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Computer Programming

Prof. Jagat Sesh Challa

Course Description

This course introduces computational thinking and software development using Python, the leading language for data science, AI, and automation. Learners begin with problem-solving strategies and progress from simple scripts to well-structured programs.

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Trimester: **01**

Credits: **03**

Weeks: **13**

Course Pre-Requisites

- High school-level mathematics;
- No prior programming experience required

References

- Python for Everybody: Exploring Data in Python 3, Severance, Charles
- Class notes

Software/Tools

- Python, Jupyter Notebook, Virtual Environments/ Anaconda

WEEK 1

GETTING STARTED WITH PROGRAMMING

Key Topics

- The computer's role in executing programs
- Basics of hardware vs. software
- Programs and Programming Languages
- Installing and configuring Python on Windows, macOS
- Working in online IDEs, Jupyter Notebooks, and Google Colab
- First look at Python syntax, statements, and common syntax errors

Learning Activities

Live Session

- Date:
- Executing basic Python programs on Jupyter Notebooks supported by our LMS

Practice Quiz

- Learn by doing: 6 practice quizzes to strengthen your foundation!

WEEK 2

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FLOWCHARTS AND DATA ON COMPUTERS

Key Topics

- Representing algorithms visually with flowcharts
- Number systems: Decimal ⇄ Binary conversion
- Two's-complement representation for negative numbers
- Internal representation of integers, real numbers, characters, and strings in memory

Learning Activities

Live Session

- Date:
- Examples of Flowcharts
- Examples of decimal to binary conversions (and vice versa)

Practice Quiz

- Learn by doing: 11 practice quizzes to strengthen your foundation!

WEEK 3

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PYTHON BASICS

Key Topics

- Variables, constants, and simple statements in Python
- Built-in I/O (input, print) and type-conversion functions
- Numeric and string expressions; arithmetic and comparison operators
- Comments, escape characters and syntax errors

Learning Activities

Live Session

- Date:
- Write basic Python programs on numerical expressions, I/O and type conversions
- Give a demo on various syntax errors

Graded Quiz

- Wrap up your learning with a graded quiz that counts toward your progress!

Practice Quiz

- Learn by doing: 9 practice quizzes to strengthen your foundation!

Experiential Learning

Objective

Give a hands-on experience in writing Python programs using numerical expressions and type conversions

Description

Programming Questions on Expressions and Type Conversions

WEEK 4

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CONDITIONAL STATEMENTS AND ERROR HANDLING

Key Topics

- Boolean logic; one-way, two-way, nested, and multi-way if-elif-else constructs
- Short-circuit evaluation
- Syntax vs. runtime errors
- Error handling using the try / except statement

Learning Activities

Live Session

- Date:
- Write Python programs illustrating if-elif-else
- Write Python programs illustrating Error-Handling

Practice Quiz

- Learn by doing: 9 practice quizzes to strengthen your foundation!

Experiential Learning

Objective

Give a hands-on experience in writing Python programs using conditional statements and handling runtime errors

Description

Programming Questions on Conditional Statements, Error Handling

WEEK 5

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ITERATIVE STATEMENTS

Key Topics

- while and for loops; loop-control keywords break, continue, pass
- Loop patterns (counters, accumulators) and nested loops for pattern printing

Learning Activities

Live Session

- Date:
- Basic program illustrating while vs. for loop
- Reverse pyramid pattern printing using while and for loops

Graded Quiz

- Wrap up your learning with a graded quiz that counts toward your progress!

Practice Quiz

- Learn by doing: 7 practice quizzes to strengthen your foundation!

Experiential Learning

Objective

Give a hands-on experience in writing Python programs using loops

Description

Programming Questions based on the while loop and the for loop

WEEK 6

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FUNCTIONS

Key Topics

- Standard-library utilities (datetime, math, random)
- Variable scope (local vs. global) and lifetime
- Measuring the execution time of programs
- Writing user-defined functions: parameters, return values, modular design
- Recursive functions, decorators, and lambda functions

Learning Activities

Live Session

- Date:
- Basic programs illustrating library functions
- A programming problem that involves creating multiple functions

Practice Quiz

- Learn by doing: 13 practice quizzes to strengthen your foundation!

Experiential Learning

Objective

Give a hands-on experience in writing Python programs using Functions

Description

Programming Questions on Python Library Functions, User-defined functions and other topics related to functions

WEEK 7

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STRINGS & FILES

Key Topics

- Strings and String operations: Indexing, slicing, split, join, replace, f-strings
- Text-file I/O: Opening, reading, writing, “with” context manager
- Processing file contents (parsing, summarising) and dealing with encodings/errors

Learning Activities

Live Session

- Date:
- Programming problems illustrating string operations and text-file I/O

Graded Quiz

- Wrap up your learning with a graded quiz that counts toward your progress!

Practice Quiz

- Learn by doing: 9 practice quizzes to strengthen your foundation

Experiential Learning

Objective

Give a hands-on experience in writing Python programs using Strings and Files

Description

Programming Questions on Strings and Files

WEEK 8

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LISTS AND SETS

Key Topics

- Lists: Creation, slicing, mutation, comprehensions, map/filter idioms
- Sets: Uniqueness properties, union, intersection, difference, symmetric difference
- Lists vs. Sets

Learning Activities

Live Session

- Date:
- Programming problems using lists and sets

Practice Quiz

- Learn by doing: 9 practice quizzes to strengthen your foundation!

Experiential Learning

Objective

Give a hands-on experience in writing Python programs using Lists and Sets

Description

Programming Questions on Lists and Sets

WEEK 9

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DICTIONARIES AND TUPLES

Key Topics

- Dictionaries for key-value storage, safe look-ups (get), and frequency counts
- Iterating over keys, values, items; dictionary comprehensions
- Tuples: Immutable sequences, packing/unpacking, when to use over lists

Learning Activities

Live Session

- Date:
- Programming problems using dictionaries and tuples

Graded Quiz

- Wrap up your learning with a graded quiz that counts toward your progress!

Practice Quiz

- Learn by doing: 9 practice quizzes to strengthen your foundation!

Experiential Learning

Objective

Give a hands-on experience in writing Python programs using Dictionaries and Tuples

Description

Programming Questions on Dictionaries and Tuples

WEEK 10

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ARRAYS WITH NUMPY

Key Topics

- Creating NumPy arrays and understanding their attributes (shape, dtype, strides)
- Indexing, slicing, reshaping; element-wise arithmetic and broadcasting
- Matrix operations, array-wide statistics, and efficient sorting
- Memory and speed comparison: Arrays vs. native Python lists

Learning Activities

Live Session

- Date:
- Programming problems illustrating operations over NumPy arrays
- Programmatically measure the running time of sorting a NumPy array vs. sorting a list, both using built-in functions. Choose various input sizes

Assignment

- A take-home assignment offering hands-on practice in file handling, functions, data structures, control flows, and NumPy with real-world data

Practice Quiz

- Learn by doing: 12 practice quizzes to strengthen your foundation!

Experiential Learning

Objective

Give a hands-on experience in writing Python programs using NumPy arrays

Description

Programming Questions on NumPy arrays and operations

WEEK 11

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SORTING & SEARCHING

Key Topics

- Selection Sort and Bubble Sort algorithms (logic, step-wise implementation)
- Linear Search vs. Binary Search: Prerequisites for Binary Search
- Empirical performance comparison of search techniques on NumPy arrays

Learning Activities

Live Session

- Date:
- Compare the running time of
  a) Selection Sort vs. Bubble Sort
  b) Binary vs. Linear Search on various inputs of different sizes (thousands to millions)

Practice Quiz

- Learn by doing: 8 practice quizzes to strengthen your foundation!

Experiential Learning

Objective

Give a hands-on experience in writing Python programs for sorting and searching

Description

Programming Questions on Sorting and Searching

WEEK 12

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OBJECT-ORIENTED PROGRAMMING

Key Topics

- Defining classes: Attributes, methods, constructors; lists of objects
- Inheritance, method overriding, and code re-use patterns
- Evaluating when OOP provides a clearer design than procedural code
- Guided case study: Building a multi-class solution to a larger problem

Learning Activities

Live Session

- Date:
- A Programming case study that involves inheritance and overriding, with a combination of a list of objects

Practice Quiz

- Learn by doing: 4 practice quizzes to strengthen your foundation!

Experiential Learning

Objective

Give a hands-on experience in writing Python programs using OOP Concepts

Description

Programming Questions on OOP concepts

WEEK 13

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MORE IN PYTHON

Key Topics

- Managing dependencies with venv virtual environments
- Basic data visualisation with Matplotlib (line, bar)
- Pandas DataFrames for tabular/ relational data manipulation
- Pointers to additional core and third-party libraries for continued study

Learning Activities

Live Session

- Date:
- A programming problem that shows how to read data from a CSV and load it into a dataframe, perform operations over that data like slicing and indexing, and create scatter plots and histograms over that data

Practice Quiz

- Learn by doing: 9 practice quizzes to strengthen your foundation!

Experiential Learning

Objective

Give a hands-on experience on writing Python programs using Dataframes and Plots

Description

Programming Questions related to Dataframes and Plots