**Python for Data Science and Machine Learning**

1. Introduction to Python

* Overview and Features
* Installation and Setup
* Basic Syntax and Structure
* Create Virtual Environment
* What is requirements.txt file?

1. Data Types, Variables and Data Structures

* Variables in Python
* Basic Data Types – int, float, str, bool, etc.
* Data Structures – List, Tuple, Set, Dictionary, etc.
* Type Casting

1. Python Control Flow

* Conditional Statements (if, elif, else)
* Loops (for, while)
* Loops Control Statement (break, continue, pass)

1. Functions

* Defining Functions
* Scope of Function
* Arguments and Return Values
* Lambda Functions with map, filter and reduce

1. Importing, Creating Modules and Packages

* Import Module and Packages
* Creating own custom Modules
* Standard Library

1. File Handling

* File Operations – read, write, append, etc.
* Working with file paths
* Context Manager

1. Exception Handling in Python

* Try, Except, Else and Finally blocks
* Raising Exceptions
* Custom Exception Classes

1. OOP (Object Oriented Programming) Concepts

* Classes and Objects
* Attributes and Methods
* Inheritance
* Polymorphism
* Encapsulation
* Abstraction

1. Advance Python

* Iterator
* Generator
* Decorator
* Function copy, closures

1. Data Analysis with Python

* Data manipulation with pandas and numpy libraries
* Data visualization using Matplotlib
* Data visualization using Seaborn

**Key Libraries**

1. **NumPy**:
   * Essential for numerical computing. It provides support for arrays, matrices, and a variety of mathematical functions.
2. **Pandas**:
   * Great for data manipulation and analysis. It offers data structures like Data Frames that make it easy to handle and analyse structured data.
3. **Matplotlib**:
   * A plotting library that enables the creation of static, animated, and interactive visualizations in Python.
4. **Seaborn**:
   * Built on Matplotlib, Seaborn provides a high-level interface for drawing attractive statistical graphics.
5. **Scikit-learn**:
   * A comprehensive library for machine learning that includes tools for classification, regression, clustering, and dimensionality reduction.
6. **TensorFlow & Keras**:
   * Popular frameworks for building deep learning models. Keras is user-friendly and runs on top of TensorFlow.
7. **PyTorch**:
   * Another powerful deep learning framework that is particularly favoured for its dynamic computation graph and ease of use in research.

**Key Concepts**

1. **Data Preprocessing**:
   * Cleaning and preparing data for analysis, including handling missing values, encoding categorical variables, and normalizing data.
2. **Exploratory Data Analysis (EDA)**:
   * Using visualizations and summary statistics to understand the underlying patterns in the data.
3. **Model Selection**:
   * Choosing the right algorithm for your task, whether it’s classification, regression, or clustering.
4. **Model Training and Evaluation**:
   * Training models on a dataset and evaluating their performance using metrics like accuracy, precision, recall, and F1 score.
5. **Hyperparameter Tuning**:
   * Optimizing the settings of a model to improve performance, often using techniques like grid search or random search.
6. **Deployment**:
   * Making models available for use in production, which can involve building APIs or integrating with applications.

**Projects for Machine Learning**

1. **House Price Prediction**

* Build a regression model to predict house prices based on features like location, size, and number of rooms using datasets like the Boston Housing dataset.

1. **Sentiment Analysis on Tweets**

* Analyse Twitter data to classify tweets as positive, negative, or neutral. Use NLP techniques and libraries like NLTK or spaCy.

1. **Image Classification**

* Use a dataset like CIFAR-10 or MNIST to classify images using deep learning techniques with TensorFlow or PyTorch.

1. **Recommender System**

* Create a simple recommender system (collaborative filtering or content-based) for movies, books, or products.

**Projects for Data Science**

1. **Exploratory Data Analysis (EDA)**

* Choose a dataset (e.g., Titanic, FIFA 21) and perform EDA to uncover insights and visualize relationships using Pandas and Matplotlib/Seaborn.

1. **Web Scrapping and Data Collection**

* Scrape data from websites using Beautiful Soup or Scrapy and analyse it. For example, collect movie ratings or product reviews.

1. **COVID-19 Data Analysis**

* Analyse COVID-19 data using publicly available datasets to visualize trends, compare countries, and forecast future cases.

1. **Social Media Analysis**

* Analyse social media metrics (likes, shares, comments) to derive insights about user engagement and content performance.