Overview

In this Nanodegree program, learners will gain in-demand competencies to perform analysis on data stored in relational and non-relational database systems to power strategic decision-making. Learn to determine, create, and execute SQL and NoSQL queries that manipulate and dissect large scale datasets. Begin by leveraging the power of SQL commands, functions, and data cleaning methodologies to join, aggregate, and clean tables, as well as complete performance tune analysis to provide strategic business recommendations. The next portion of the program will equip learners with job-ready skills in data pre-processing, visualization, and analysis using Power BI as the primary tool. Learners will then connect Power BI to multiple data sources, process and transform data to prepare it for reporting and visualization, and build compelling data visualizations that tell a story and employ best design practices. They will be able to draw insights from data dashboards and visualizations that can help a business make critical decisions.

Additionally, a recommended course on using Python has been added to this learning stream to better prepare learners working in data operations. The course enables learners to manipulate large datasets, write code to collect data, compute descriptive statistics, and create an interactive interface in the terminal using Python.

Upon completion of this program, learners will have the most valuable programming tools and languages used by data scientists today.
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.

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
Create a custom study plan to suit your personal needs and use this plan to keep track of your progress toward your goal.

PROGRESS TRACKER
Personalized milestone reminders help learners stay on track and focused as they work to complete their Nanodegree program.
Malavica Sridhar  
**PRODUCT MANAGER AT WAYMO**  
Mal Sridhar is currently a product manager at Waymo. Prior to her current role, she was a Senior Product Manager at CircleUp. Mal started her career as a management consultant at McKinsey & Company and is passionate about leveraging data to transform industries.

Ziad Saab  
**SOFTWARE DEVELOPER**  
Ziad is a seasoned software developer who loves mentoring and teaching. Currently working as an independent contractor, he previously co-founded and taught full-stack web development at DecodeMTL, Montreal’s first web development bootcamp.

Derek Steer  
**CEO & CO-FOUNDER, MODE**  
Derek will introduce you to the SQL language and how to use SQL queries to analyze data in relational databases. He is the co-founder and CEO of Mode Analytics. He has worked as a data analyst in various companies, including Microsoft, Yammer, and Facebook.
Richard Kalehoff  
INSTRUCTOR  
Richard is a course developer with a passion for teaching. He has a degree in computer science and first worked for a nonprofit doing everything from front end web development, to backend programming, to database and server management.

Juno Lee  
CURRICULUM LEAD AT UDACITY  
Juno is the curriculum lead for the School of Data Science. She has been sharing her passion for data and teaching, building several courses at Udacity. As a data scientist, she built recommendation engines, computer vision and NLP models, and tools to analyze user behavior.

Josh Bernhard  
DATA SCIENTIST AT NERD WALLET  
Josh has been sharing his passion for data for nearly a decade at all levels of university, and as lead data science instructor at Galvanize. He’s used data science for work ranging from cancer research to process automation.

Karl Krueger  
COMMAND LINE INSTRUCTOR  
Karl is a course developer at Udacity. Before joining Udacity, Karl was a Site Reliability Engineer (SRE) at Google for eight years, building automation and monitoring to keep the world’s busiest web services online.
Joseph Lozada  
BUSINESS INTELLIGENCE  
AND OPERATIONS PROFESSIONAL

Joseph works as a client services team leader at Morneau Shepell, where he manages a team of analysts and oversees the data management and systems functionality for his clients. He also works as an adjunct instructor of Excel and Power BI analytics at the Community College of Rhode Island.

Sean Chandler  
SENIOR BUSINESS INTELLIGENCE  
ENGINEER AT HUMANA

Sean is a senior business intelligence engineer at Humana, where he oversees an enterprise community of thousands of users and developers. His Power BI work has been featured recently at the Microsoft Business Applications Summit and on Microsoft Mechanics.

Lenore R Flower  
SENIOR BUSINESS INTELLIGENCE SPECIALIST

Lenore is a senior business intelligence specialist with a background in finance and a passion for empowering her colleagues to make data-driven decisions—even if the information they have to work with is a little rough around the edges.
Course 1: SQL for Data Analysis

When it comes to extracting insights from stored data, SQL is one of the most versatile tools available. Learn how to execute core SQL commands to define, select, manipulate, control access, aggregate, and join data and data tables. Understand when and how to use subqueries, several window functions, as well as partitions to complete complex tasks. Clean data, optimize SQL queries, and write select advanced JOINs to enhance analysis performance. Explain which cases you would want to use particular SQL commands, and apply the results from queries to address business problems.

Project: Deforestation Exploration

SQL is most commonly used to manipulate and analyze data to inform decision making. In this project, you will act as a data analyst for an organization on a mission to reduce deforestation around the world and to raise awareness about this important environmental topic. First, you’ll clean any erroneous values in a table, join that table to another lookup table to bring in a new categorical and quantitative variable, and return a new view of all categories greater than a reference value. Then, you will create and execute SQL queries to perform calculations using variables from those disparate data sets to answer questions for stakeholders. Your analysis will help you better understand which countries and regions around the world seem to have forests that have been shrinking in size, and also which countries and regions have the most significant forest area. Lastly, you will compile your answers and summarize your analysis into a report that can be shared with a leadership team.

<table>
<thead>
<tr>
<th>LESSON TITLE</th>
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<tbody>
<tr>
<td>BASIC SQL</td>
<td>• Write common SQL commands including SELECT, FROM, and WHERE.</td>
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<td>• Use logical operators like LIKE, AND, and OR.</td>
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<tr>
<td>SQL JOINS</td>
<td>• Write JOINs in SQL to combine data from multiple sources to answer more complex business questions.</td>
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<td></td>
<td>• Understand different types of JOINs and when to use each type.</td>
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<tr>
<td>SQL AGGREGATIONS</td>
<td>• Write common aggregations in SQL including COUNT, SUM, MIN, and MAX.</td>
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<td>• Write CASE and DATE functions, as well as work with NULLs.</td>
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</table>
## Course 1: SQL for Data Analysis cont.

<table>
<thead>
<tr>
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</table>
| SQL Subqueries & Temporary Tables | • Write subqueries to run multiple queries together.  
• Learn the types of subquery placement and formatting.  
• Use temp tables to access a table with more than one query. |
| SQL Data Cleaning | • Learn and apply the basics of data cleaning strategies in SQL to normalize or create a column from existing data.  
• Perform the appropriate data cleaning methodology based on goals for further analysis. |
| SQL Window Functions | • Apply core window functions to tackle analysis tasks that require further targeting or segmentation.  
• Use other window functions including RANK, NTILE, LAG, LEAD new functions along with partitions to complete complex tasks. |
| SQL Advanced Joins and Performance Tuning | • Learn how and when to use advanced joins (e.g., self joins) to write queries that run quickly across giant datasets.  
• Learn the high-level tradeoffs with queries, including performance and what you can do to optimize them. |
| Project: Deforestation Exploration | • Apply basic and advanced query techniques to compile strategic recommendations from a large dataset. |
Course 2: Management of Relational & Non-Relational Databases

Databases need to be structured properly to enable efficient and effective querying and analysis of data. Build normalized, consistent, and performant relational data models. Use SQL Database Definition Language (DDL) to create the data schemas designed in Postgres and apply SQL Database Manipulation Language (DML) to migrate data from a denormalized schema to a normalized one. Understand the tradeoffs between relational databases and their non-relational counterparts, and justify which one is best for different scenarios. With a radical shift of paradigms, learn about MongoDB and Redis to get an understanding of the differences in behaviors and requirements for non-relational databases.

Project

Udiddit, A Social News Aggregator

Many of today's most popular web applications have supporting database structures that allow them to customize and aggregate information within seconds. In this project, you will build the supporting data structures for Udiddit, a social media news aggregator site. First, you'll investigate the provided data model for potential errors such as lack of normalization, consistency rules, and proper indexing. Then, you will create a new, normalized database using DDL based on the denormalized one that is provided. Lastly, you will write DML queries to migrate the data from the denormalized schema to their normalized schema.

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<tr>
<td>NORMALIZING DATA</td>
<td>• Organize data in a format suitable for relational databases.</td>
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<td>• Get a grasp on database normal forms.</td>
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<tr>
<td>DATA DEFINITION</td>
<td>• Write common SQL commands with CREATE TABLE and ALTER TABLE.</td>
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<tr>
<td>LANGUAGE (DDL)</td>
<td>• Use different data types to model real-world situations.</td>
</tr>
<tr>
<td>DATA MANIPULATION</td>
<td>• Write common SQL commands with INSERT, UPDATE, and DELETE.</td>
</tr>
<tr>
<td>LANGUAGE (DML)</td>
<td>• Use SQL functions to manipulate numbers, strings, and dates.</td>
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## Course 2: Management of Relational & Non-Relational Databases, cont.

<table>
<thead>
<tr>
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<tr>
<td><strong>Consistency with Constraints</strong></td>
<td>• Implement business rules at the database level using SQL commands with CONSTRAINT, UNIQUE, PRIMARY KEY, and CHECK.</td>
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<td>• Formalize the relations between tables using SQL FOREIGN KEY and its variations.</td>
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<tr>
<td><strong>Performance with Indexes</strong></td>
<td>• Fix some slow SQL queries by introducing database indexes with the SQL command CREATE INDEX.</td>
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<td>• Introspect SQL queries through the query planner with EXPLAIN and EXPLAIN ANALYZE.</td>
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<td>• Assess whether a use-case is a good candidate for indexing.</td>
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<tr>
<td><strong>Intro to Non-Relational Databases</strong></td>
<td>• Articulate why non-relational databases were created and their tradeoffs compared to relational databases.</td>
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<tr>
<td></td>
<td>• Add, modify, and query data in a MongoDB database.</td>
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<td></td>
<td>• Use the right MongoDB design patterns for various real-life situations. Adam</td>
</tr>
<tr>
<td></td>
<td>• Add, modify, and query data in a Redis database.</td>
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<td>• Use Redis as a standalone database to build the data part of a small application.</td>
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Course 3: Preparing and Modeling Data

In a perfect world, every BI professional would be able to rely on a pristine data warehouse and enterprise level data models to easily build and deploy reliable data models—but where do you even start when the data you need for a single report lives in a bunch of different files and software systems?

This is where preparing and modeling data becomes essential. This course is a crucial step in Power BI for anyone who needs to mash together multiple data sources, clean them, restructure them, and harmonize them into a single and efficient data model to support reporting. We’ll cover Power BI’s built-in Extract-Transform-Load (ETL) tool, Power Query, learn foundational data modeling principles, cover some introductory DAX (Data Analytics Expressions), and touch on troubleshooting and optimization.

Each of these steps creates the foundation for beautiful reports and efficient DAX, ideally positioning students to take on the remaining courses in the Nanodegree program.

Introduction to Preparing and Modeling data culminates with a final project in which you will create a data model and Power BI report for Seven Sages Brewing, a small company struggling to leverage their disjointed data to facilitate smart decision-making. Your mission is to tame their datasets and create an efficient data model that will help the company better understand what products are popular—and profitable—so they can mark smart decisions about what products to prioritize as the company continues to grow.

Students will demonstrate an understanding of core data modeling principles, including the ability to clean, organize and structure data in Power Query, to make a date table, to build a data model with the appropriate relationships and filters and to create a simple report using common visualizations and DAX measures.
Course 4: Creating Visualizations with Power BI

In this course, students will learn how to carry Power BI beyond mere bar charts and transform their reports into data exploration & storytelling tools that companies can use to better understand their data. Students will start by learning about a variety of common and more advanced data visualizations, ranging from bar charts and line charts to scatter plots and bubble maps. Then, students will learn how to design reports around these data visuals in order to focus user attention on key insights, help users navigate different features and report pages, and enable accessibility options for diverse audiences. Next, the student will learn how to use filters and slicers to make the Power BI tools they develop more interactive and encourage users to explore datasets and visuals. Finally, the course will culminate with students combining elements they have learned from the rest of the lesson to deliver a couple of advanced features capable of elevating how users navigate and engage with visuals and the report itself.

Project 

Building a Power BI report for Waggle

Waggle is a hot new start-up that produces smart devices for pets. Their leading product, the Lapdog collar, has been a tremendous success for the company and it allows pet owners to easily track their dog’s steps, heart rate and general health from the convenience of their phone. The product has been so successful, in fact, that the company is considering releasing a similar product for cats called Lapcat and has been testing hundreds of prototypes in the field for the past several months.

Now, the data from those tests has been compiled and Waggle leadership has requested a Power BI report that summarizes key insights comparing Lapcat and Lapdog devices that can be presented to the CEO. This project will test students on the data visualization and report design skills learned in the course while also challenging them to implement a variety of interactive features that can enhance the user experience. By the end of the project, students will have designed a detailed Power BI report with many data visuals that tell the story of how the new Lapcat devices compared to Lapdog collars.
## Nanodegree Program Overview

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<th>LESSON TITLE</th>
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<td>WELCOME TO CREATING VISUALIZATIONS WITH POWER BI</td>
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</table>
  - Describe the learning objective of the course.
  - Explain why data visualization is important for business intelligence.
  - Identify the main stakeholders that BI analysts interact with.
  - Identify when data visualization is useful and when it is not. |
| BUILDING COMPELLING DATA VISUALIZATIONS | 
  - Identify important business metrics and pair them with appropriate data visuals.
  - Build common data visuals, including bar charts and line charts.
  - Design complementary visuals, including cards, donut charts, and tables.
  - Build more complex data visuals, including scatter plots and bubble maps.
  - Recognize standard formatting options for Power BI visuals and navigate the unique formatting features that vary between visuals. |
| DESIGNING USER-FRIENDLY REPORTS | 
  - Customize Power BI themes with unique color palettes.
  - Insert elements like images, shapes and buttons to create compelling and versatile layouts for their reports.
  - Apply design principles that reduce noise & highlight data stories.
  - Maximize accessibility for diverse user groups. |
Course 5: Data Wrangling with Python

In this part, you'll learn to represent and store data using Python data types and variables, and use conditionals and loops to control the flow of your programs. You'll harness the power of complex data structures like lists, sets, dictionaries, and tuples to store collections of related data. You'll define and document your own custom functions, write scripts, and handle errors. You will also learn to use two powerful Python libraries—Numpy, a scientific computing package, and Pandas, a data manipulation package.

**Project**

Explore US Bikeshare Data

You will use Python to answer interesting questions about bikeshare trip data collected from three US cities. You will write code to collect the data, compute descriptive statistics, and create an interactive experience in the terminal that presents the answers to your questions.

<table>
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</table>
| **WHY PYTHON PROGRAMMING**        | • Gain an overview of what you'll be learning and doing in the course.  
• Understand why you should learn programming with Python.                                                                                                   |
| **DATA TYPES AND OPERATORS**      | • Represent data using Python's data types: integers, floats, booleans, strings, lists, tuples, sets, dictionaries, compound data structures.  
• Perform computations and create logical statements using Python's operators: Arithmetic, Assignment, Comparison, Logical, Membership, Identity.  
• Declare, assign, and reassign values using Python variables.  
• Modify values using built-in functions and methods.  
• Practice whitespace and style guidelines.                                                                                                                     |
| **CONTROL FLOW**                  | • Write conditional expressions using if statements and boolean expressions to add decision making to your Python programs.  
• Use for and while loops along with useful built-in functions to iterate over and manipulate lists, sets, and dictionaries.  
• Skip iterations in loops using break and continue.  
• Condense for loops to create lists efficiently with list comprehensions.                                                                                   |
## Course 5: Data Wrangling with Python cont.

<table>
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</table>
| **FUNCTIONS** | - Define your own custom functions.  
- Create and reference variables using the appropriate scope.  
- Add documentation to functions using docstrings.  
- Define lambda expressions to quickly create anonymous functions.  
- Use iterators and generators to create streams of data. |
| **SCRIPTING** | - Install Python 3 and set up your programming environment.  
- Run and edit python scripts.  
- Interact with raw input from users.  
- Identify and handle errors and exceptions in your code.  
- Open, read, and write to files.  
- Find and use modules in Python Standard Library and third-party libraries.  
- Experiment in the terminal using a Python Interpreter. |
| **NUMPY** | - Create, access, modify, and sort multidimensional NumPy arrays (ndarrays).  
- Load and save ndarrays.  
- Use slicing, boolean indexing, and set operations to select or change subsets of an ndarray.  
- Understand difference between a view and a copy of ndarray.  
- Perform element-wise operations on ndarrays.  
- Use broadcasting to perform operations on ndarrays of different sizes. |
| **PANDAS** | - Create, access, and modify the main objects in Pandas, Series and DataFrames.  
- Perform arithmetic operations on Series and DataFrames.  
- Load data into a DataFrame.  
- Deal with Not a Number (NaN) values. |
Course 6: Command Line Essentials

Learn how to use version control and share your work with other people in the data science industry.

**Project**

Post your work on Github

In this project, you will learn important tools that all programmers use. First, you'll get an introduction to working in the terminal. Next, you'll learn to use git and Github to manage versions of a program and collaborate with others on programming projects. In this project you will post two different versions of a Jupyter Notebook capturing your learnings from the course, and add commits to your project Git repository.

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<tr>
<td>SHELL WORKSHOP</td>
<td>• The Unix shell is a powerful tool for developers of all sorts. Get a quick introduction to the basics of using it on your computer.</td>
</tr>
</tbody>
</table>
| PURPOSE & TERMINOLOGY  | • Learn why developers use version control and discover ways you use version control in your daily life.  
• Get an overview of essential Git vocabulary.  
• Configure Git using the command line.                                                                                                                                                                                                                                                                                                                                                                                 |
| CREATE A GIT REPO       | • Create your first Git repository with git init.  
• Copy an existing Git repository with git clone.  
• Review the current state of a repository with the powerful Git status.                                                                                                                                                                                                                                                                                                                                                     |
| REVIEW A REPO'S HISTORY| • Review a repo's commit history Git log.  
• Customize Git log's output using command line flags in order to reveal more (or less) information about each commit.  
• Use the Git show command to display just one commit.                                                                                                                                                                                                                                                                                                                                                   |
## Optional & Extracurricular Course

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<tr>
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| ADD COMMITS TO A REPO                 | • Master the Git workflow and make commits to an example project.  
• Use Git diff to identify what parts of a file have been changed in a commit.  
• Learn how to mark files as “untracked” using .gitignore. |
| TAGGING, BRANCHING, AND MERGING       | • Tagging, branching, and merging.  
• Organize your commits with tags and branches.  
• Jump to particular tags and branches using Git checkout.  
• Learn how to merge together changes on different branches and crush those pesky merge conflicts. |
| UNDOING CHANGES                       | • Learn how and when to edit or delete an existing commit.  
• Use Git commit’s -amend flag to alter the last commit.  
• Use Git reset and git revert to undo and erase commits. |
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.

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.

“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.”

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