



THE SCHOOL OF ARTIFICIAL INTELLIGENCE

# Natural Language Processing

NANODEGREE SYLLABUS



# Overview

## This Nanodegree is Built in Partnership With



In this program, you'll learn and put in practice the concepts behind natural language processing and speech recognition, including machine translation, part of speech tagging, and sentiment analysis. This course will cover the latest in deep learning architectures, which, combined with the more classical probabilistic methods used in a variety of applications, will give you a repertory of techniques widely used in the industry.

With the practical skills you gain in this course, you'll be able to build your own models which will extract information from text or voice data, and enable you to solve real-world challenges.

This program will enhance your existing machine learning and deep learning skills with the addition of natural language processing and speech recognition techniques. These skills can be used in various applications such as part of speech tagging and machine translation, among others. You'll develop the skills you need to start applying natural language processing techniques to real-world challenges and applications.

The program is comprised of 3 courses and 3 projects. Each project will contribute to an impressive professional portfolio that showcases your mastery of natural language processing and deep learning techniques.

## Program Information



### TIME

3 months  
Study 10 hours/week



### LEVEL

Specialist



### PREREQUISITES

Significant experience with Python, and entry-level experience with probability and statistics, and deep learning architectures. Ability to write a class in Python and add comments to your code for others to read. Familiarity with the term "neural networks" and differential math that drives back propagation.



### HARDWARE/SOFTWARE REQUIRED

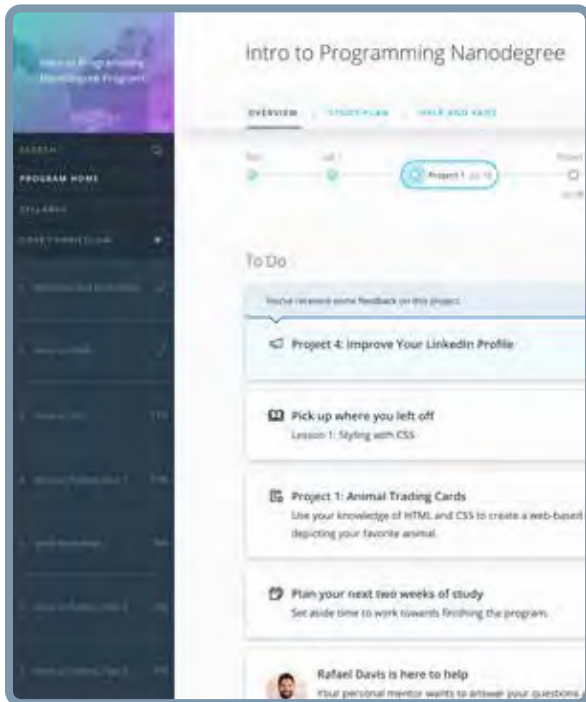
A 64-bit operating system with at least 8GB of RAM, along with administrator account permissions sufficient to install programs including Anaconda with Python 3.5 and supporting packages. Your network should allow secure connections to remote hosts (like SSH).



### 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

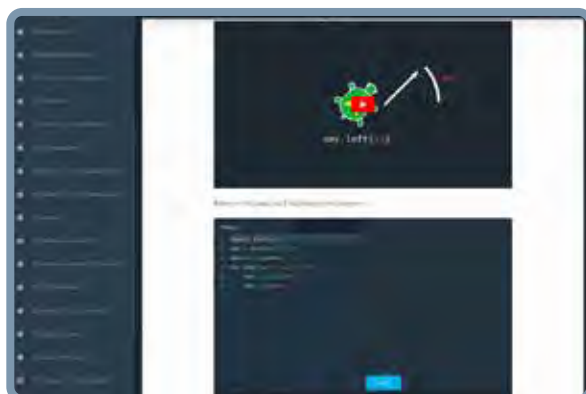
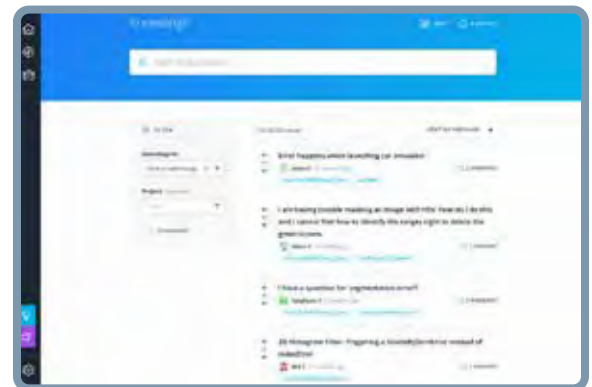
Learners leverage the power of community through a simple, yet powerful chat interface built within the classroom. Learner Hub connects learners with their technical mentor and fellow learners.

## 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.

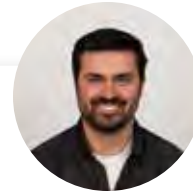
# Learn with the Best



**Jay Alammar**

INSTRUCTOR

Jay has a degree in computer science, loves visualizing machine learning concepts, and is the Investment Principal at STV, a \$500 million venture capital fund focused on high-technology startups.



**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.



**Dana Sheahan**

CONTENT DEVELOPER

Dana is an electrical engineer with a Master's in Computer Science from Georgia Tech. Her work experience includes software development for embedded systems in the Automotive Group at Motorola, where she was awarded a patent for an onboard operating system.



## Course 1: Introduction to Natural Language Processing

Learn text processing fundamentals, including stemming and lemmatization. Explore machine learning methods in sentiment analysis. Build a speech tagging model.

### Project

### Part of Speech Tagging

Use several techniques, including table lookups, n-grams, and hidden Markov models, to tag parts of speech in sentences, and compare their performance.

This project demonstrates text processing techniques that allow you to build a part of speech tagging model. You will work with a simple lookup table, and progressively add more complexity to improve the model using probabilistic graphical models. Ultimately you'll be using a Python package to build and train a tagger with a hidden Markov model, and you will be able to compare the performances of all these models in a dataset of sentences.

#### LESSON TITLE

#### LEARNING OUTCOME

#### INTRODUCTION TO NLP

- Learn the main techniques used in natural language processing.
- Get familiarized with the terminology and the topics in the class.
- Build your first application with IBM Watson.

#### TEXT PROCESSING

- See how text gets processed in order to use it in models.
- Learn techniques such as tokenization, stemming, and lemmatization.
- Get started with part of speech tagging and named entity recognition.

#### PART OF SPEECH TAGGING WITH HIDDEN MARKOV MODELS

- Learn how hidden Markov models are defined.
- Train HMMs with the Viterbi and the Baum-Welch algorithms.
- Use HMMs to build a part of speech tagging model.

# Nanodegree Program Overview

## Course 2: Computing with Natural Language

Learn advanced techniques like word embeddings, deep learning attention, and more. Build a machine translation model using recurrent neural network architectures.

### Project

### Machine Translation

Build a deep neural network that functions as part of an end-to-end machine translation pipeline. Your completed pipeline will accept English text as input and return the French translation. You'll be able to explore several recurrent neural network architectures and compare their performance.

First you will pre-process the data by converting text to sequence of integers. Then you will build several deep learning models for translating the text into French. As a final step, you will run this models on English test to analyze their performance.

#### LESSON TITLE

#### LEARNING OUTCOME

#### FEATURE EXTRACTION AND EMBEDDINGS

- Express logical constraints as Python functions.
- Use constraint propagation & search to solve all Sudoku puzzles.

#### MODELING

- Learn to represent problems in terms of logical constraints.
- Use constraint propagation to limit the potential solution space.
- Incorporate backtracking search to find a solution when the set of constraints is incomplete.

#### DEEP LEARNING ATTENTION

- List of external resources for you to continue learning about CSPs.

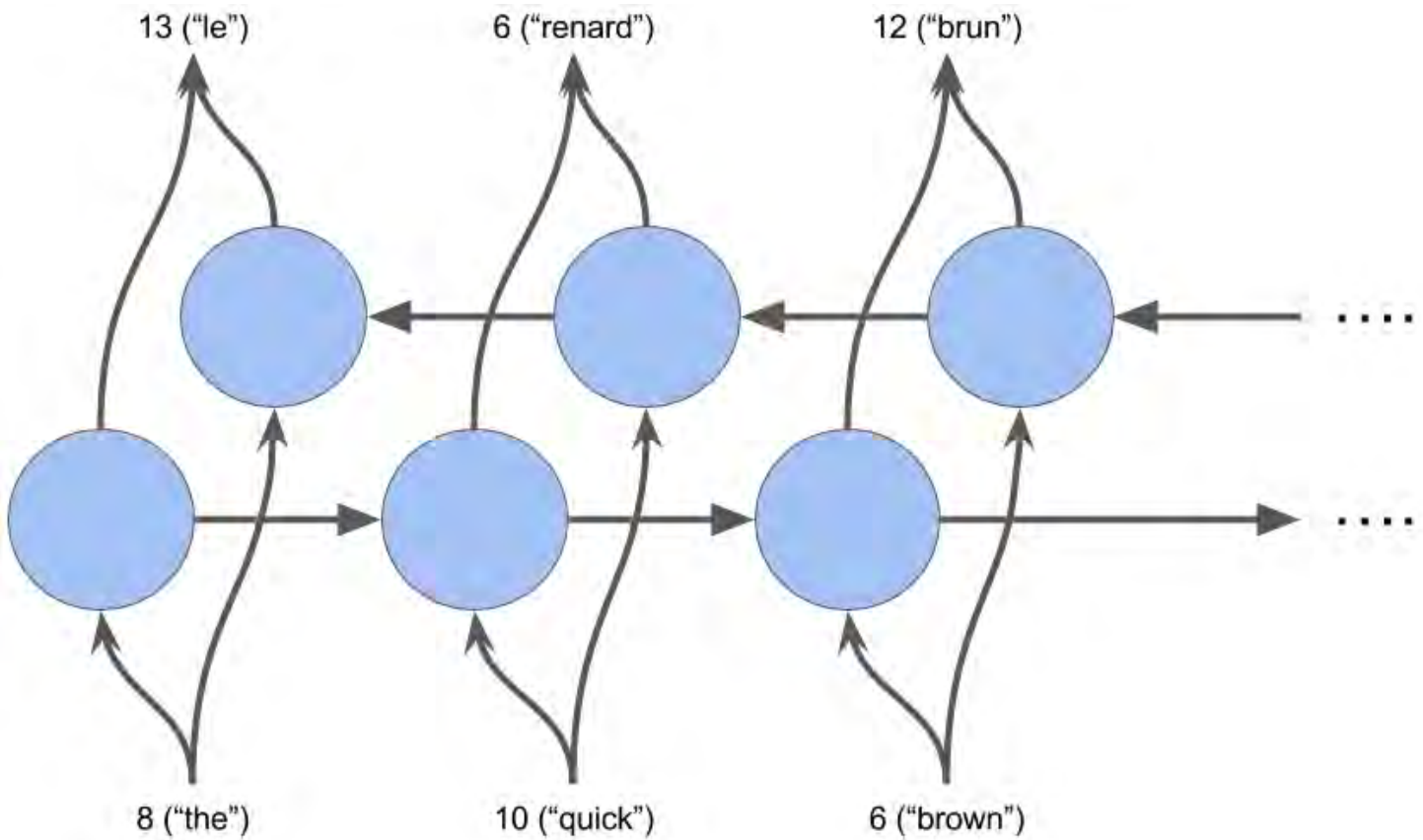
#### INFORMATION SYSTEMS

- Learn about information extraction and information retrieval systems.
- Learn about question answering and its applications.



## Project Example

## Machine Translation



*A learner-submitted illustration of a Machine Translation project solution.*

# Nanodegree Program Overview

## Course 3: Communicating with Natural Language

Learn voice user interface techniques that turn speech into text and vice versa. Build a speech recognition model using deep neural networks.

### Project

### Speech Recognizer

Build a deep neural network that functions as part of an end-to-end automatic speech recognition (ASR) pipeline. The model will convert raw audio into feature representations, which will then turn them into transcribed text.

You'll begin by investigating a dataset, that will be used to train and evaluate your models. Your algorithm will first convert any raw audio to feature representations that are commonly used for ASR. You will then build neural networks that map these features to transcribed text.

#### LESSON TITLE

#### LEARNING OUTCOME

#### INTRO TO VOICE USER INTERFACES

- Learn the basics of how computers understand spoken words.
- Get familiar with the most common VUI applications.
- Set up your AWS account and build Alexa skill with an existing template.

#### ALEXA HISTORY SKILL

- Learn the basics of Amazon AWS.
- Create your own fully functional Alexa skill using Amazon's API.
- Deploy your skill for everyone to use it.

#### INTRODUCTION TO SPEECH RECOGNITION

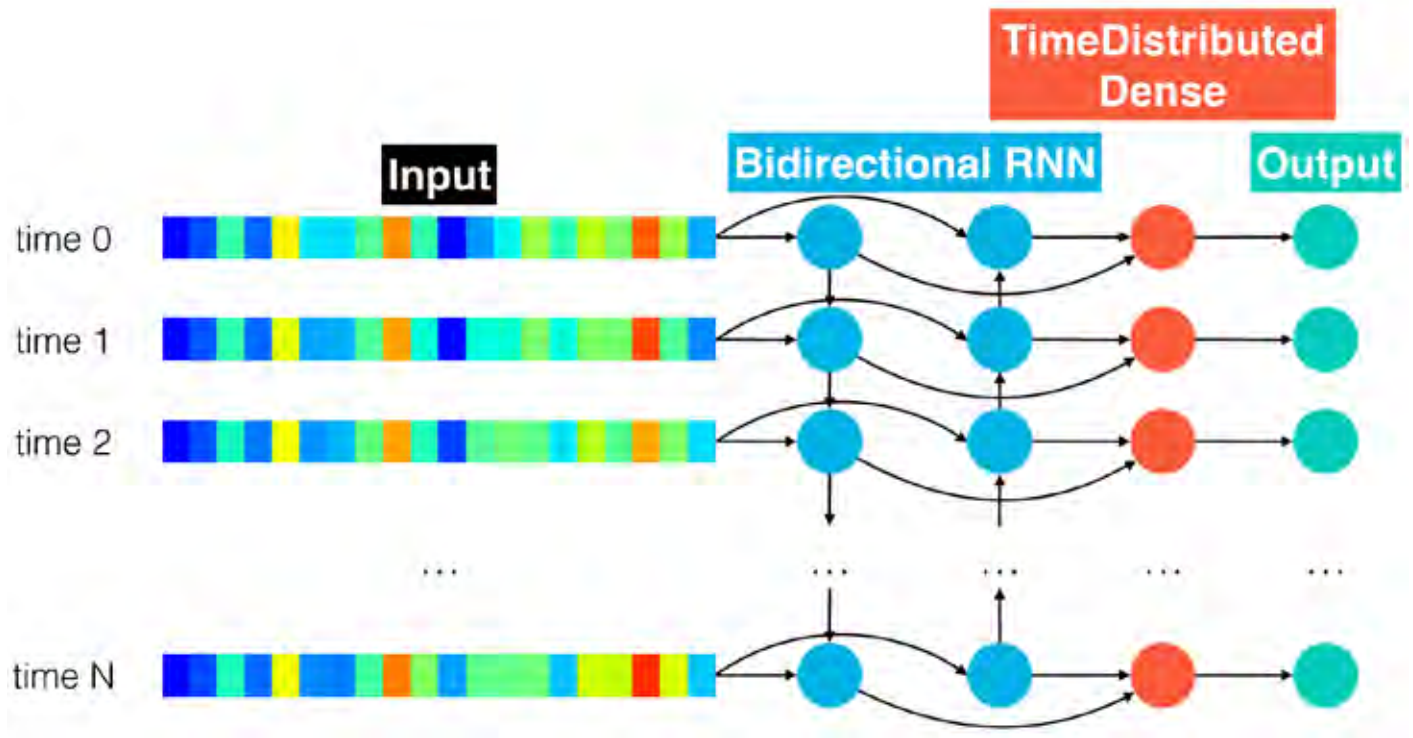
- Learn the pipeline used for speech recognition.
- Learn to process and extract features from sound signals.
- Learn to build probabilistic and machine learning Language models in order to extract words and grammar from sound signals.





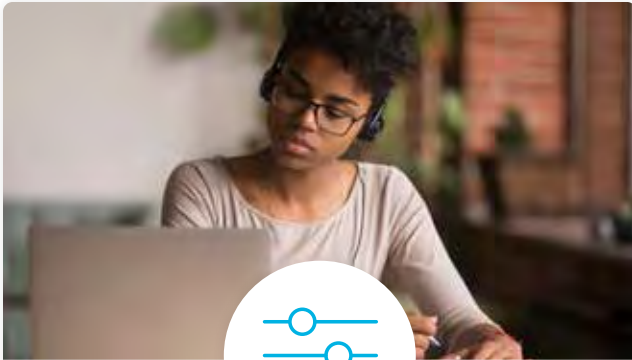
## Project Example

## Speech Recognition



*A learner-submitted illustration of a Speech Recognition project solution.*

# 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.




**Expert Project Reviewers**

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



**Projects Reviewed**

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



**Hours Average Turnaround**

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



**Average Reviewer Rating**

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



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