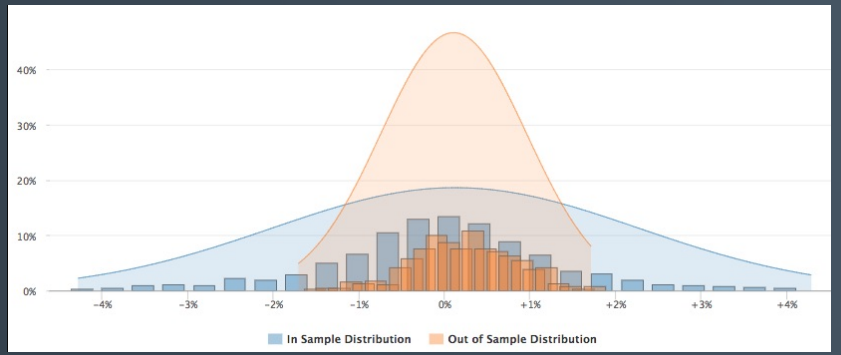

Data Matching Why?

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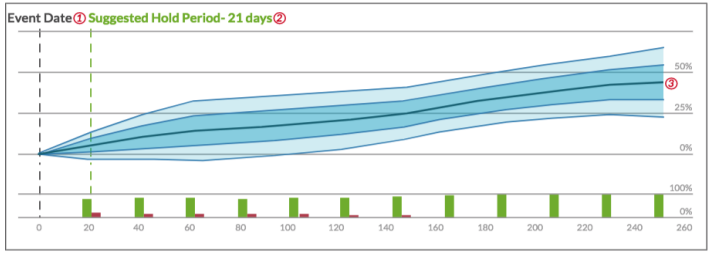
The Following Data Sources Are Recommended

Company	About	Relevancy Score
Credit Card Transaction	**Company A** provides sentiment scores that can be utilized for market/index timing transactions across time horizons.	80% (0, 20, 100)
Social Media Sentiment	Since 2000, **Company B** has been the world leader in capturing sentiment information from retail investors, owning the world's largest database of retail investor sentiment poll opinions.	70% (0, 30, 100)
GPS Location	**Company C** is a registered investment advisory firm. Over the last thirty years, their research platform, SMA/UMA strategies, indexes, and team of analysts have created more informed, conversations for advisors, investment managers and their clients.	60% (0, 40, 100)

- **Is the data effective for my constituents list?**
- **Is the signal suitable for my investment style**
  - **Hold Time**
  - **Long/Short risk tolerance**
  - **Concentration and turnover requirements**

Event Study Analysis



Backtest Charts

What is a Deep Neural Network

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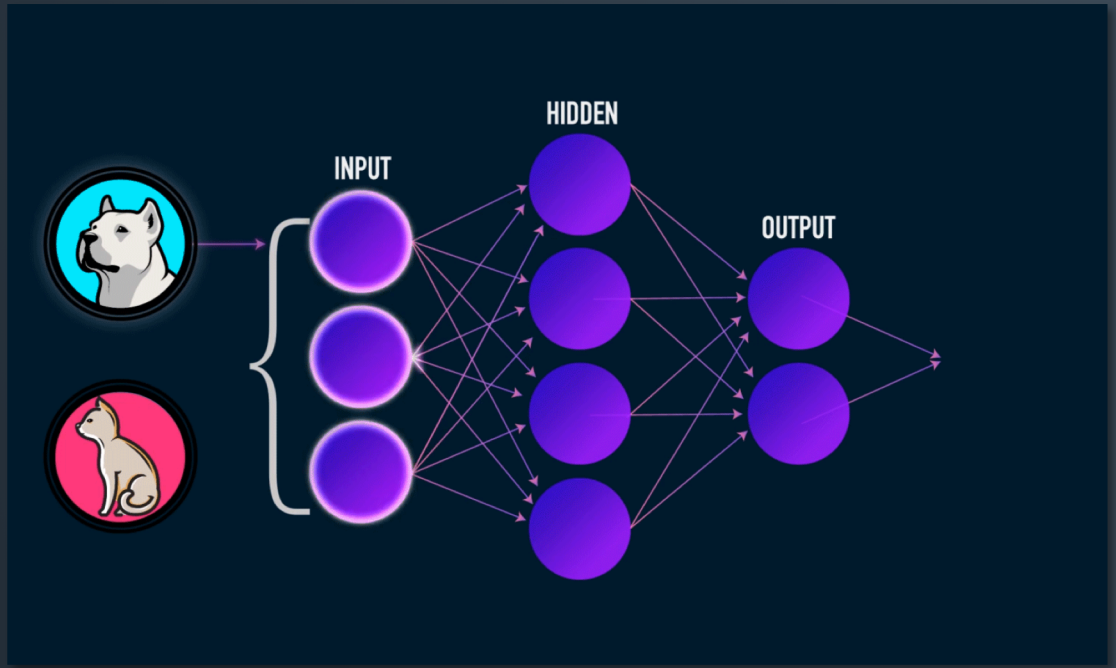
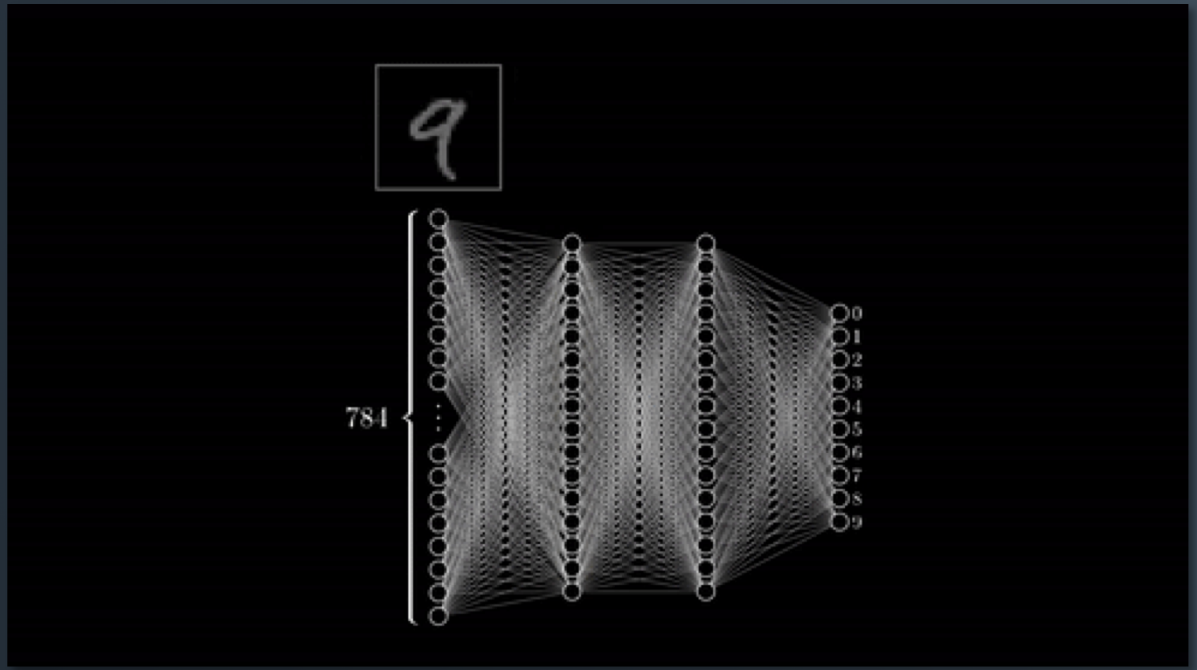


Animated gif by James Loy. Source: https://towardsdatascience.com/how-to-build-your-own-neural-network-from-scratch-in-python-68998a08e4f6

- Input Layer of Neurons.
- Multiple Hidden Layers.
- Feeds forward information.
- Output layer.

How Does The Network Learns?



Video by 3Blue1Brown. Source: https://www.youtube.com/watch?v=aircAruvnKk

- An image of hand written digit One layer identifies edges.
- Subsequent layers identify patterns.
- Output layer identifies the full object.

Realistic Visualization of image classification

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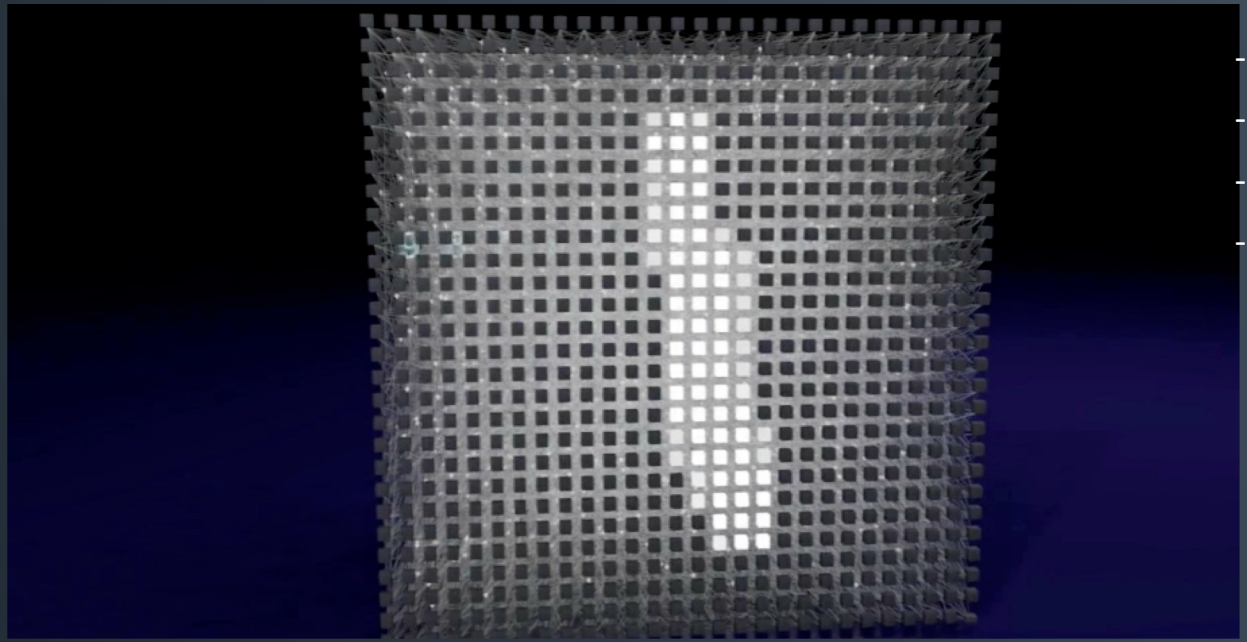

- Real world network is complex
- Feed forward Neuron Activation
- Output layer identifies the object
- Backpropagation and gradient descent

Video Source: https://www.cybercontrols.org/neuralnetworks

Example of a Modern CNN

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- CNN forms additional tasks by filtering special patterns.
- Layers are added to down sample a complex image.

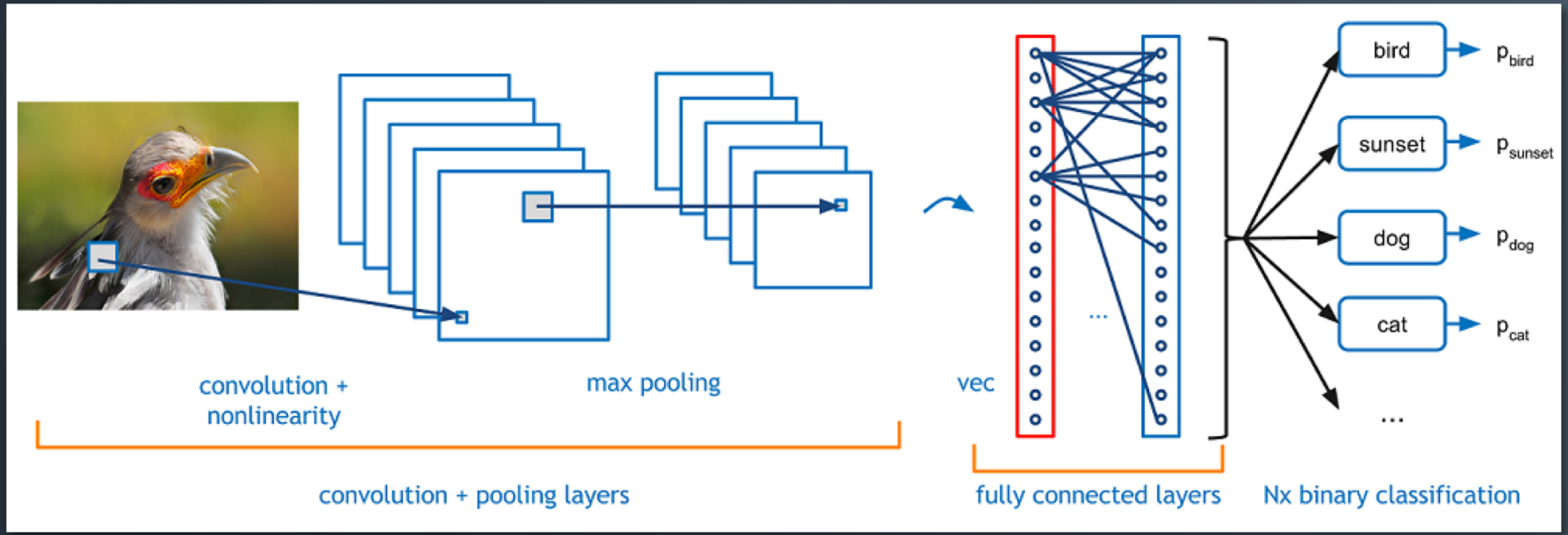

Image by Rob Hess. Source: https://code.flickr.net/2014/10/20/introducing-flickr-park-or-bird/

Multichannel Breakdown of an Image

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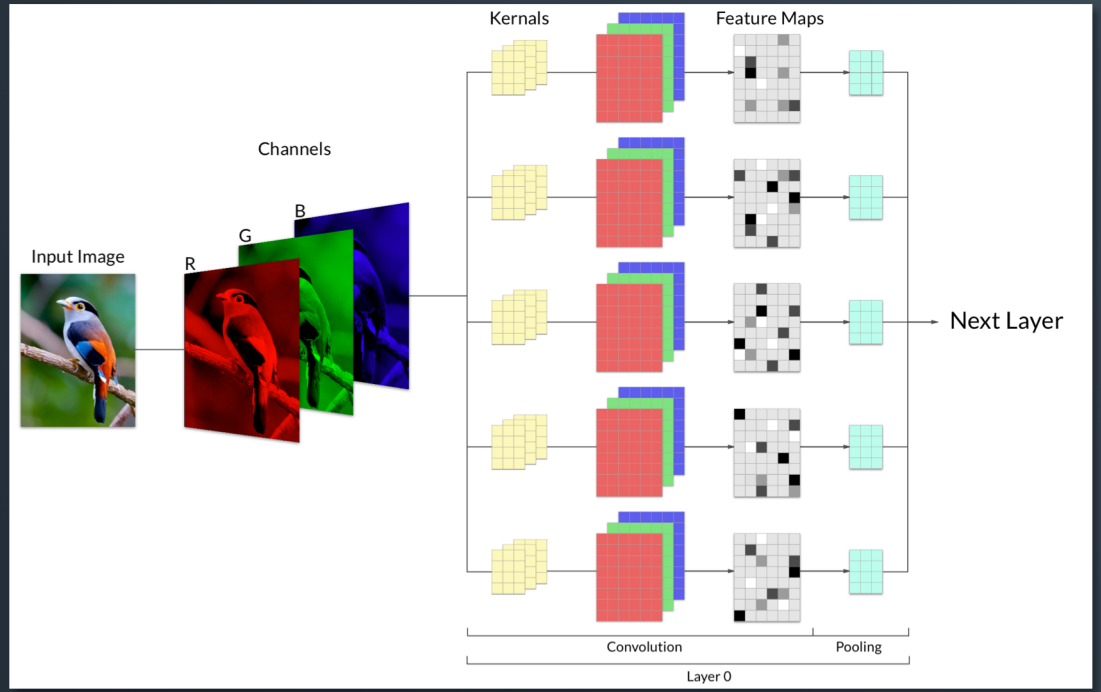

- High degree of accuracy in modern Deep Learning and CNN for image classification or object detection.
  - Autonomous Vehicles
  - Facebook Tagging
  - Amazon purchase habits
  - Netflix
  - Autocomplete Text

Can we apply the same principles to stocks?

We Can Apply the Same Concept to Stocks

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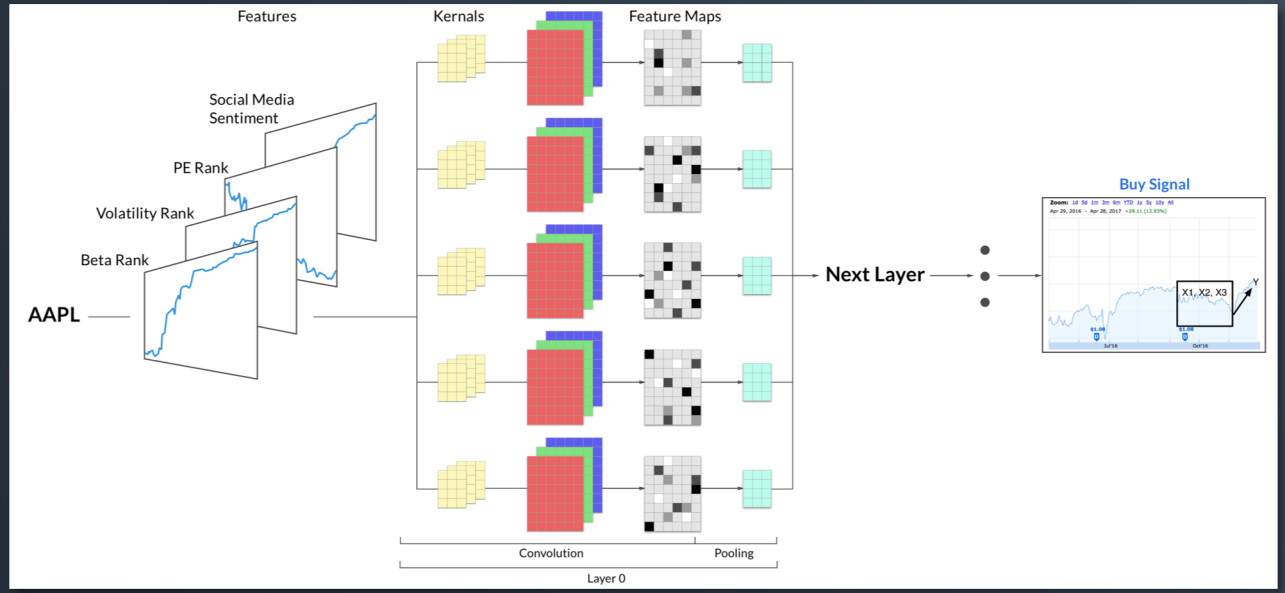

Multiple timeseries images of feature values over time.

- Technical Features
- Fundamental Features
- Macro Econ Features
- Alternative Data Features
- Social Media Sentiment
- Corporate Action
- Analysts Recommendations
- News Feed Sentiment

Google's Tensor Board

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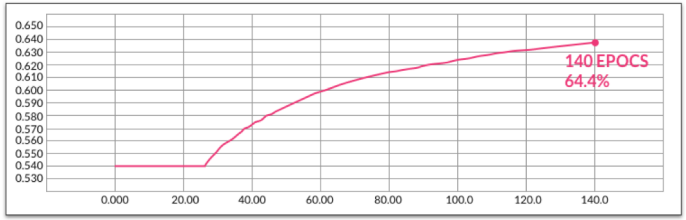
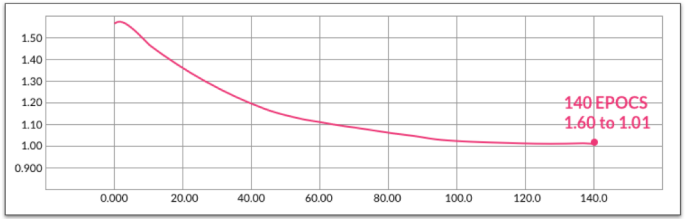
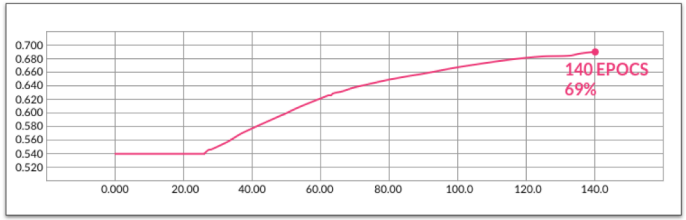
Validation Accuracy



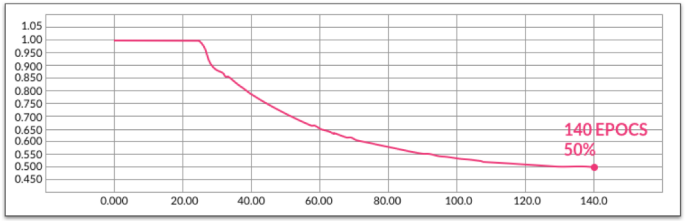
Validation Loss



Validation Precision



Validation Percent 1 Label



Out of Sample

Google's Tensor Board

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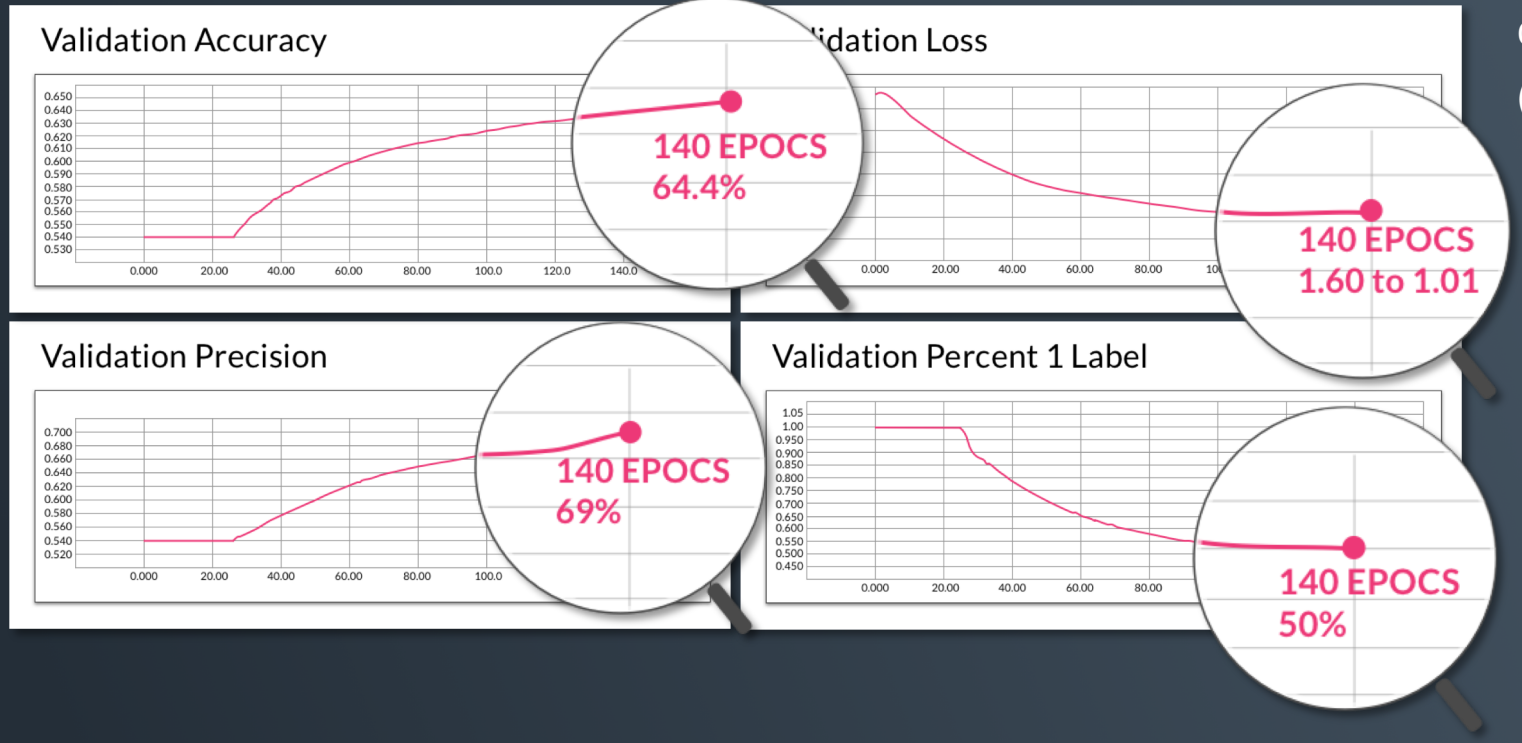

Out of Sample

(Zoom)

Making It Easier for the Machine to Learn

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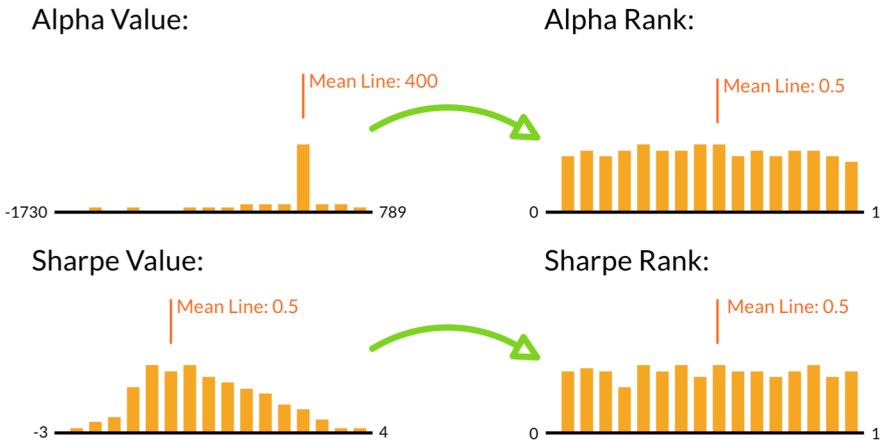
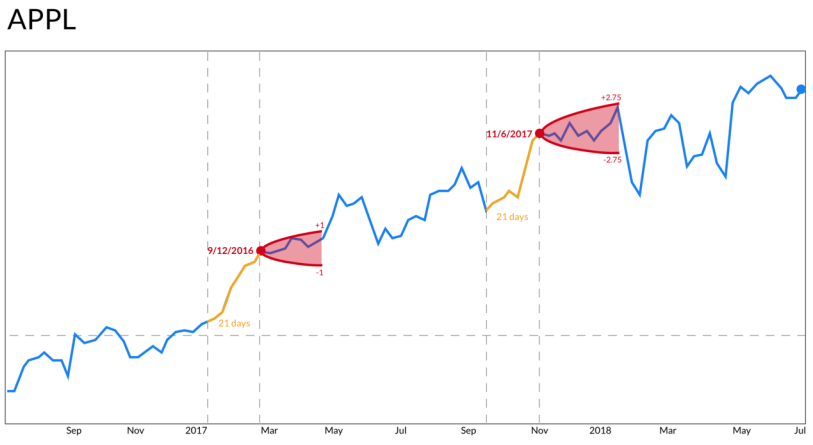
Uniformly Distributed Features



Dynamic Label Data using ATR



Making It Easier for the Machine to Learn

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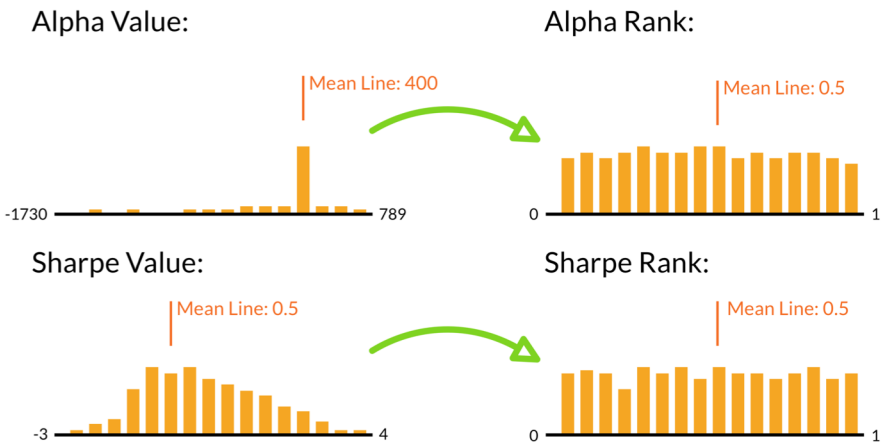

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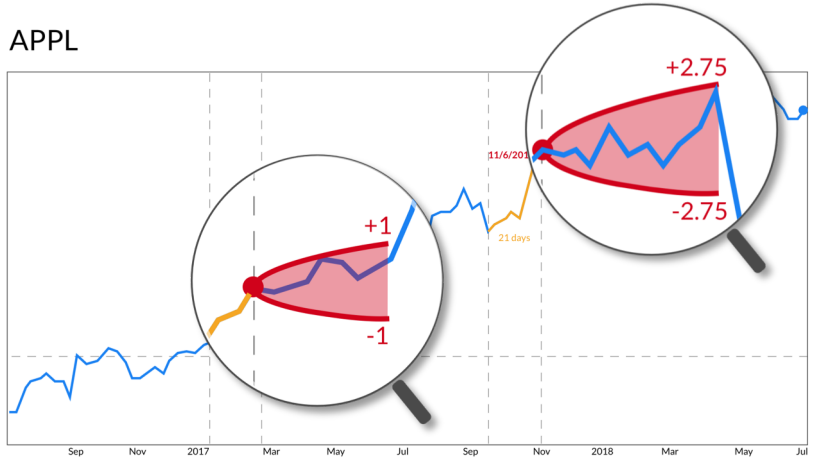

APPL Backtest

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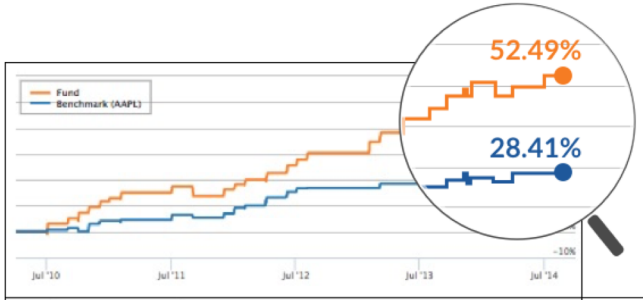
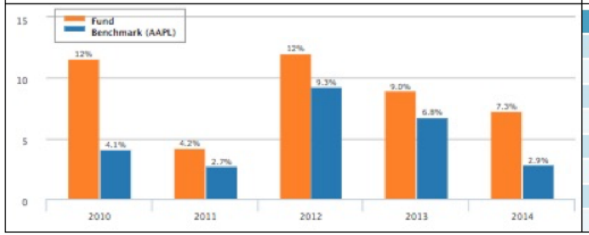
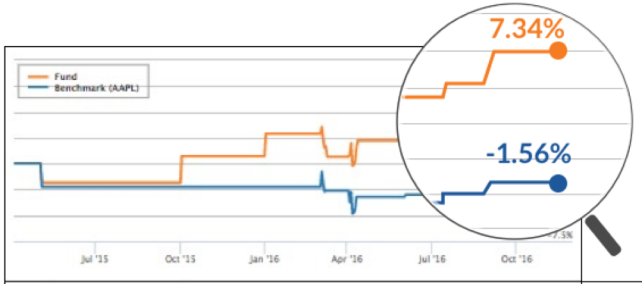
Results are Exposure Adjusted
In Sample: 4/6/2010 to 9/30/2014

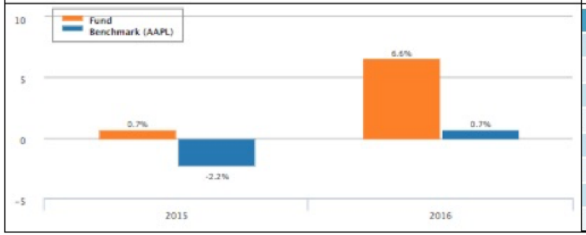




	Strategy Overall	Bench Overall
Abs. Return	52.49%	28.41%
Rel. Return	24.08%	N/A
Beta	0.04	N/A
Std. Dev	0.34%	0.24%
Sharpe	1.76	1.50
Draw Down	-4.38%	-2.22%
IR	-0.72	N/A
R²	0.04	N/A

Results are Exposure Adjusted
Out of Sample: 4/6/2015 to 12/1/2016





	Strategy Overall	Bench Overall
Abs. Return	7.34%	-1.56%
Rel. Return	8.90%	N/A
Beta	0.02	N/A
Std. Dev	0.27%	0.22%
Sharpe	1.01	-0.26
Draw Down	-3.64%	-4.84%
IR	0.30	N/A
R²	0.01	N/A

Thank you!

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