DSMA 113: Introduction to Python Programming

Credits: 3

Lecture Hours: 45

Course Objectives

The main objective of this course is to provide students with both theoretical and practical knowledge of various concepts in the Python programming language. After completing this course, students will be able to:

- Understand basic programming concepts including syntax, data types, variables, and operators.
- Apply computational thinking techniques to develop efficient algorithms and solutions.
- Utilize Python's built-in data structures such as lists, tuples, dictionaries, and sets.
- Implement object-oriented programming concepts.
- Learn file handling concepts for reading from and writing to different file formats.
- Work with popular Python libraries such as NumPy, Pandas, and Matplotlib for data manipulation and visualization.

Course Description

This course covers different concepts of Python programming, including fundamental language features, operators, built-in data types, control structures, functions, object-oriented programming, file operations, modules and packages, and libraries like NumPy, Pandas, and Matplotlib for data science.

Course Details

Unit 1: Introduction (5 LHs)

- Python Introduction, Why Python? Installing and Running Python using Interactive shell and console, Using IDLE and Jupyter Notebook
- Installing libraries, Working with Virtual Environment
- Writing Comments, Indentation, Tokens, Identifiers, Keywords, Literals, Variables and Constants
- Operators

Unit 2: Decision and Loops (10 LHs)

- Conditional/Selection Statements: if statement, if-else statement, Nested if statements, switch statement
- Looping/Iteration Statements: for loop, while loop, do-while loop
- Control Statements: break, continue, return
- Exception Handling: try, catch, finally, pass

Unit 3: Built-In Data Types (8 LHs)

- Numeric Types: Integers, Floating Point Numbers, and Complex Numbers

- String: Indexing and Slicing, String Formatting, Escape Sequences, Boolean

- List: Indexing and Slicing, Updating Items, Adding and Removing Items, Looping, Copying, List Comprehension, Sorting, Copying, and Joining

- Tuple: Updating, Indexing and Slicing, Unpacking, Looping, Joining

- Set: Accessing, Adding and Removing Items, Set Operations, Frozenset, Range

- Dictionary: Creation, Accessing, Conditionals, and Looping

- Binary Types

- None Type

Unit 4: Functions (5 LHs)

- Benefits of using Functions, Creating and Calling Functions, Passing Arguments

- Packing and Unpacking Arguments using Tuples and Dictionaries

- Return Values and Returning Multiple Values

- Recursive Function, Lambda Function

Unit 5: Object-Oriented Programming Concepts (2 LHs)

- Object-Oriented Principles – Classes and Objects, Encapsulation, Inheritance, Polymorphism, Data Hiding and Abstraction

Unit 6: File Handling (3 LHs)

Introduction, File Opening Modes, Reading and Writing Files, The os Module and Common Functions, The with Statement.

Unit 7: Common Python Libraries (10 LHs)

- NumPy: Array Creating, Dimensions, Data Types, Array Attributes, Indexing and Slicing, Array Copy and View, Creating Array from Numerical Range, Array Broadcasting, Iterating Over Array, Sorting and Searching, Statistical Functions

- Pandas: Series and DataFrames, Creating DataFrames, The head and tail Functions, Attributes, Working with Missing Data, Indexing, Slicing, and Subsetting, Merging and Joining DataFrames, Working with CSV Files

- Matplotlib: Marker, Line, Color, Label, Grid Lines, Subplot, Scatter Plot, Bar Graph, Histogram, Pie Chart, Box Plot, Heatmap, Violin Plot

Unit 8: Developing a Project (2 LHs)

- Project definition and functional specifications

- Top Down Analysis, Decomposition of Projects into different modules and inter-module relationships

- Data flow diagrams

- Translation of Different modules into code

Laboratory Work

The laboratory work includes writing programs using the Python programming language covering all the concepts studied in each unit of the course. Final project of 10 credit hours will be assigned to the students which will help students to put together most of the programming concepts developed in earlier exercises. This project might consist of:

1. Exploratory Data Analysis (EDA): Students will analyze datasets to discover patterns, identify anomalies.

2. Regression Analysis: Students will implement regression models to explore relationships between variables, predict outcomes.

References

1. D. Udayan, L. Aubrey, M. Chris, and N. Narges, *Introduction to Python Programming*. OpenStax, 2024.

2. Kenneth A. Lampart, *Fundamentals of Python*. Cengage Learning, 2021.

3. Cody Jackson, *Learn Programming in Python with Cody Jackson*. Packt Publishing, 2018.

4. Fabrizio Romano and Heinrich Kruger, *Learn Python Programming – An In-Depth Introduction to the Fundamentals of Python*, 3rd ed. Packt Publishing, 2021.

5. M. Summerfield, *Programming in Python 3: A Complete Introduction to the Python Language*. Addison-Wesley Professional, 2009.