

A Beginners guide to problem solving and programming in Python



Dr. Bharat Singh Deora

Mr. K. Rama Krishna

Prof. Melwin D Souza

Prof. Vaishali Gajendra Shende

A BEGINNERS GUIDE TO PROBLEM SOLVING AND PROGRAMMING IN PYTHON

FIRST EDITION

Authors

Dr. BHARAT SINGH DEORA

Mr. KALLURI RAMA KRISHNA

Prof. MELWIN D SOUZA

Prof. VAISHALI GAJENDRA SHENDE



(SCIENTIFIC INTERNATIONAL PUBLISHING HOUSE)

**BOOK TITLE: A BEGINNERS GUIDE TO PROBLEM SOLVING
AND PROGRAMMING IN PYTHON**

Edition: First - 2022

Copyrights © Authors

No part of this text book may be reproduced or transmitted in any form by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without permission in writing from the copyright owners.

Disclaimer

The authors are solely responsible for the contents published in this text book. The publishers or editors do not take any responsibility for the same in any manner. Errors, if any, are purely unintentional and readers are requested to communicate such errors to the editors or publishers to avoid discrepancies in future.

ISBN: 978-93-5625-307-0

MRP: Rs. 550/-

PUBLISHER & PRINTER: Scientific International Publishing House

Website: www.sipinternationalpublishers.com

PREFACE

This book is designed for use in courses on A beginners Guide to problem solving and programming in Python at the undergraduate/postgraduate level, particularly designed for the structured curriculum of Bachelor of Technology and Bachelor of Engineering – Computer science & Engineering

Although the contents of the book follows the essential content of complete concepts of A beginners Guide to problem solving and programming in Python is sufficiently broad in scope and rigorous in coverage to satisfy any undergraduate and postgraduate requirements in the field of IT/CSE.

The book is organized into five sections:

Chapter 1, describes about the computational strategies, Problem solving techniques, notations of an algorithm ie., Pseudocode, Flowchart, basics of python programming which covers the variables, identifiers, arithmetic operator, values & type, python statement, operator, operator precedence, expressions & statements, functions etc.,

Chapter 2, covers the data types in python, list, characteristics, string, python dictionary, modules, packages, libraries etc.,

Chapter 3, delivers the file handling & exception handling, data files in python, file operation, file methods & python exception handling etc.,

Chapter 4, covers about the python modules, listing of modules, variables in a modules, modules loading & execution, frameworks in python etc.,

Chapter 5, includes the object oriented programming in python, OOPS concept, class, inheritance, polymorphism, encapsulation, overriding methods, constructor and abstraction in python, along with some illustration programs etc.,

The analyses and discussion, covering these five sections in the various chapters of this book, are based on the readings recommended for this course. However, wherever required, we have supplemented from other sources reference. A select bibliography is given at the end of the book for reference to the authors cited in the text

I hope this thoroughly book on A beginners Guide to problem solving and programming in Python will prove handy and useful to students and teachers on the same.

Acknowledgment

First and foremost, praises to God, the Almighty, for his immense shower of blessing and kindness throughout the work and has allowed us to finish successfully.

We are sincerely grateful to our Institution Management, Director, Principal, Faculties, Students, and all our family members for providing continuous support and motivation during the work.

We would also like to take the opportunity to express our special thanks of gratitude to the publisher for providing a golden chance by giving us the most awaited platform to showcase our novel work.

Any attempt at any level can't be satisfactorily completed without our students' collaborative effort, resulting in our Book being unique

TABLE OF CONTENTS

Chapter No.	Contents	Page No.
1	BASICS OF PYTHON	01
	1.1 Introduction	01
	1.2 Problem Solving Techniques	02
	1.3 Notations of an algorithm	07
	1.3.1 Pseudocode	07
	1.3.2 Flowchart	09
	1.3.3 Limits of problem solving	11
	1.4 Beginning with python programming	12
	1.5 Python Interpreter and Interactive Mode	14
	1.6 Python Variables and Identifiers	16
	1.7 Values and Type	18
	1.8 Operators	20
	1.8.1 Arithmetic Operators	20
	1.8.2 Relational Operators	24
	1.8.3 Bitwise Operators	28
	1.8.4 Assignment Operators	29
	1.8.5 Bitwise AND and Assignment Operator	35
	1.8.6 Identity Operators	38
	1.8.7 Membership Operators	39
	1.9 Operator precedence	39
	1.10 Expressions and Statements	41
	1.15 Conditionals	41
	1.11.1 If Statement	42
	1.11.2 If Else Statement	42

1.11.3	elif Statements	43
1.11.4	Nested if-else Statements	44
1.12	Loop Structures	44
1.12.1	While Loop	45
1.12.2	For in Loop	46
1.12.3	Iterating by Index of Sequence	47
1.12.4	Else statement with for loops	47
1.13	Loop Control Statements	49
1.13.1	Continue Statement	49
1.13.2	Break Statement	49
1.13.3	Pass Statement	50
1.14	Functions	50
1.14.1	Types of function	50
1.14.2	Arguments of a Function	51
1.14.3	Types of Arguments	52
1.14.4	Keyword arguments	52
1.14.5	Variable Length arguments	53
1.14.6	Docstring	53
1.14.7	Return Statement	54
1.14.8	Python function within functions	56
1.15	Scope of Variables	57
1.15.1	Scope Rules in Functions	58
1.16	Recursion Function	62
	Sample Problems	68
2	DATA TYPES IN PYTHON	75
2.1	Introduction	75
2.2	Python List	77
2.2.1	Characteristics of Lists	78

2.2.2 List Indexing and Splitting	79
2.2.3 An updating List Values	81
2.2.4 Python List Operations	82
2.2.5 Delete List Elements	82
2.3 Python Tuple	83
2.3.1 Accessing value in tuple	83
2.3.2 Updating Tuples	83
2.3.3 Deleting Tuples	84
2.3.4 Basic Tuples Operation	84
2.4 Python's set	86
2.4.1 Unordered Set	86
2.4.2 Set Items in data type	87
2.4.3 The Set Constructor	88
2.5 Strings in Python	88
2.5.1 Creating a String	89
2.5.2 Strings indexing and splitting	89
2.5.3 Reassigning Strings	92
2.5.4 Deleting and Updating the String	92
2.5.5 Deleting the String	92
2.6 Python Dictionary	94
2.6.1 Creating the dictionary	94
2.6.2 Adding elements to a dictionary	96
2.6.3 Deleting elements using del keyword	97
2.7 Python Modules	99
2.7.1 Renaming a Module	100
2.7.2 Using dir () function	101
2.8 Packages in Python	101
2.9 Libraries in Python	107
2.10 Python Standard Libraries	108

	2.11 Use of Libraries in Python Program	109
3	FILE HANDLING AND EXCEPTION HANDLING	113
	3.1 Python File Handling	113
	3.2 Data Files in Python	113
	3.3 File Operation	114
	3.3.1 To Opening a File	114
	3.3.2 Close () Method	116
	3.3.3 Reading File	117
	3.3.4 Writing File	123
	3.4 Python File Methods	124
	3.5 Python Exception Handling	125
	3.6 Exceptions	126
	3.7 Types of Exception Handling	127
	3.7.1 Try and Except Statement	127
	3.7.2 Catching Statement Exception	128
	3.7.3 Finally Keyword in Python	130
	3.8 Declaring Multiple Exceptions	134
	3.9 Random Methods	140
	3.10 File Handling Functions	142
4	INTRODUCTION TO PYTHON MODULES	149
	4.1 Introduction	149
	4.2 Mechanism of Python Modules	150
	4.3 Listing of Modules	150
	4.4 Variable in a Module	151
	4.5 Module Loading and Execution	152

4.6 Python Libraries for data processing and Modeling	154
4.7 Python Standard Library	155
4.8 List of Python Libraries	156
4.8.1 TensorFlow	156
4.8.2 Scikit-Learn	158
4.8.3 Numpy	159
4.8.4 Keras	159
4.8.5 PyTorch	160
4.8.6 Pandas	162
4.8.7 Matplotlib	162
4.8.8 Plotly	163
4.8.9 SciPy	163
4.8.10 Seaborn	163
4.8.11 Ggplot	164
4.9 Frameworks in Python	164
4.10 List Of Frameworks	167
4.10.1 Django	168
4.10.2 Flask	169
4.10.3 Bottle	170
4.10.4 CherryPy	171
4.10.5 Alohttp	172
4.10.6 Dash	172
4.10.7 Falcon	173
4.10.8 Giotto	174
4.10.9 Growler	174
4.10.10 Uvloop	175
4.10.11 Sanic	176
4.10.12 MorePath	176
4.10.13 PicNic	177

	4.10.14 Pylons	177
	4.10.15 Pyramid	178
	4.10.16 Turbogears	178
	4.10.17 Web2py	179
	4.10.18 Hug	180
	4.10.19 Cubic Web	181
5	OBJECT ORIENTED	183
	PROGRAMMING IN PYTHON	
	5.1 Introduction	183
	5.2 OOP Concept	183
	5.3 Class and its Methods	184
	5.4 Inheritance	194
	5.5 Encapsulation	203
	5.6 Polymorphism	208
	5.7 Python Constructor	213
	5.9 Abstraction in Python	220
	ILLUSTRATION PROGRAMS	231

CHAPTER 1

ALGORITHMIC PROBLEM SOLVING

1.1 INTRODUCTION

Problem solving is the systematic approach to define the problem and creating number of solutions. The problem solving process starts with the problem specifications and ends with a correct program. Python is a high-level object-oriented programming language that was created by Guido van Rossum. It was designed with an emphasis on code readability, and its syntax allows programmers to express their concepts in fewer lines of code. Python is a programming language that lets you work quickly and integrate systems more efficiently. It is also called general-purpose programming language as it is used in almost every domain mentioned below:

- Web Development
- Software Development
- Game Development
- AI & ML
- Data Analytics

Two kinds of applications that process high-level languages into low-level languages

- Interpreters
- Compilers

An interpreter reads a high-level program line by line and executes it. A compiler reads the program as a whole and translates it into a low-level program, which can then be run.

Few points about Python Programming Language

1. Python is the most widely used multi-purpose, high-level programming language.
2. Python allows programming in Object-Oriented and Procedural paradigms.
3. Python programs generally are smaller than other programming languages like Java. Programmers have to type relatively less and indentation requirement of the language, makes them readable all the time.
4. Python language is being used by almost all tech-giant companies like – Google, Amazon, Facebook, Instagram, Dropbox, Uber... etc.

5. The biggest strength of Python is huge collection of standard library which can be used for the following: Machine Learning GUI Applications (like Kivy, Tkinter, PyQt etc.) Web frameworks like Django (used by YouTube, Instagram, Dropbox) Image processing (like OpenCV, Pillow), Web scraping (like Scrapy, BeautifulSoup, Selenium) , Test frameworks, Multimedia, Scientific computing, Text processing and many more..

1.2 PROBLEM SOLVING TECHNIQUES

The process of computational problem solving involves understanding the problem, designing a solution, and writing the solution (code). In other words, Computational thinking is an approach to solving problems using concepts and ideas from computer science, and expressing solutions to those problems so that they can be run on a computer.

Problem-solving technique includes four elements:

1. Algorithms.
2. Flowcharts.
3. Pseudocodes.
4. Programs

Algorithms

It is defined as a sequence of instructions that describe a method for solving a problem. In other words it is a step by step procedure for solving a problem

- Should be written in simple English
- Each and every instruction should be precise and unambiguous.
- Instructions in an algorithm should not be repeated infinitely.
- Algorithm should conclude after a finite number of steps.
- Should have an end point
- Derived results should be obtained only after the algorithm terminates.