

# Algo Depth

## Quantitative Research Fellowship

A six month research program providing real world experience with big data, machine learning, and high performance technologies. Fellows grow their ability in skills demanded by the large technology and quantitative research firms. Recent alumni moved to Silicon Valley, New York, and other large markets to further their career, while remaining in close network with Algo Depth. Fellows are often non US citizens on F-1 visa, and are sponsored for OPT during their six months.

## Your bridge to a career in quantitative finance or big tech

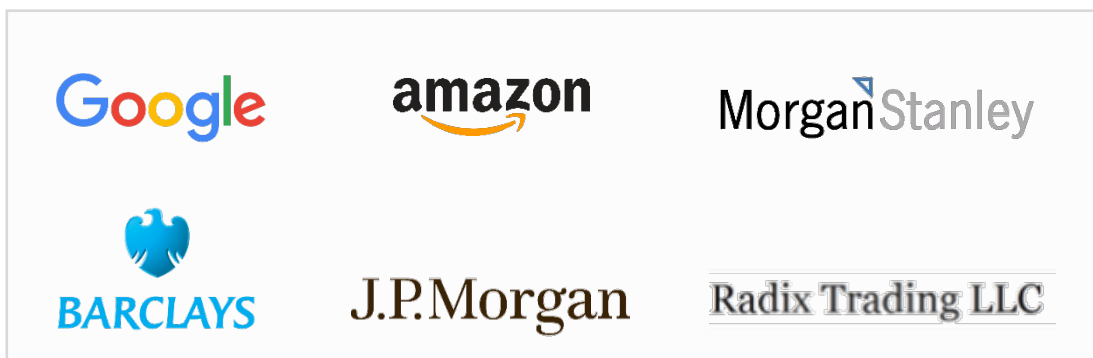
Are you a recent PhD graduate or post-doc looking to apply deep learning, reinforcement learning, and other mathematical techniques into a career in quantitative research? Do you want the challenge of discovering profitable trading signals in a fast paced industry that is implementing the best technology?

Top quantitative trading firms are applying advanced techniques in artificial intelligence (AI) and technology to gain an edge in financial markets. The industry is moving away from previous trends of speed and statistical arbitrage to research. Doctorates and Post Doctorates recently completing their studies often have the fundamental skills to excel in this industry, but lack the thing most funds look for: experience. With a growing popularity for implementing state of the art algorithms in the quantitative space, candidates must position themselves to stick out from the crowd.

Algo Depth's Quantitative Research Fellowship bridges the gap between academia and industry. This intensive full-time, six month program, requires individuals to further their area of research, while applying their skills to try generate real signals in financial market data. Fellows spend time learning, researching, and implementing algorithms in: deep learning, quantum machine learning, probabilistic modeling, portfolio optimization, reinforcement learning, or physics finance. They learn through a self-directed setting, with close guidance provided by two members of Algo Depth's research team. Fellows are encouraged to attend three conferences of their choice sponsored by the program, generating ideas for implementing their research to make real quantitative trading signals.

1. 6-month, full-time, quantitative research training.
2. Needs based scholarships available.
3. Learn about, research, and implement alpha signals.
4. Attend three quantitative conferences.
5. Publish industry research.
6. Present to Algo Depth's network of quants.

Share your research to individuals from:



## The Bigger Picture of Computer Driven Trading

Companies are researching the ability of these algorithms for predicting future stock prices, order execution, risk management, and portfolio optimization. The complete industry of quantitative research is moving to automation, and more significantly, computer-driven decision making.

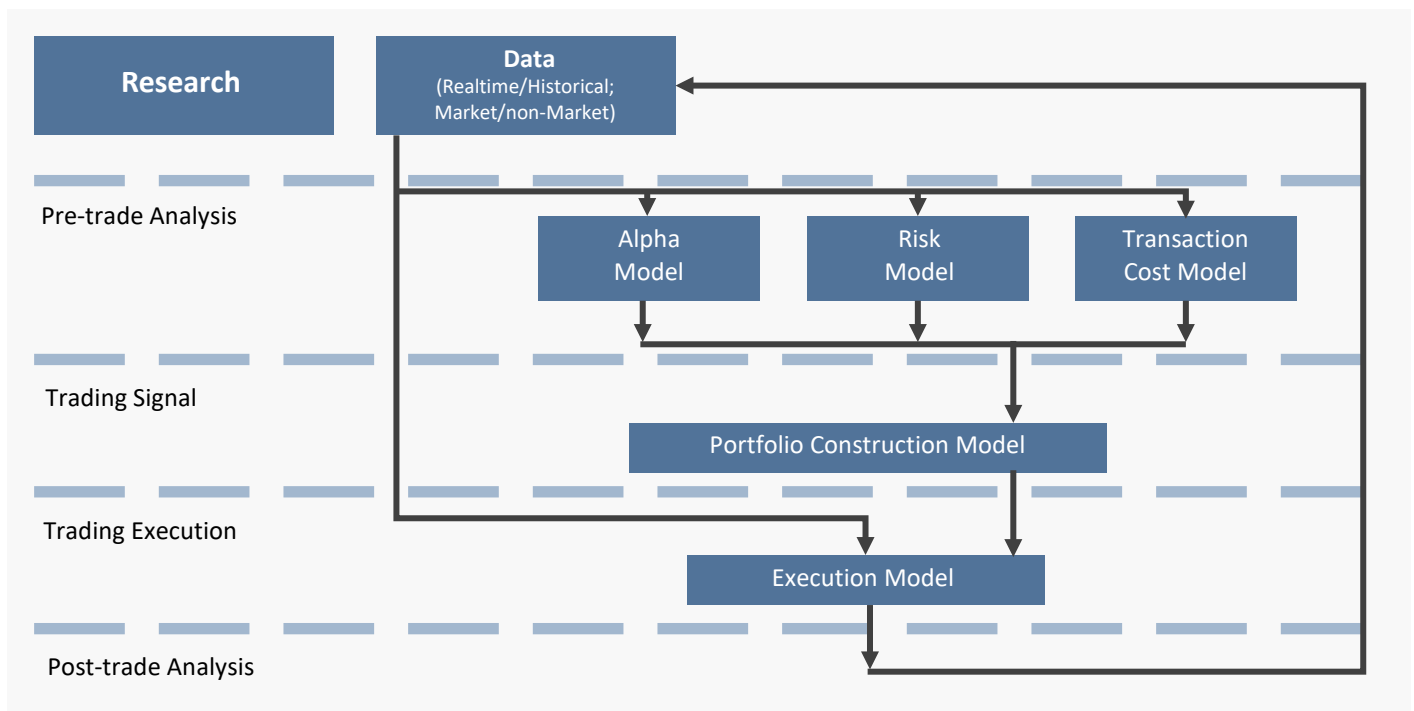


Figure 1. above shows the architecture of an algorithmic trading system. During the fellowship program, you will gain an in depth understanding of how the industry operates, and test your strategy on Algo Depth's internal trading system. Your research will delve specifically into alpha models, which by definition are signals detected in a world of noise.

# Learn How to Generate Alpha Signals

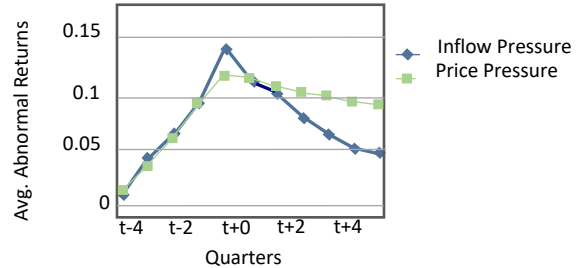
Four Steps To Optimize

## 1. Alpha Research

$$\mu^l = \frac{1}{H} \sum_{i=1}^H a_i^l \quad \sigma^l = \sqrt{\frac{1}{H} \sum_{i=1}^H (a_i^l - \mu^l)^2}$$

The way to calculate layer normalization's mean and variance at the layer level.

Feature significance: Short term appreciation, long term decline



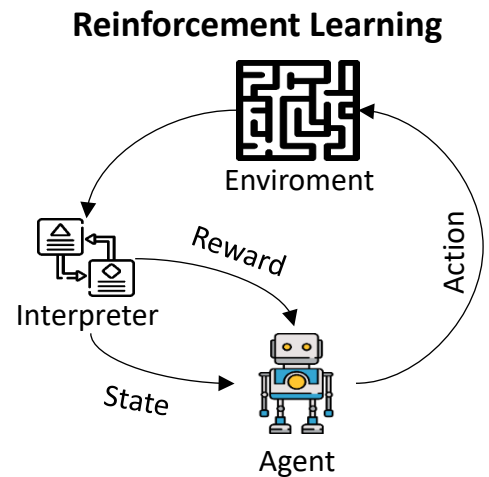
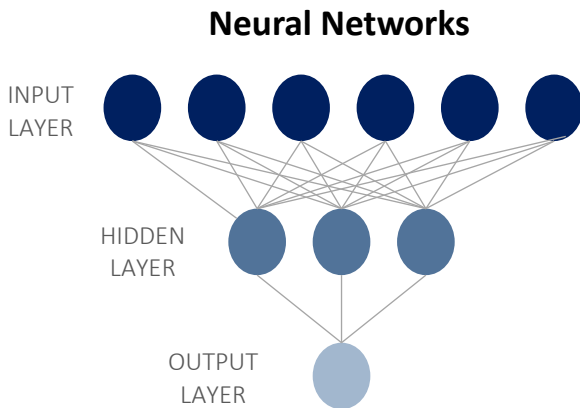
Extensive literature review can find significant alpha features

## 2. Data Structures

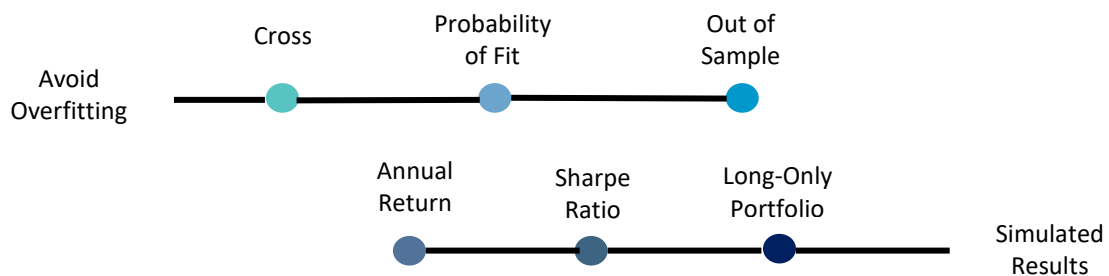
Inputs: features from literature review and market information, ticker universe, prediction horizon

Date	Potential Alpha Features (Need Research)				Prediction
Monthly Signals	Flow	Fund Focus	Fund Type	Allocation	Constituent Future Return

## 3. Model Architecture



## 4. Backtest and Analysis



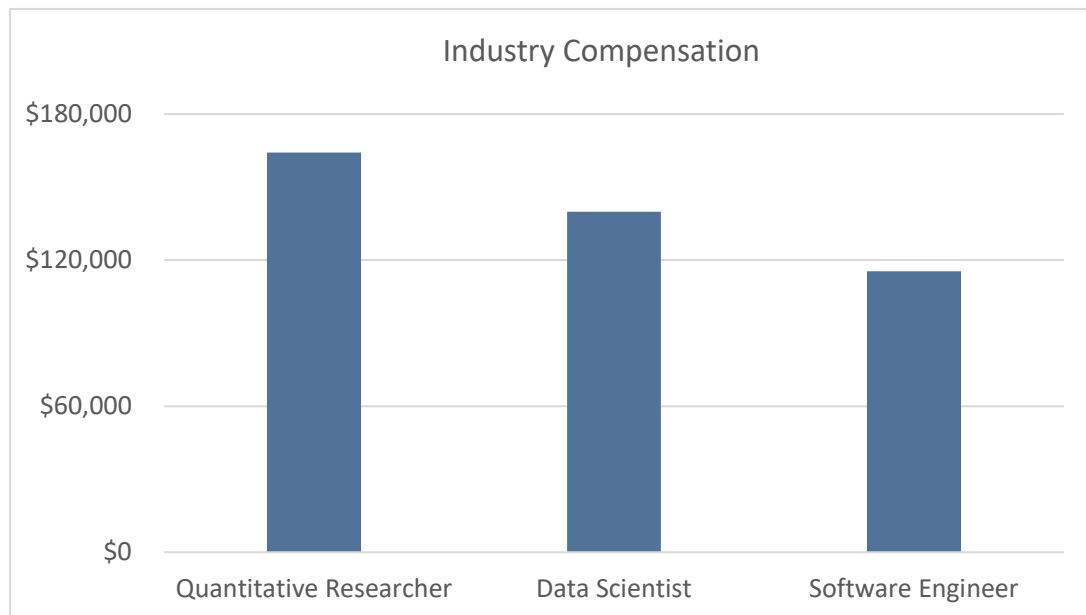
## Bridge the Gap Between Academia and Industry

Idea generation is a critical components to succeeding in quantitative research. State of the art techniques often come from reading a recent publication, going through open source code, or attending a leading conference. For this purpose, fellows attend three conference during their six months. Though they are time dependent, we encourage participation at:

- Neural Information Process System
- International Conference on Machine Learning
- Knowledge Discovery and Data Mining

## Rewarding Intellectually and Financially

In the competition to generate alpha, firms worldwide seek the most innovative techniques to gain an edge. Technology is core component in trading, and quantitative research is its jet fuel. Scientists in this field are forced to constantly learn and work hard to succeed, but are rewarded accordingly. Figure 1 below displays the salaries of the three common positions received after the Algo Depth fellowship.



Source: Glassdoor

The difficulty with quantitative research is not only in the work itself, but also breaking into the industry. Those who gain experience in developing strategies on their own are significantly more likely to succeed in the long term.

## Strategies You Might Research

**Convolutional Neural Networks (CNN)** are useful in extracting features from inputs, recognizing patterns based on the feature mappings. CNN's superior ability of pattern recognition within a large-dimension data set allows it to form predictions or classification based on the input data. Fully connected layers and SoftMax layer are usually added after the convolutional layers.

We form input matrixes as a combination of market and financial data. CNNs filter high-dimensional data to lower dimensional matrices, generating a more robust prediction model.

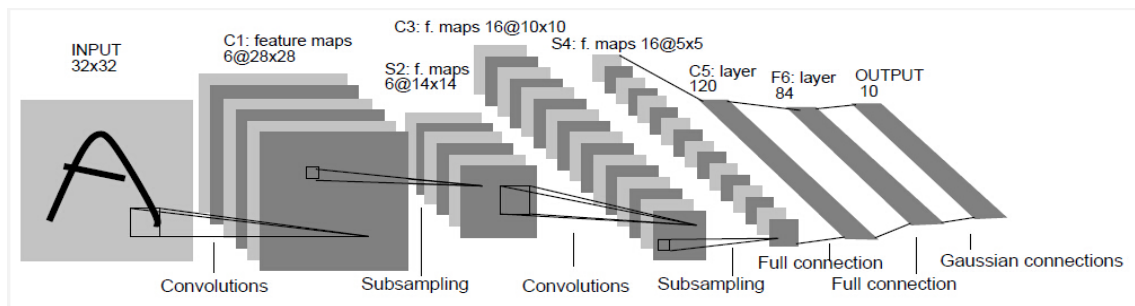
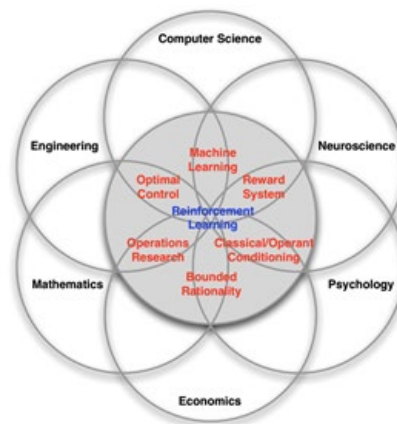


Figure 1. Convolutional Neural Network Architecture

**Deep Q Learning:** The action value function  $Q(s, a)$  has two parameters  $s$  and  $a$  - traditionally we use a two-dimensional matrix to represent it. However, using a matrix means the state and action are all finite and cannot be very large. In real-world problems, the state space is usually high-dimensional. For example, in Atari games the states are the images in each game frame.



One way to address this is to use a function to approximate  $Q$  values with a set of parameters, then rewrite  $Q(s, a)$  to  $Q(s, a; \theta)$ . In order to generalize the function approximator, we can use a deep neural network to represent  $Q$  values, this is the DQN method (Mnih, 2015).

The loss function for DQN is:  $L_i(\theta_i) = E_{s,a,r,s'} \left[ \left( y_i^{DQN} - Q(s, a; \theta_i) \right)^2 \right]$  with  $y_i^{DQN} = \left( r_i + \gamma \max_{a'} Q(s', a'; \theta^-) \right)$ ,  $\theta^-$  is target network,  $\theta_i$  is online network.

## Program Breakdown

Month 1: **Training** – Learn through research and start developing an alpha strategy.

Month 2: **Framework** – Complete your trading framework.

Month 3: **Optimization** – Run your strategy on AWS to optimize hyperparameters.

Month 4: **Simulation** – Connect your modularized code to a trading system.

Month 5: **Production** – Test on historical market data, analyze signal results.

Month 6: **Presentation** – Publish research and present to industry practitioners.



STATE OF THE ART  
ALGORITHMS



DEEP TECHNICAL  
RESEARCH

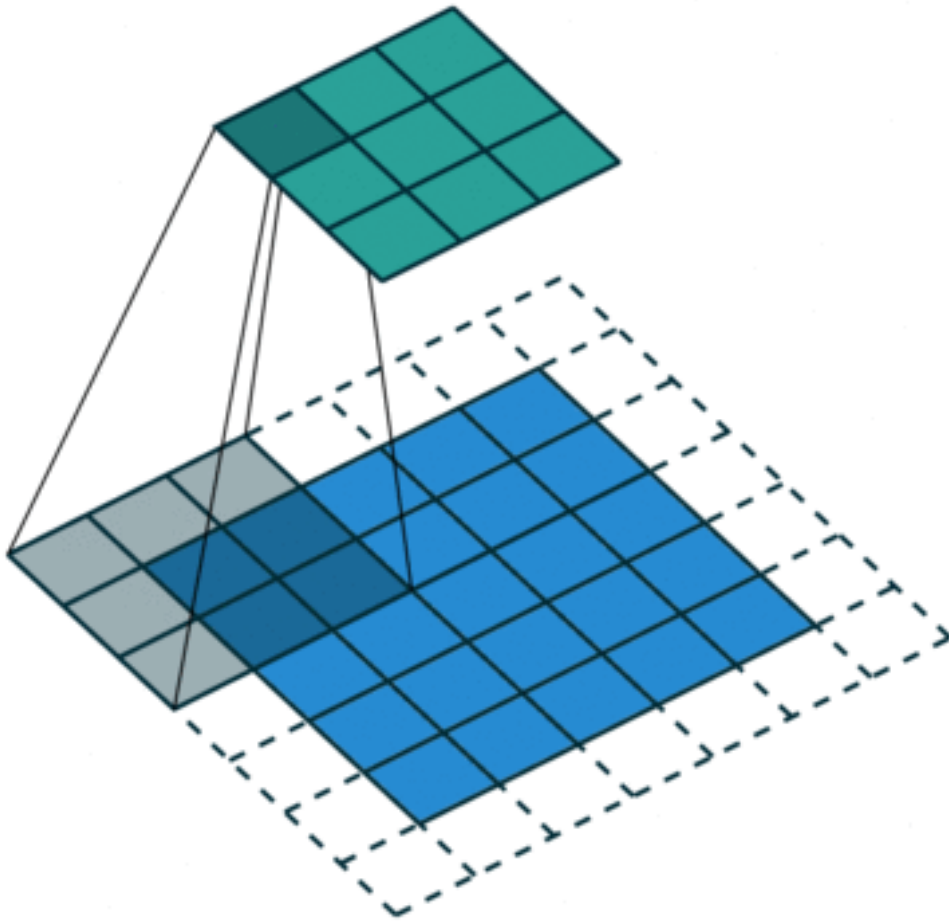


REAL TIME ALPHA  
SIGNALS

## Present to Algo Depth's Network Upon Fellowship Completion

In preparing for a career in the quantitative field, fellows publish content on their strategy framework. This is shared across a close group of previous researchers who know work at the biggest banks, proprietary trading firms, and technology companies in the world.

**Bridge The Gap To A Big Tech Or Quantitative Finance Career**



[Apply Today](#)