



Learning Objectives: Python Essentials (“Python 100”)

Last updated Spring 2026.

Course Objectives

By the end of this course, students will:

- Apply fundamental Python programming concepts to solve real-world problems.
- Work effectively with various data structures and manipulate data efficiently.
- Utilize Pandas for data analysis and manipulation, including data cleaning, transformation, and aggregation.
- Use SQL to interact with databases and retrieve relevant data.
- Scrape data from websites using Python libraries like Selenium.
- Store and retrieve data in different formats, such as databases, CSV, and JSON files.
- Create informative and visually appealing data visualizations using Matplotlib, Seaborn and Streamlit.
- Develop a comprehensive data pipeline to collect, clean, analyze, and visualize data.
- Apply ethical considerations when working with data, including privacy, bias, and fairness.
- Collaborate effectively with others on data-driven projects.

Lesson-by-Lesson Objectives

Week	Lesson Name	Students will be able to...
1	Intro to Python	Learn foundational Python programming skills, including setting up a development environment, writing and executing Python code, and using core programming concepts such as variables, data types, operators, functions, and control flow structures. They will also be introduced to debugging techniques and error handling to help identify and resolve problems in their code.
2	Data Structures and File Handling	Explore core Python data structures such as lists, tuples, dictionaries, and sets. They will also learn how to read and write to text and CSV files, use external modules, capture keyboard input, interact with the operating system, and manage project dependencies using virtual environments.

CTD Learning Objectives: Python Essentials

3	Advanced Python Skills	Apply key advanced Python concepts including decorators, list comprehensions, closures, and custom class definitions. They will learn how to write cleaner, more modular code using these features and gain insight into how such patterns are used in real-world frameworks like Dash.
4	Intro to Data Engineering	Load, preview, and inspect datasets from different formats (CSV, JSON, dictionaries) using Pandas. They will explore basic selection techniques and apply simple cleaning steps such as removing duplicates and filling missing values.
5	Data Cleaning and Validation	Clean and standardize real-world datasets by handling missing values, duplicates, outliers, and inconsistent formats. They will validate ranges and categories, apply encoding and basic feature engineering, and use advanced tools such as regular expressions to prepare data for analysis.
6	Data Wrangling and Aggregation	Manipulate and summarize data using filtering, grouping, and aggregation. They will practice combining datasets with merges, joins, and concatenation, and will reshape and enrich data using pivot tables and column transformations.
7	Intro to Data Visualization	Create and customize both basic and advanced data visualizations using Python libraries such as Matplotlib and Seaborn. By the end of this lesson, students will be able to effectively tell stories with data using visual representation, enhancing their ability to communicate insights.
8	Intro to Web Scraping	Gain a comprehensive understanding of web scraping, focusing on the fundamentals such as HTML structure, DOM representation, and using Python libraries like Selenium and WebDriver Manager to scrape and extract data from web pages. Additionally, students will explore the ethical aspects of web scraping, including adhering to guidelines provided by robots.txt and managing server requests responsibly.
9	Intro to Databases and SQL	Gain foundational knowledge of SQL databases using Python and SQLite. They will define relational schemas, insert and query data using SQL, handle many-to-many relationships, and interact with databases directly from Pandas for analysis and reporting.
10	Advanced SQL and Database Integration	Deepen their understanding of SQL by learning advanced techniques such as subqueries, complex JOINS,

		aggregation with functions, and using HAVING for conditional filtering. This lesson also introduces performance optimization techniques, transactions, parameterized queries, window functions, and more.
11	Advanced Data Visualization	Create both static and interactive data visualizations using Python libraries such as Pandas, Plotly, and Dash. They will practice working in their own repositories, explore key chart types, and build a simple dashboard to support real-time data exploration. Optional materials introduce Streamlit as an alternative dashboarding tool.

Final Project Outcomes

Students will demonstrate proficiency by completing two capstone projects:

Kaggle Data Analysis Project Students will conduct a comprehensive data analysis using real-world datasets that demonstrates their ability to:

- Load, clean, and transform data using Pandas (handling missing values, duplicates, and feature extraction)
- Aggregate and analyze data patterns through grouping operations and statistical functions
- Communicate insights through diverse, well-designed visualizations and data-driven conclusions

Web Scraping Dashboard Project Students will build an end-to-end data pipeline and interactive application that showcases their ability to:

- Extract data from live websites using web scraping techniques (Selenium) while handling common challenges
- Process and clean scraped data into structured formats for analysis
- Design and deploy an interactive dashboard (Streamlit/Dash) with user controls and meaningful visualizations