



THE SCHOOL OF ARTIFICIAL INTELLIGENCE

# AI for Trading

NANODEGREE SYLLABUS



# Overview

## AI for Trading Nanodegree Syllabus

THIS NANODEGREE PROGRAM WAS BUILT IN COLLABORATION WITH

**WORLDQUANT.**

In this program, you'll analyze real data and build financial models for trading.

Whether you want to level up in finance, obtain new skills in quant trading, or learn the latest AI applications in quantitative finance, this program offers you the opportunity to gain mastery of valuable data and AI skills.

This nanodegree program is comprised of 8 courses and 8 projects that are described in detail in this syllabus.

Building a project is one of the best ways to demonstrate the skills you've learned, and each project will contribute to an impressive professional portfolio that will demonstrate your newly acquired knowledge of quantitative finance.

### Program Information



#### TIME

6 months  
Study 10 hours/week



#### LEVEL

Specialist



#### PREREQUISITES

Experience programming with Python, and familiarity with statistics, linear algebra, and calculus.



#### HARDWARE/SOFTWARE REQUIRED

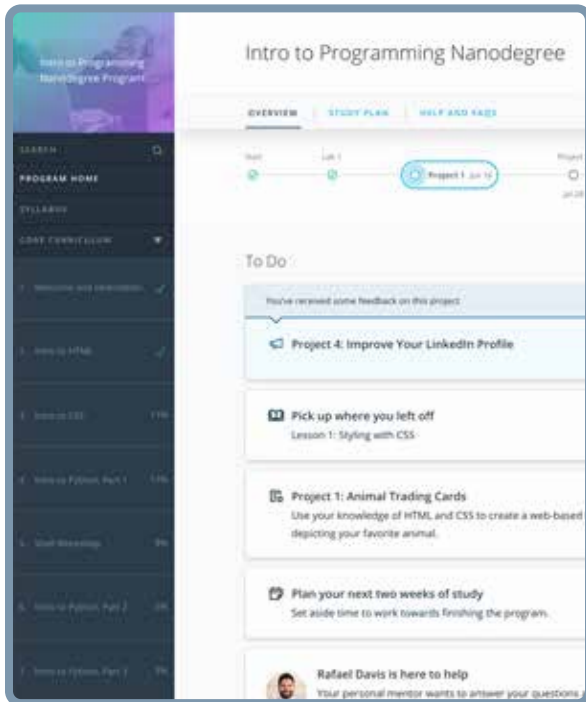
Computer running OS X or Windows; Python 3.7



#### LEARN MORE ABOUT THIS NANODEGREE

Contact us at [enterpriseNDs@udacity.com](mailto:enterpriseNDs@udacity.com).

# Our Classroom Experience



## REAL-WORLD PROJECTS

Learners build new skills through industry-relevant projects and receive personalized feedback from our network of 900+ project reviewers. Our simple user interface makes it easy to submit projects as often as needed and receive unlimited feedback.

## KNOWLEDGE

Answers to most questions can be found with Knowledge, our proprietary wiki. Learners can search questions asked by others and discover in real-time how to solve challenges.

## LEARNER HUB

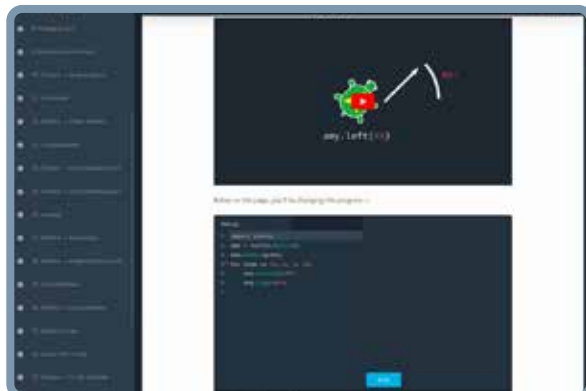
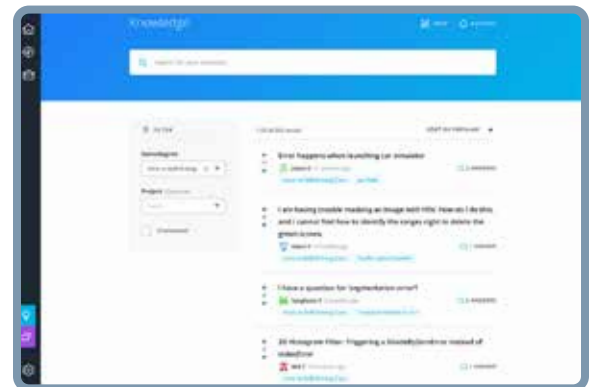
Learners leverage the power of community through a simple, yet powerful chat interface built within the classroom. Learner Hub connects learners with their technical mentor and fellow learners.

## WORKSPACES

Learners can check the output and quality of their code by testing it on interactive workspaces that are integrated into the classroom.

## QUIZZES

Understanding concepts learned during lessons is made simple with auto-graded quizzes. Learners can easily go back and brush up on concepts at anytime during the course.



## CUSTOM STUDY PLANS

Mentors create a custom study plan tailored to learners' needs. This plan keeps track of progress toward learner goals.

## PROGRESS TRACKER

Personalized milestone reminders help learners stay on track and focused as they work to complete their Nanodegree program.

# Learn with the Best



**Cindy Lin**

CURRICULUM LEAD

Cindy is a quantitative analyst with experience working for financial institutions such as Bank of America Merrill Lynch, Morgan Stanley, and Ping An Securities. She has an MS in Computational Finance from Carnegie Mellon University.



**Brok Bucholtz**

INSTRUCTOR

Brok has a background of more than five years software engineering experience from companies like Optimal Blue. Brok has built Udacity projects for the Self Driving Car, Deep Learning, and AI Nanodegree programs.



**Eddy Shyu**

INSTRUCTOR

Eddy has worked at BlackRock, Thomson Reuters, and Morgan Stanley, and has an MS in Financial Engineering from HEC Lausanne. Eddy taught data analytics at UC Berkeley and contributed to Udacity's Self-Driving Car program.



**Luis Serrano**

INSTRUCTOR

Luis was formerly a Machine Learning Engineer at Google. He holds a PhD in mathematics from the University of Michigan, and a Postdoctoral Fellowship at the University of Quebec at Montreal.



**Arpan Chakraborty**

INSTRUCTOR

Arpan is a computer scientist with a PhD from North Carolina State University. He teaches at Georgia Tech (within the Masters in Computer Science program), and is a coauthor of the book Practical Graph Mining with R.



## Parnian Barekatin

INSTRUCTOR

Parnian is a self-taught AI programmer and researcher. Previously, she interned at OpenAI on multi-agent Reinforcement Learning and organized the first OpenAI hackathon. She also runs a ShannonLabs fellowship to support the next generation of independent researchers.



## Elizabeth Otto Hamel

INSTRUCTOR

Elizabeth received her PhD in Applied Physics from Stanford University, where she used optical and analytical techniques to study activity patterns of large ensembles of neurons. She formerly taught data science at The Data Incubator.



## Juan Delgado

CONTENT DEVELOPER

Juan is a computational physicist with a Masters in Astronomy. He is finishing his PhD in Biophysics. He previously worked at NASA developing space instruments and writing software to analyze large amounts of scientific data using machine learning techniques.



## Cezanne Camacho

CURRICULUM LEAD

Cezanne is a machine learning educator with a Masters in Electrical Engineering from Stanford University. As a former researcher in genomics and biomedical imaging, she's applied machine learning to medical diagnostic applications.



## Mat Leonard

INSTRUCTOR

Mat is a former physicist, research neuroscientist, and data scientist. He completed his PhD and Postdoctoral Fellowship at the University of California, Berkeley.

# Nanodegree Program Overview

## Course 1: Basic Quantitative Trading

In this course, you will learn about market mechanics and how to generate signals with stocks. Your first project is to develop a momentum trading strategy.

### Project

### Trading with Momentum

In this project, you will learn to implement a momentum trading strategy and test if it has the potential to be profitable. You will work with historical data of a given stock universe and generate a trading signal based on a momentum indicator. You will then compute the signal and produce projected returns. Finally, you will perform a statistical test to conclude if there is alpha in the signal.

#### LESSON CONTENT

Lesson 1: Introduction

Lesson 2: Stock Prices

Lesson 3: Market Mechanics

Lesson 4: Data Processing

Lesson 5: Stock Returns

Lesson 6: Momentum Trading



## Course 2: Advanced Quantitative Trading

In this course, you will get to know the workflow that a quant follows for signal generation, and also learn to apply advanced quantitative methods in trading.

### Project

### Breakout Strategy

In this project, you will code and evaluate a breakout signal. You will run statistical tests to test for normality and to find alpha. You will also learn to find outliers and evaluate the effect that filtered outliers could have on your trading signal. You will run various scenarios of your model with or without the outliers and decide if the outliers should be kept or not.

#### LESSON CONTENT

Lesson 1: Quant Workflow

Lesson 2: Outliers and Filtering Signals

Lesson 3: Regression

Lesson 4: Time Series Modeling

Lesson 5: Volatility

Lesson 6: Pairs Trading and Mean Reversion

# Nanodegree Program Overview

## Course 3: ETFs, Indices, Stocks

In this course, you will learn about portfolio optimization, and financial securities formed by stocks such as market indices, vanilla ETFs, and Smart Beta ETFs.

### Project

### Smart Beta and Portfolio Optimization

In this project, you will create two portfolios utilizing smart beta methodology and optimization. You will evaluate the performance of the portfolios by calculating tracking errors. You will also calculate the turnover of your portfolio and find the best timing to rebalance. You will come up with the portfolio weights by analyzing fundamental data, and by quadratic programming.

#### LESSON CONTENT

##### Lesson 1: Stocks, Indices and Funds

##### Lesson 2: ETFs

##### Lesson 3: Portfolio Risk and Return

##### Lesson 4: Portfolio Optimization







## Course 4: Factor Investing and Alpha Research

In this course, you will learn about alpha factors and risk factors, and construct a portfolio with advanced portfolio optimization techniques.

### Project

### Multi-factor Model

In this project, you will research and generate multiple alpha factors. Then you will apply various techniques to evaluate the performance of your alpha factors and learn to pick the best ones for your portfolio. You will formulate an advanced portfolio optimization problem by working with constraints such as risk models, leverage, market neutrality and limits on factor exposures.

#### LESSON CONTENT

##### Lesson 1: Factors Models of Returns

##### Lesson 2: Risk Factor Models

##### Lesson 3: Alpha Factors

##### Lesson 4: Advanced Portfolio Optimization with Risk and Alpha Factors Models



# Nanodegree Program Overview

## Course 5: Sentiment Analysis with Natural Language Processing

In this course, you will learn the fundamentals of text processing and use them to analyze corporate filings and generate sentiment-based trading signals.

### Project

### Sentiment Analysis using NLP

In this project, you will apply Natural Language Processing on corporate filings, such as 10Q and 10K statements, from cleaning data and text processing, to feature extraction and modeling. You will utilize bag-of-words and TF-IDF to generate company-specific sentiments. Based on the sentiments, you will decide which company to invest in, and the optimal time to buy or sell.

#### LESSON CONTENT

Lesson 1: Intro to Natural Language Processing

Lesson 2: Text Processing

Lesson 3: Feature Extraction

Lesson 4: Financial Statements

Lesson 5: Basic NLP Analysis



## Course 6: Advanced Natural Language Processing with Deep Learning

In this course, you will get to know how deep learning is applied in quantitative analysis and get to use Recurrent Neural Networks (RNN) and Long Short-Term Memory Networks (LSTM) to generate trading signals.

### Project

### Sentiment Analysis with Neural Networks

In this project, you will build deep neural networks to process and interpret news data. You will also play with different ways of embedding words into vectors. You will construct and train LSTM networks for sentiment classification. You will run backtests and apply the models to news data for signal generation.

#### LESSON CONTENT

Lesson 1: Introduction to Neural Networks

Lesson 2: Training Neural Networks

Lesson 3: Deep Learning with PyTorch

Lesson 4: Recurrent Neural Networks

Lesson 5: Embeddings & Word2Vec

Lesson 6: Sentiment Prediction RNN

# Nanodegree Program Overview

## Course 7: Combining Multiple Signals

In this course, you will learn about advanced techniques to select and combine the factors that you've generated from both alternative data and market data.

### Project

### Combining Signals for Enhanced Alpha

In this project, you'll combine signals on a random forest for enhanced alpha. While implementing this, you'll have to solve the problem of overlapping samples. For the dataset, we'll be using the end of day from Quotemedia and sector data from Sharadar.

#### LESSON CONTENT

Lesson 1: Overview

Lesson 2: Decision Trees

Lesson 3: Model Testing and Evaluation

Lesson 4: Random Forests

Lesson 5: Feature Engineering

Lesson 6: Overlapping Labels

Lesson 7: Feature Importance



## Course 8: Simulating Trades with Historical Data

In this course, you will learn to refine trading signals by running a rigorous backtest. You will know how to keep track of your P&L while your algorithm buys and sells.

### Project

### Backtesting

In this project, you will build a fairly realistic backtester that uses the Barra data. The backtester will perform portfolio optimization that includes transaction costs, and you'll implement it with computational efficiency in mind, to allow for a reasonably fast backtest. You'll also use performance attribution to identify the major drivers of your portfolio's profit-and-loss (PnL). You will have the option to modify and customize the backtest as well.

#### LESSON CONTENT

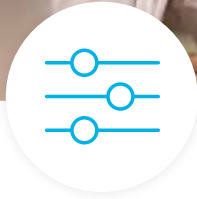
##### Lesson 1: Intro to Backtesting

##### Lesson 2: Optimization with Transaction Costs

##### Lesson 3: Attribution



# Our Nanodegree Programs Include:



## Pre-Assessments

Our in-depth workforce assessments identify your team's current level of knowledge in key areas. Results are used to generate custom learning paths designed to equip your workforce with the most applicable skill sets.



## Dashboard & Progress Reports

Our interactive dashboard (enterprise management console) allows administrators to manage employee onboarding, track course progress, perform bulk enrollments and more.



## Industry Validation & Reviews

Learners' progress and subject knowledge is tested and validated by industry experts and leaders from our advisory board. These in-depth reviews ensure your teams have achieved competency.



## Real World Hands-on Projects


Through a series of rigorous, real-world projects, your employees learn and apply new techniques, analyze results, and produce actionable insights. Project portfolios demonstrate learners' growing proficiency and subject mastery.

# Our Review Process



## Real-life Reviewers for Real-life Projects

Real-world projects are at the core of our Nanodegree programs because hands-on learning is the best way to master a new skill. Receiving relevant feedback from an industry expert is a critical part of that learning process, and infinitely more useful than that from peers or automated grading systems. Udacity has a network of over 900 experienced project reviewers who provide personalized and timely feedback to help all learners succeed.




**Vaibhav**  
UDACITY LEARNER

*"I never felt overwhelmed while pursuing the Nanodegree program due to the valuable support of the reviewers, and now I am more confident in converting my ideas to reality."*

\_\_\_\_\_ now at \_\_\_\_\_  
**CODING VISIONS INFOTECH**


## All Learners Benefit From:




Line-by-line feedback for coding projects



Industry tips and best practices



Advice on additional resources to research



Unlimited submissions and feedback loops

## How it Works

Real-world projects are integrated within the classroom experience, making for a seamless review process flow.

- Go through the lessons and work on the projects that follow
- Get help from your technical mentor, if needed
- Submit your project work
- Receive personalized feedback from the reviewer
- If the submission is not satisfactory, resubmit your project
- Continue submitting and receiving feedback from the reviewer until you successfully complete your project

## About our Project Reviewers

Our expert project reviewers are evaluated against the highest standards and graded based on learners' progress. Here's how they measure up to ensure your success.

**900+**

**Expert Project Reviewers**

Are hand-picked to provide detailed feedback on your project submissions.

**1.8M**

**Projects Reviewed**

Our reviewers have extensive experience in guiding learners through their course projects.

**3**

**Hours Average Turnaround**

You can resubmit your project on the same day for additional feedback.

**4.85 /5**

**Average Reviewer Rating**

Our learners love the quality of the feedback they receive from our experienced reviewers.



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