

# **AI DEVELOPMENT WITH PYTHON**

### **MODULE 1 – INTRODUCTION TO PYTHON PROGRAMMING**

MODULE 2 – DATA ANALYSIS IN PYTHON USING PANDAS

# MODULE 3 – FOUNDATIONS OF NUMERICAL COMPUTING WITH NUMPY

MODULE 4 – DATA VISUALIZATION USING MATPLOTLIB AND SEABORN

**MODULE 5 – MACHINE LEARNING IN AI** 

**MODULE 6 – DEEP LEARNING IN AI** 

**MODULE 7 – NATURAL LANGUAGE PROCESSING IN AI** 

#### **MODULE 1 – INTRODUCTION TO PYTHON PROGRAMMING**

- 1. GETTING STARTED WITH PYTHON
  - Overview of Python History, Features and Applications
  - Installing Python and setting up the development environment
- 2. PYTHON BASICS
  - Introduction to Python syntax Variables, Data types and Operators
  - Understanding indentation and code blocks
  - Basic input/output operations using input() and print() functions
  - Comments
- 3. CONTROL FLOW STATEMENTS
  - Conditional statements if, elif and else

- Looping constructs for loops and while loops
- Break and Continue

#### 4. DATA STRUCTURES IN PYTHON

- Lists Creating lists, Indexing, Slicing and List methods
- Tuples Defining tuples, Accessing elements and Tuple operations
- Dictionaries Creating dictionaries, Accessing values and Dictionary methods
- Sets Creating sets, Set operations and Set methods
- 5. OPERATORS
  - Arithmetic operators, Assignment operators, Comparison operators, Logical operators, Membership operators, Identity operators
  - Understanding operator precedence
- 6. FUNCTIONS AND MODULES
  - Defining and calling functions in python
  - Function parameters and return values
  - Writing modular code organizing functions into modules
  - Importing modules and using built-in python modules
- 7. OBJECT-ORIENTED PROGRAMMING (OOP)
  - Introduction to Object-Oriented programming concepts
  - Classes and Objects Defining classes, Creating objects and Accessing attributes and methods
  - Inheritance and Polymorphism
  - Encapsulation Hiding implementation details and restricting access to data and methods
  - Data Abstraction
- 8. JSON (JAVASCRIPT OBJECT NOTATION)
  - Introduction to JSON and its importance in data interchange
  - Parsing JSON data in python using the json module
  - Serializing Python objects to JSON format and vice versa
- 9. FILE HANDLING
  - Reading from and writing to files in python
  - Working with text files Opening, Reading, Writing and Closing files
  - Handling Excel files Reading data from Excel files

#### 10. EXCEPTION HANDLING

• Understanding exceptions and error types in python

• Using try, except and finally blocks for error handling 11. PACKAGES

- Overview of python packages
- Installing and managing packages using **pip**
- 12. SCOPE
  - Understanding variable scope in python Local and Global scopes
- 13. REGULAR EXPRESSIONS (regex)
  - Introduction to regular expressions and their importance in text processing
  - Syntax and patterns in regular expressions
  - Using the re module in python for pattern matching, searching and substitution

#### MODULE 2 – DATA ANALYSIS IN PYTHON USING PANDAS

#### 1. INTRODUCTION TO PANDAS

- Overview of Pandas library
- Installing Pandas
- Pandas data structures Series and Dataframes
- Advantages of using Pandas for data analysis
- 2. EXPLORING DATA WITH PANDAS
  - Loading and Inspecting data reading from CSV
  - Previewing data head, tail, sample
  - Basic information about data shape, size, datatypes
  - Descriptive statistics mean, median, mode, variance etc
- 3. DATA MANIPULATION WITH PANDAS
  - Selecting and indexing data loc, iloc, Boolean indexing
  - Handling missing data Identifying missing values, filling, dropping
  - Data transformation Applying functions, mapping, replacing values
  - Combining datasets Concatenation, Merging, Joining
- 4. DATA AGGREGATION AND GROUPING
  - Grouping data Split-apply-combine strategy

- Aggregating data Sum, Mean, Median, Count
- Grouping by multiple variables
- Applying custom aggregation function

#### 5. DATA CLEANING AND PREPARATION

- Handling duplicate data
- String manipulation Splitting, Concatenating, Extracting substrings
- Data normalization and scaling
- Handling categorical data

#### MODULE 3 – FOUNDATIONS OF NUMERICAL COMPUTING WITH NUMPY

#### 1. INTRODUCTION TO NUMPY

- What is NumPy?
- Why use NumPy for numerical computing?
- Installing NumPy

#### 2. NUMPY ARRAYS

- Understanding NumPy arrays creation, attributes and properties
- Array indexing and slicing
- Array manipulation reshaping, concatenation, splitting
- Handling different dimensions in NumPy arrays 0-D, 1-D, 2-D, 3-D
- 3. NUMPY OPERATIONS
  - Basic arithmetic operations with arrays
  - Universal functions (ufuncs) in NumPy
- 4. AGGREGATION AND STATISTICAL OPERATIONS
  - Computing aggregates Sum, Mean, Median, Min, Max etc
  - Statistical operations Variance, Standard deviation etc
  - Random number generation with NumPy

#### 5. LINEAR ALGEBRA WITH NUMPY

- Matrix operations Addition, Subtraction, Multiplication
- Matrix decomposition LU decomposition, QR decomposition
- Solving linear equations using NumPy

#### 6. NUMPY AND DATASCIENCE

- Using NumPy with Pandas for data manipulation and analysis
- Applying NumPy in data preprocessing tasks
- Handling missing data and outliers with NumPy

## MODULE 4 – DATA VISUALIZATION USING MATPLOTLIB AND SEABORN

- 1. INTRODUCTION TO DATA VISUALIZATION
  - Importance of data visualization in data analysis and communication
  - Overview of Matplotlib and Seaborn libraries for data visualization in python
- 2. GETTING STARTED WITH MATPLOTLIB
  - Basic plotting Line plots, Scatter plots, Bar plots, Histogram
  - Customizing plots Colors, Markers, Labels, Titles, Axes, Legends
  - Saving plot to files
- 3. INTRODUCTION TO SEABORN
  - Overview of seaborn library and its advantages over Matplotlib
  - Understanding seaborn aesthetics and themes
- 4. STATISTICAL PLOTS WITH SEABORN
  - Visualizing distributions Histograms, Kernel density estimation (KDE) plots
  - Box plots, Violin plots and Swarm plots for categorical data
- 5. REGRESSION PLOTS AND CORRELATION
  - Visualizing linear relationship scatter plots with regression lines
  - Pairwise relationships correlation heatmaps and clustermaps

#### **MODULE 5 – MACHINE LEARNING IN AI**

- 1. INTRODUCTION TO MACHINE LEARNING
  - Understanding the fundamentals of machine learning

- Differentiating between Supervised, Unsupervised and Reinforcement learning
- Real-world applications of machine learning
- 2. SUPERVISED LEARNING
  - Regression Models
    - Simple linear regression
    - Multiple linear regression
    - Polynomial linear regression
  - Classification Models
    - Logistic regression
    - Naive bayes
    - KNN classifier
    - Decision tree
- 3. UNSUPERVISED LEARNING
  - Overview of unsupervised learning algorithms
  - Clustering algorithms
    - o K-means
    - Hierarchical clustering
    - o DBSCAN
- 4. REINFORCEMENT LEARNING
  - Basics of reinforcement learning
  - Reinforcement learning algorithms
    - Q-learning
    - Deep Q Networks
- 5. INTEGRATION WITH TENSORFLOW AND KERAS
  - Introduction to TensorFlow and Keras for deep learning.
  - Building neural networks using TensorFlow and Keras.
  - Training and evaluating deep learning models for classification and regression tasks.
- 6. INTEGRATION WITH OPENCV FOR IMAGE PROCESSING
  - Introduction to OpenCV library for image processing.
  - Reading and displaying images, basic image manipulations.
  - Feature extraction, object detection, and tracking with OpenCV.

#### **MODULE 6 – DEEP LEARNING IN AI**

#### 1. INTRODUCTION TO DEEP LEARNING

- Understanding the basics of neural networks
- History and evolution of deep learning
- Real world applications of deep learning
- 2. ARTIFICIAL NEURAL NETWORKS (ANNs)
  - Architecture of ANNs Input layer, Hidden layer, Output layer
  - Activation functions Sigmoid, ReLU, Softmax, Identity
- 3. CONVOLUTIONAL NEURAL NETWORKS (CNNs)
  - Architecture of CNNs Convolutional layers, Pooling layers, Fully connected layers
  - CNN building blocks Filters, Strides, Padding
  - Applications of CNNs in image recognition, object detection and segmentation
- 4. RECURRENT NEURAL NETWORKS (RNNs)
  - Architecture of RNNs Recurrent layers, LSTM cells, GRU cells
  - Handling sequential data with RNNs Time series prediction, Natural language processing
  - Applications of RNNs in text generation, sentiment analysis and language translation
- 5. K-NEAREST NEIGHBORS (KNN)
  - Introduction to the K-Nearest Neighbors algorithm.
  - Implementation workflow and parameters.
  - Use cases and applications of KNN in classification and regression tasks.

#### MODULE 7 – NATURAL LANGUAGE PROCESSING IN AI

- 1. INTRODUCTION TO NATURAL LANGUAGE PROCESSING (NLP) AND AI
  - Basics of natural language processing and its importance in AI

- Overview of NLP tasks Text classification, Sentiment analysis, Machine translation
- 2. TEXT REPRESENTATION AND EMBEDDINGS
  - Bag-of-words model and TF-IDF representation
  - Word embeddings Word2Vec, GloVe, fastText
  - Document embeddings Doc2Vec, Sentence embeddings
- 3. TEXT CLASSIFICATION
  - Overview of text classification tasks and algorithms
  - Supervised learning approaches Logistic regression, Naive Bayes
  - Deep learning models for text classification CNNs, RNNs
- 4. LANGUAGE MODELLING AND GENERATION
  - Language modelling with n-grams and RNNs
  - Text generation techniques Markov chains, Recurrent neural networks
- 5. MACHINE TRANSLATION
  - Basics of machine translation and its challenges
  - Statistical machine translation Vs neural machine translation
  - Sequence-to-sequence models and attention mechanisms