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Neuravest Research, Inc.

Designing and Building a la Carte Quantitative Trading Strategies

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neuravest™

Building Investment Strategies Powered by Adaptive AI

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About Neuravest

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+ Create and manage algorithmically-traded model portfolios backed by alternative data.
+ Streamline alternative data and machine learning research to deliver a wide array of investment portfolios at scale:

+ Thematic Model portfolios (i.e. Equities (long/short/market neutral), FX, Futures, Global Macro, Fixed Income, Risk Parity, Sector Rotation, Pairs Trading

+ Institutional Portfolio + Extending **your** portfolio with **uncorrelated** assets for **multi-strat performance** and **diversification**.

+ Bespoke Model portfolios (Implementing **your** vision), **customized hedging baskets, additive uncorrelated portfolios.**

Putting our money where our mouth is:

+ Asset Management: **We deploy our own capital for empirical validation**

How We Do It

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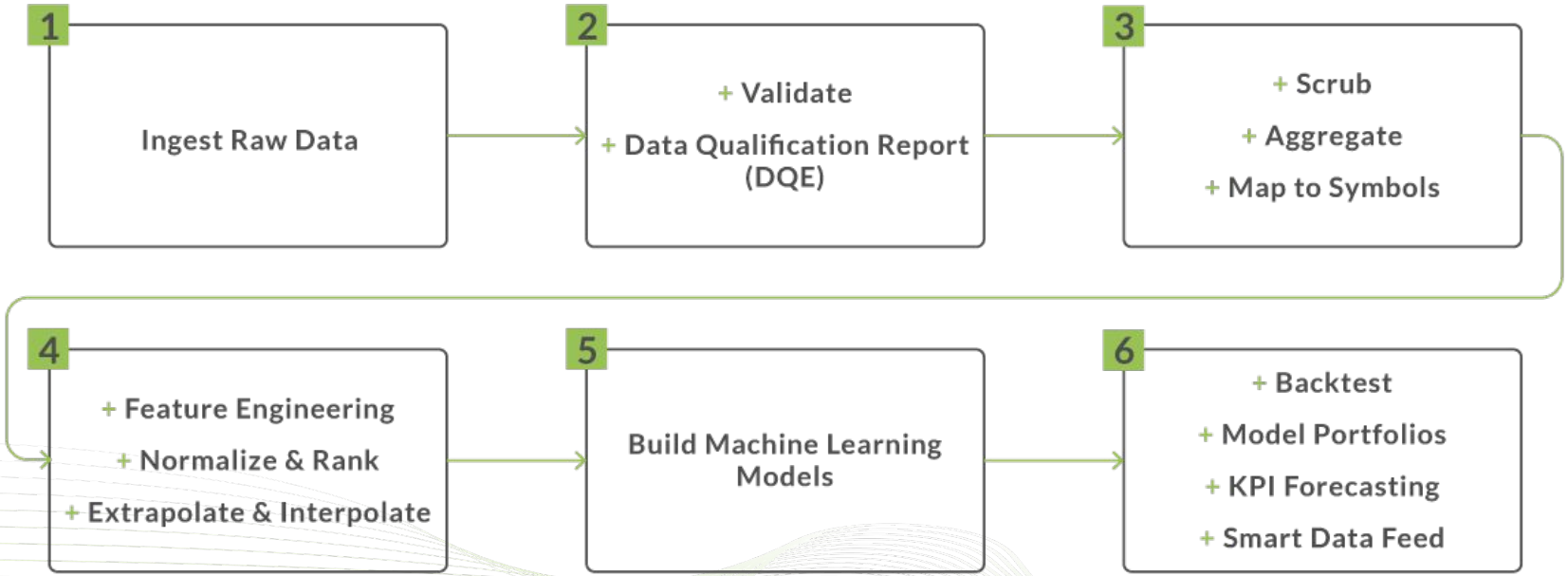
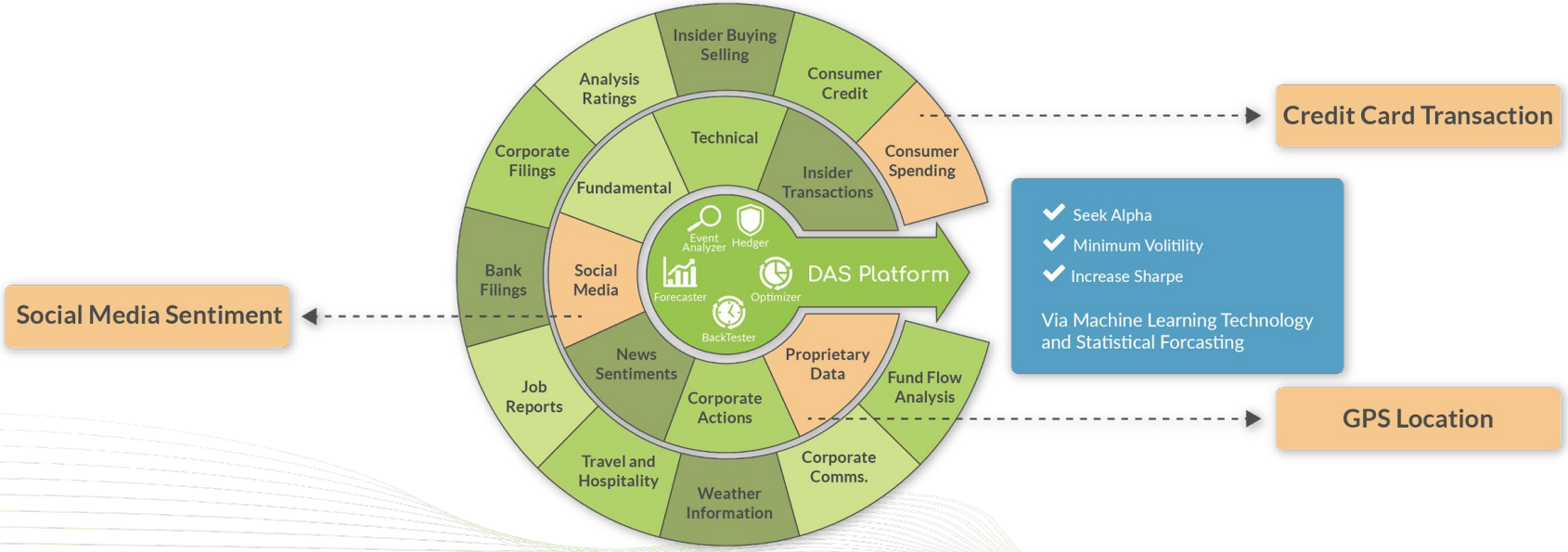


Applying Data ML to Investment

Leverage a variety of uncorrelated data types to uncover insight and create investment opportunities.



A Regimented & Automated Data Validation Process

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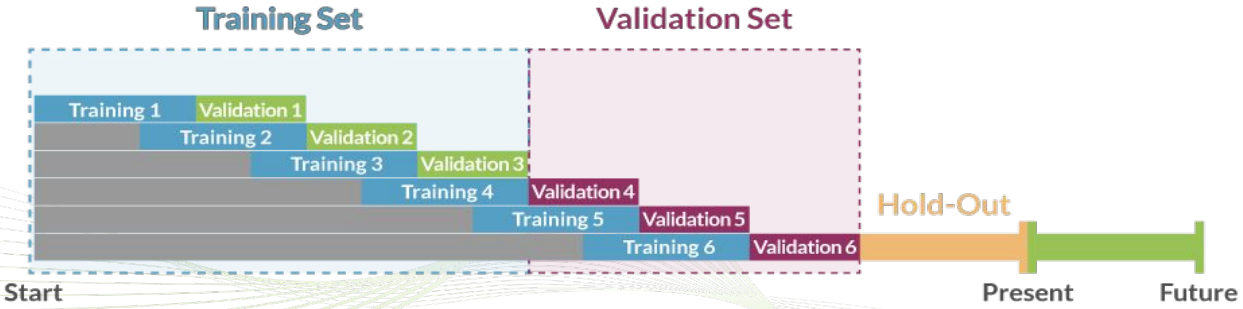
PHASE I

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

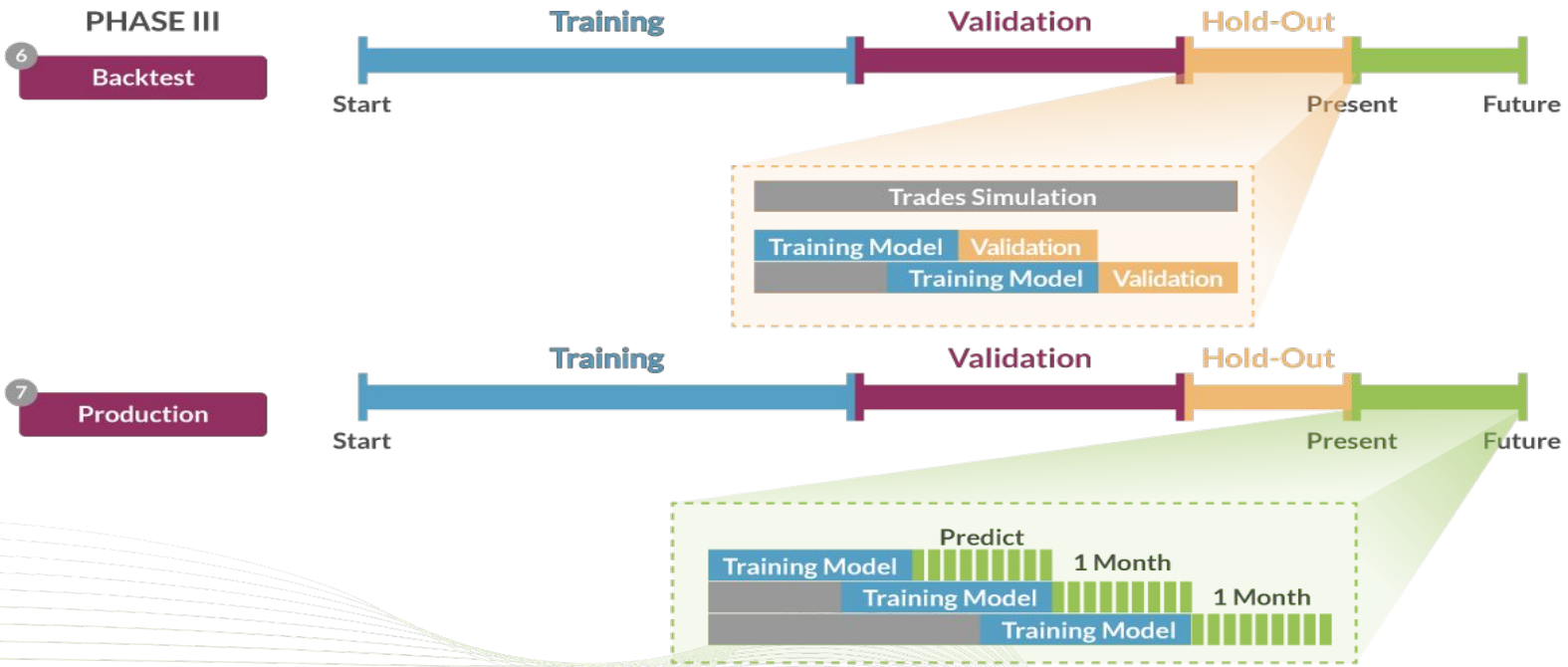
PHASE II

4. Feature Selection

5. Hyperparameter Search Cross Validation



Data Validation Process (continued)



How are AI & Big Data Used For Financial Market Research?

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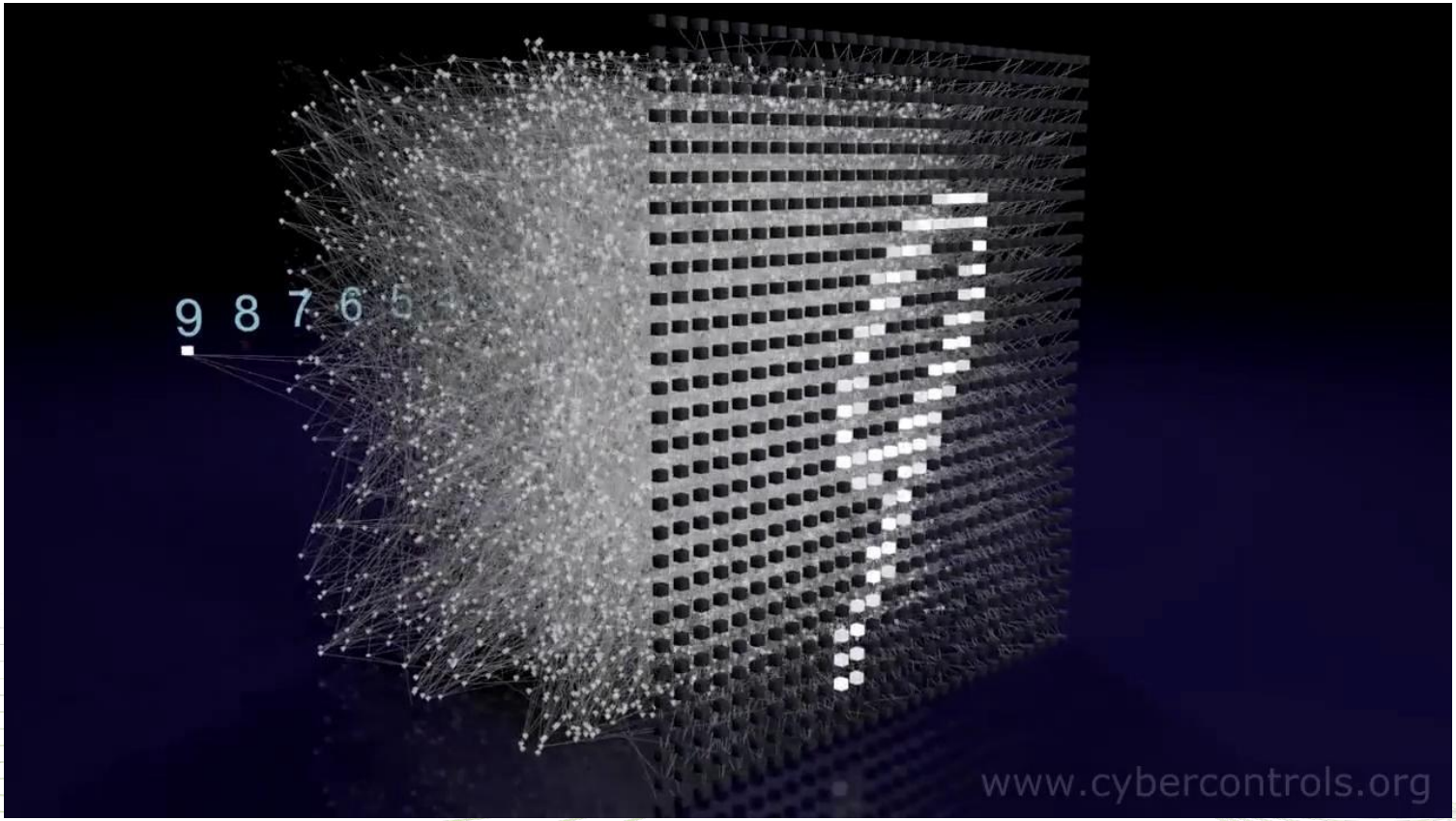
Deep Learning Methods



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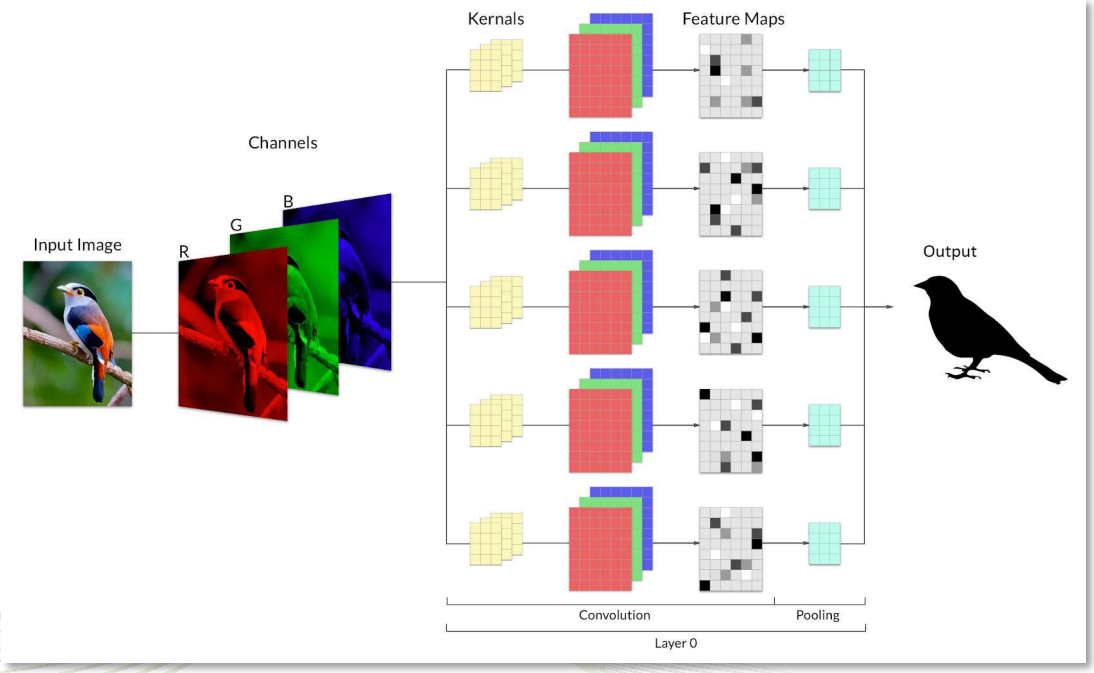
Advanced AI and Computer Vision For Stock Forecasting

High degree of accuracy in modern Deep Learning and CNN for image classification or object detection.

- Autonomous Vehicles
- Facebook Tagging
- Amazon purchase habits
- Netflix
- Google Search

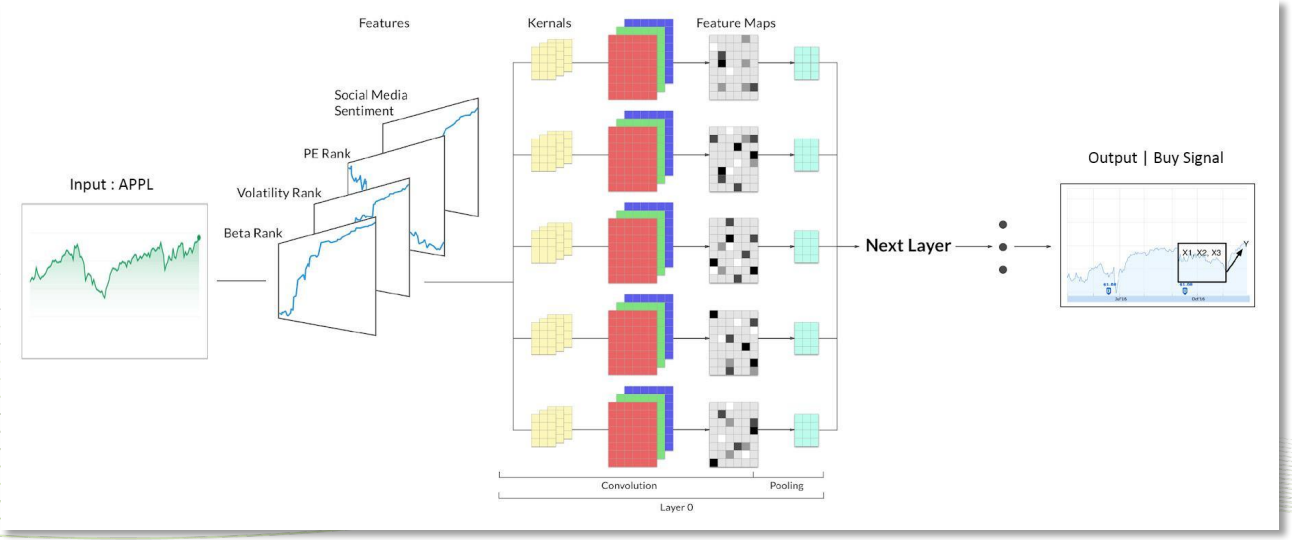
Can we apply the same principles to the market?



Multi-Factor Time Series Charts For Buy/Sell Classification

Multiple time series images of feature values.

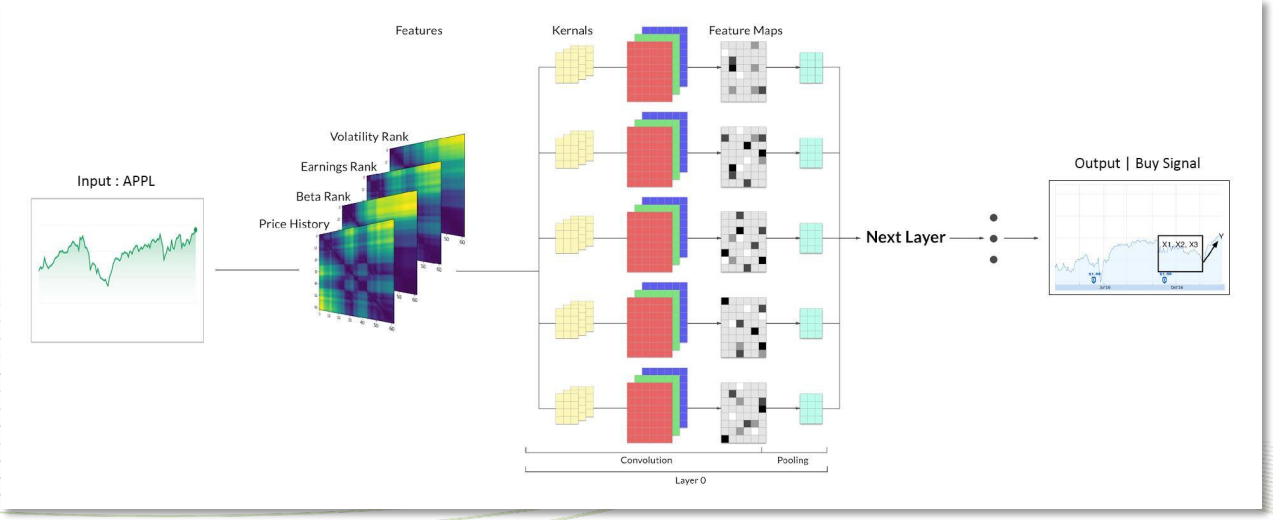
- Technical Features
- Fundamental Features
- Macro Econ Features
- Alternative Data Features
- Social Media Sentiment
- Corporate Action
- Analysts Recommendations
- News Feed Sentiment
- etc...



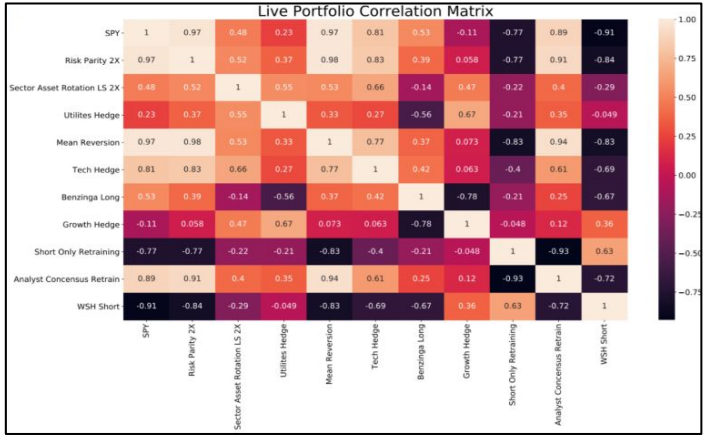
We Can Apply the Same Concept to Stocks

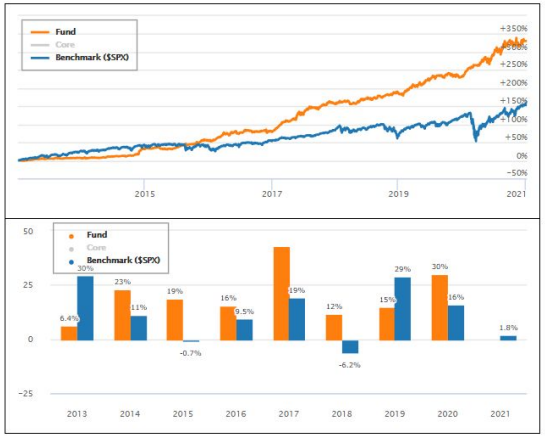
Multiple time series images of feature values.

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



Multi-Strategy Top Down & Bottom Up Portfolio 3X





	Strategy Overall	Bench Overall	Strategy TTM	Bench TTM
Abs. Return	330.50%	168.17%	28.45%	17.13%
Rel. Return	162.32%	N/A	11.32%	N/A
Beta	0.08	N/A	0.02	N/A
Std. Dev	0.56%	1.08%	0.81%	2.18%
Sharpe	2.11	0.81	2.01	0.63
Draw Down	-5.63%	-33.92%	-5.63%	-33.92%
IR	0.27	N/A	0.11	N/A
R^2	0.02	N/A	0.00	N/A

Historical Summary

	1 Yr	2 Yr	3 Yr	5 Yr	10 Yr
Ann. Return	28.45%	23.32%	18.45%	22.72%	N/A
Std. Dev	0.81%	0.67%	0.60%	0.61%	N/A
Ann. Volatility	12.88%	10.69%	9.59%	9.70%	N/A

Hypothetical backtest simulation, past performance is not indicative of future returns.

View Backtest

Combining multiple uncorrelated strategies into one portfolio

- Our platform is able to dynamically optimize a fund's allocation between independent uncorrelated portfolios and combine all underlying assets into one strategy.
- Such combination is designed to allow for potential returns in multiple markets that slowly accrue over time
- The extreme low volatility can be exploited by dialing leverage up or down based on market risk, measured by an AI model driven from global macro factors.

Intraday Futures Trading

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Game Plan

- **Developing Intraday Futures Long / Short Strategy:**
  - Background
  - Why
  - Asset Identification
  - Establishing a Hypothesis
  - Identifying Relevant Datasets
  - Objective Function and Labeling
  - Training the Model
  - Execution Logic
  - Model Evaluation
  - Conclusions

What are we after?

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- Goal:
  - Create an algorithmic approach using AI
  - Build upon existing domain knowledge
  - Produce long and short trades at an intraday level

↓

"Automated approach to systematically replicate and improve upon the behaviors of successful traders, using predictive data & machine learning."

Why Intraday Futures?

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- Asset Reasons:
  - Strong liquidity
  - Inexpensive to trade both long and short
  - Trading available ~23 hours a day 5/6 days a week
  - Highly leverageable
  - Active / volatility intraday

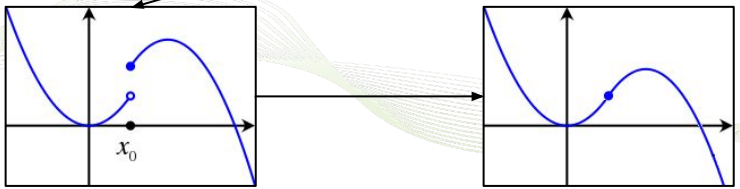
- Modeling Reasons:
  - Can't be a simple, obvious solution (efficient market)
  - Humans are notoriously prone to impulse and lack of patience
  - Human can't be glued to the screen to identify trading opportunities for both long and short
  - More data can be dissected faster on which to train machine learning algorithms

Why Apply Machine Learning?

- Challenges of non-algorithmic trading:
  - Subject to flaws in human psychology
  - Subject to human cognitive biases
  - Difficult to systemically replicate human identified patterns
  - Tools and indicators can be overly exploited
  - Inflexible to changes in market regime
  - Not automated - Exhausting and time consuming

Identifying Relevant Assets

- Three key attributes:
  - Volatility
  - Liquidity
  - Leverageable
- Examples:
  - NQ (NASDAQ)
  - CL (Oil)
  - VX (VIX)
- First Steps:
  - Acquire tick level data
  - Aggregate into bars
  - Stitch into a continuous series across



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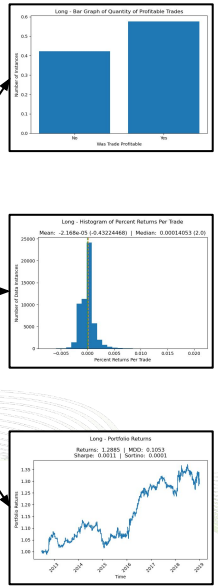
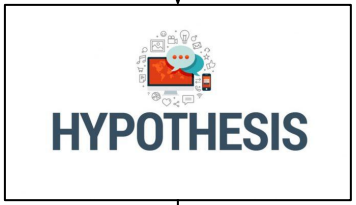
Establishing a Hypothesis

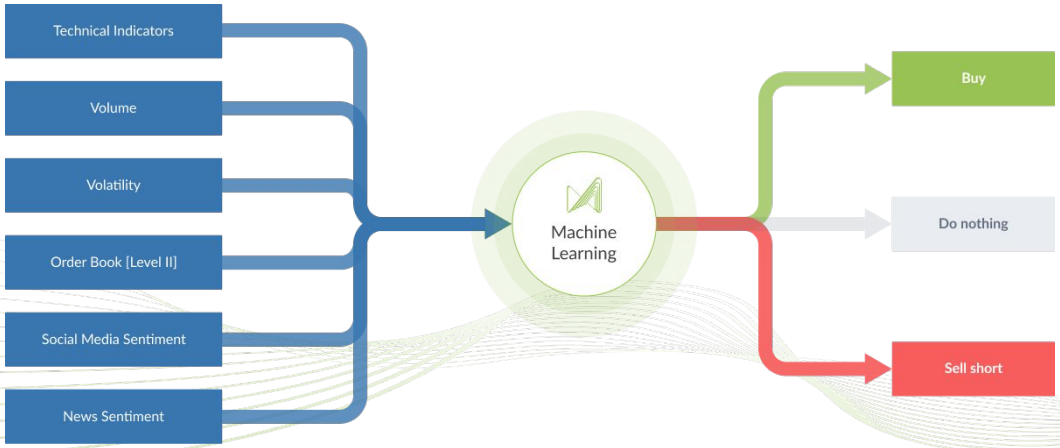
- Steps:
  - From domain knowledge, human insights, and intuition…
  - Formulate a hypothesis
  - Conduct initial data visualization to check feasibility





Acquiring Relevant Datasets

- Obtain orthogonal datasets that could provide uncorrelated information in support of hypothesis:
  - Volume
  - Volatility
  - Order Book, Level II (Level II is where you get the chain of buyers and sellers)
  - News Sentiment
  - Social Media Sentiment



Feature Engineering Using Computer Vision

- Steps:
  - Acquire relevant datasets, clean, and preprocess
  - Represent relevant section of time series as a 2D recurrence plot
  - Layer recurrence plots to create a multidimensional input
  - Deep learning algorithms generically extract features via backpropagation

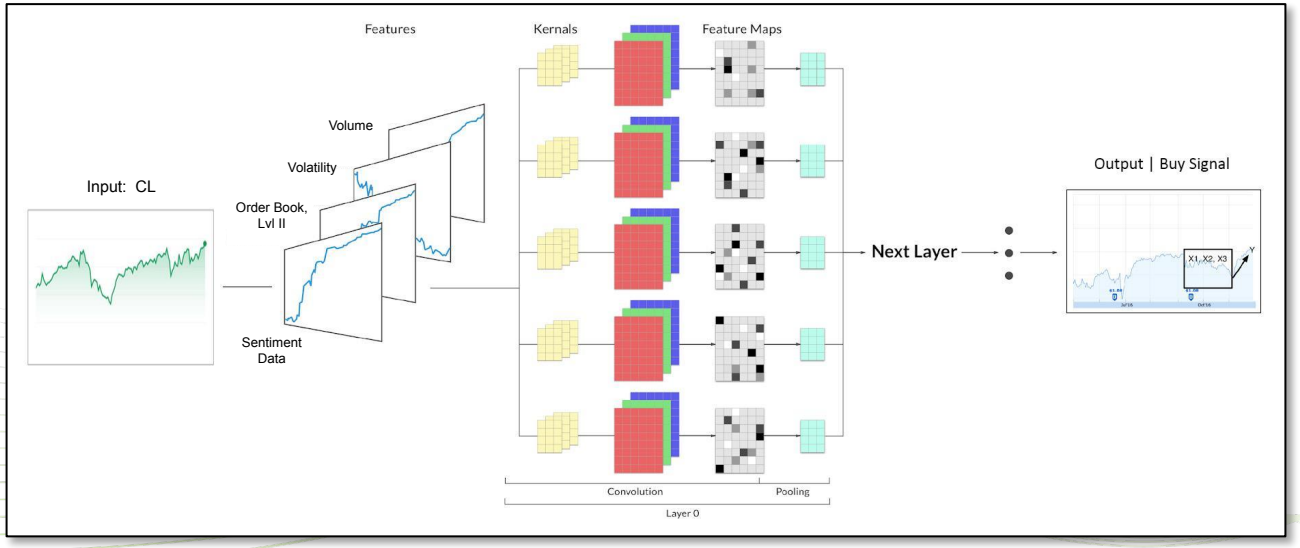
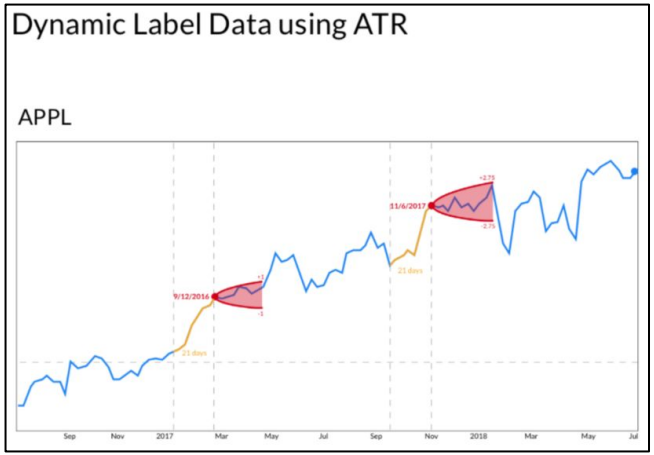
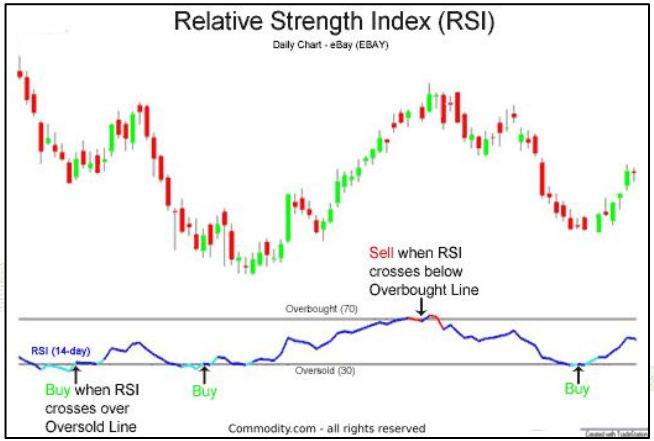


Figure: Depiction of applying computer vision to generically extract features

Choosing an Objective Function

- What is “Labeling”?
  - Assigned categories to based on desired behavior
  - Machine learning algorithms learn to discriminate between categories
  - Typically 2 (binary) or 3 labels are used
- What should an AI model learn?
  - Price movements
  - Indicator movements
  - Trade entries
  - Trade exits
  - Etc.





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Training a Machine Learning Model

- Advantages of algorithmic trading using Computer Vision:
  - Patterns can come in different sizes and shapes; computers identify predictive depictions
  - Deep learning computer vision technology attempts to replicate a human's cognitive association with an input pattern to an output behavior
  - The goal is to generalize pattern recognition and train a machine to identify predictive occurrences

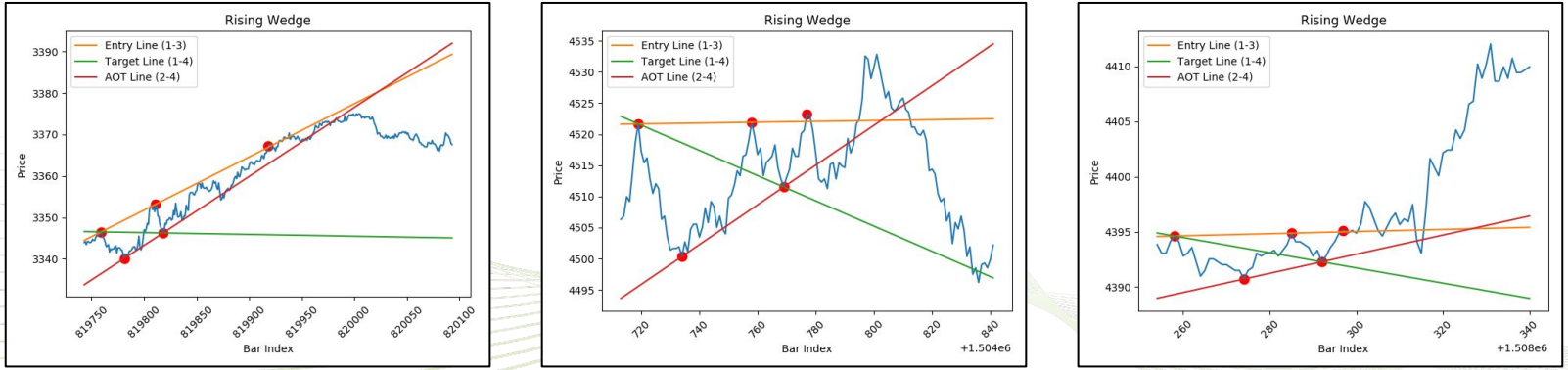


Figure: Example of visual ambiguity common in technical analysis via the rising wedge pattern.

Execution Logic

- How do you go from machine learning model to executing trades?
  - Entry
    - Usually informed directly by the machine learning model
  - Exit
    - Usually informed by chosen objective function
    - Also informed by risk profile of trader
  - Allocation
    - Innumerable potential strategies
    - Primary goal is to mitigate risk and lock in profits early so that you can play with the house's money!

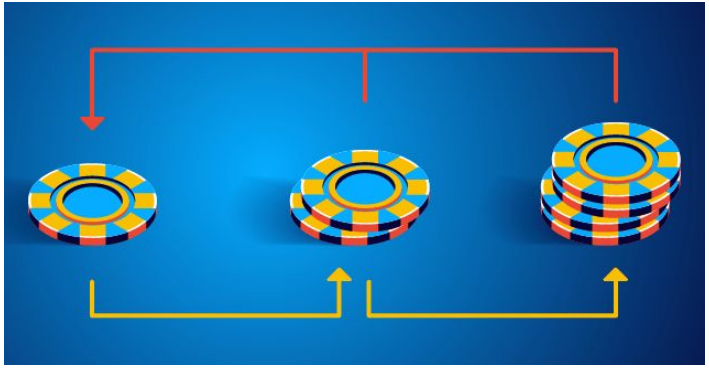
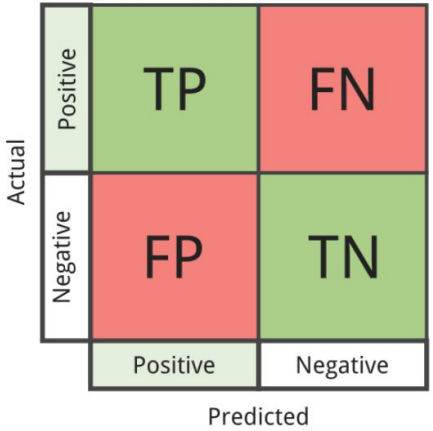


Figure: Results-based logic can be used to increase or decrease allocation.

Model Evaluation

- Challenge - Understanding Behavior:
  - A model does well during a bullish market; is performance significant?
  - A model has a high win rate; is it tradable?
  - Etc.
- Solution - Analyze ML Metrics:
  - Removes noise from evaluation process
  - Provides insight of ability to capture signal
  - Additional lens to judge performance
  - Approaches:
    - Precision, Recall, MCC, etc.
    - Confusion Matrix, ROC Curve, etc.



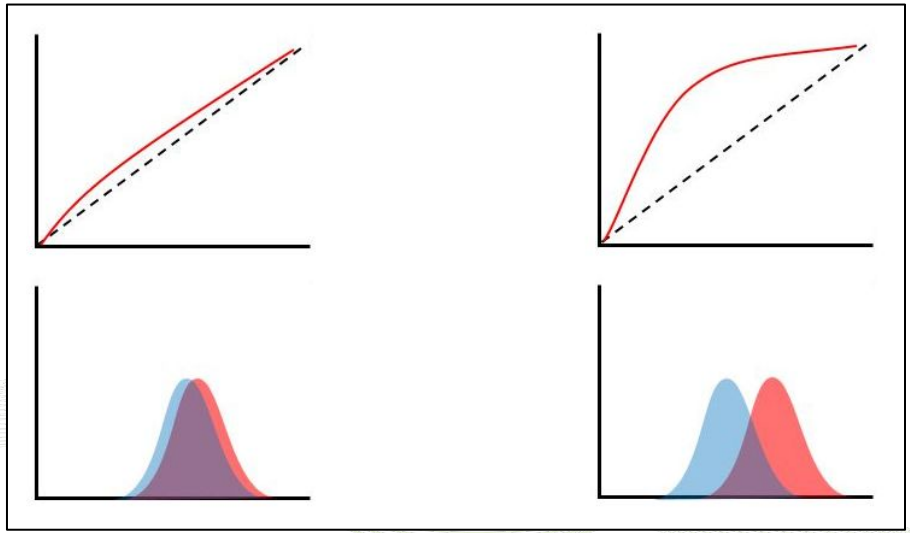


Figure: Depiction of using confusion matrix and ROC to assess class separability

Conclusions

- Backtest:
  - NASDAQ Futures (/NQs)
  - Executed on 1-minute bars
  - Dynamically retrained to adjust to market regime
  - Algorithmic selection of most predictive features
  - Intratrade allocation and execution logic
  - Trades both long and short

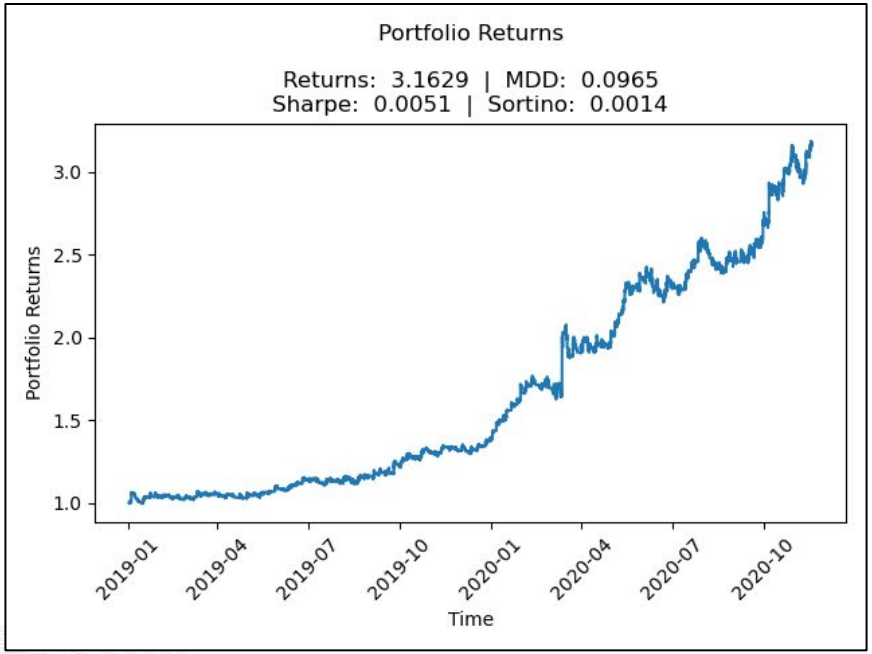


Figure: Portfolio returns of /NQ notional over time

Hypothetical results
Past performance is not indicative of future returns. See disclaimer on last slides.

Questions?

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To the extent investment returns are presented, such investment returns are either hypothetically backtested or reflect a perpetual paper trading simulation and are labeled as such. Returns are presented as net returns, inclusive of transaction costs, slippage and short borrowing costs (when applicable). Results are net of transactions' costs, management fees of 40 basis points of AUM, and performance of 10% on excess return above 8% hurdle rate.

Investment returns presented reflect the reinvestment of dividends and other earnings, do not reflect the deduction of any transaction fees that may be incurred, and do not account for taxes than an investor may owe as a result of any investment gains. Investors may incur taxes as a result of investing, and may pay different transaction costs to the broker-dealer executing the transactions for their account(s).

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- Actual price was available for execution
- Capacity and daily float was supportive of volume traded.
- Transaction cost and slippage are reflective of real-world brokerage fees.

Hypothetical backtested returns do not reflect actual trading and do not reflect the impact that material economic and market factors may have had on Neuravest's decision-making at the time.

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Asset allocation/diversification does not guarantee a profit or protect against a loss.

***For Backtests**

For the Hypothetical backtest results, past performance is not indicative of future returns. Results are net of transactions' costs, management fees of 40 basis points of Assets Under Management (AUM), and performance fees which use a hurdle rate of 8%. Our performance fee in excess of hurdle rate is 10%.

****For Our Model Portfolios**

Hypothetical paper trading simulation results, past performance is not indicative of future returns. Results are net of transactions' costs, management fees of 40 basis points of AUM, and performance of 10% on excess return above 8% hurdle rate.
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