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Python Programming

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*This book is dedicated to my Grandmother and Father-in-Law,
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for their eternal inspiration for writing this book.*

Dr. S. Sridhar

*This book is dedicated to my Mother, Father, Husband, and Sister,
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Dr. J. Gitanjali.
I fervently hope that this book will repay the perpetual debt I owe.*

Dr. J. Indumathi

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me about life.*

Mr. V. M. Hariharan

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PREFACE

In the 20th Century, One of the most game-changing technological advancements was the invention of personal computers. Everyone uses computers for a variety of activities like sending and receiving emails, games, online chats, and accessing government records online. Basic knowledge is required to operate computers even for those who are not exposed to the usage of computers. The development of such proficiency is necessary for everyone in the present society.

Computer Science and Information Technology students are expected to go further to develop software applications by satisfying the increasing demands of society, schools, colleges, and universities. As a direct consequence, the programming profession is in great demand. It is predicted that the students will need to have an in-depth understanding of the fundamentals of programming to have a successful professional career in IT industry. Python is an open-source programming language that emerges as a popular choice among students for its ease of learning and simplicity.

The knowledge of Python along with problem-solving skills are rated as the greatest requirements of any modern IT Industry. This book is an attempt to provide Python programming knowledge and problem-solving skills.

About the Book

The book Python Programming is designed to be a textbook for undergraduate and postgraduate students. The book aims to provide knowledge of Python programming. The book begins with the basics of Python Programming followed by the basics of algorithms and further focuses on topics like Introduction to programming language, looping, functions, and data structures like lists, tuples, sets, dictionary, and strings. It covers functional programming concepts such as higher-order functions. It also covers Object Oriented Programming concepts such as inheritance and polymorphism. The book also deals with modules and packages, errors and exceptions, Python Testing, Profiling, Debugging, and File Handling. The book then focuses on GUI Programming. An introduction to data analytics, databases, network programming, and security is provided in this book.

The book is also helpful for diploma courses, school curricula, competitive examinations like GATE, coding interviews, and coding competitions. The industry can use this book for importing training and certificate courses. This book is also ideal for self-study who wishes to make a career in the IT field.

Features of this Book

This book will help the reader navigate Python, whether a beginner or an experienced coder. This book will help the reader to maximize Python's power, versatility, and general-purpose nature as a programming language.

- This book explains python in a light and approachable manner and does not require much background knowledge.
- Complete syllabus coverage of most Indian Universities
- Special focus on Computational Thinking, algorithm writing, algorithm analysis, and Data structures such as lists, tuples, sets, dictionaries, strings, stacks, and queues.
- Functional Oriented Programming - List Comprehension, Iterator, Generators, higher-order functions, functional decorators, Object Oriented Programming, Meta Class
- Focus on python packages: os, sys, sympy, math, pycompile, pickle, tkinter, turtle, cython.
- Special Focus on Python tools: doctest, pytest, unittest, cProfile, timeit, Pdb, Numpy, Pandas, Matplotlib and Scikit-learn, Sqlite, beautifulsoup.
- Focus on Concepts such as Context Manager, Multi-threading, Socket programming, cryptography, ethics of programming, and web scrappers.
- Special topics like Python Debugging, Testing, Profiling, Databases like SQLite, Network, and Optimization techniques
- Provide real-world examples as case studies online.
- Helps by providing Summary, Glossary, Try-out questions, Programming Questions, and Multiple-choice questions.
- Rich pedagogy techniques like crossword, and jumbled words to reinforce the concepts.
- Instructor manual, and PowerPoint Presentations to assist Instructors.

Organisation of the Book

This book, there are twenty-two chapters.

Chapter 1 titled “Introduction to Programming” introduces the basic concepts of programming. The reader is taken on a journey through the fundamentals of Python as well as the terminologies that are associated with Python.

Chapter 2 titled “Problem Solving and Algorithms” introduces the basics of computational skills that are necessary for solving problems. This chapter places a strong emphasis on the importance of algorithms. This chapter deals with algorithm writing, flowcharts, algorithm analysis, and asymptotic notations.

Chapter 3 titled “Introduction to Python,” sheds light on the basics of programming in Python, data types, and how to manipulate them with different operators.

Chapter 4 titled “Decision Structures” provides insights into how to take decisions. if statements, if-else statements, if-elif statements, and nested-if statements are dealt in this chapter.

Chapter 5 titled “Looping Statements” deals with elaboration on how the computer can assist repetition using programming constructs like while, for, and nested loops. In this chapter, statements like break, continue, and pass statements are discussed.

Chapter 6 is on functions. The chapter illustrates how a function should be constructed.

Chapter 7 illustrates the list data structure. The chapter focuses on list creation, list processing, list functions, and methods.

Chapter 8 illustrates the tuple data structure. This chapter focuses on tuple creation, tuple processing, tuple function, and methods.

Chapter 9 titled, “Sets and Dictionary” provides the reader with an introduction to the unordered collection of items as well as their respective implementations. This chapter introduces sets, set operations, and set methods. This chapter also focuses on dictionary operations.

Chapter 10 is about strings. This chapter focuses on the storage and manipulation of strings. The chapter also focuses on string functions and methods.

Chapter 11 titled, “Advanced functions”, introduces the functional programming paradigm. It takes the basics of chapter 6 and illustrates the advanced function concepts like higher-order functions like map, filter, and reduce. This chapter also introduces recursion and function decorators.

Chapter 12 titled, “Object Oriented Programming”, explains the fundamentals of object-oriented programming (OOP), including class, objects, attributes, and methods.

Chapter 13 titled, “Inheritance” focuses on the intricacies of working with inheritance in Python. This chapter deals with the fundamentals of inheritance, different forms of inheritance, and the significance of UML in object-oriented programming.

Chapter 14 titled, “Advanced class” introduces concepts like overloading, overriding, static methods, and class methods, as well as abstract base class (ABC) and metaclass.

Chapter 15 titled, “Modules in python” focus on modules and packages. The construction of large Python programs using modules and packages is explained in this chapter. Also, this chapter focuses on built-in packages like sys, os, sympy and py_compile.

Chapter 16 titled, “Errors and Exceptions” explains errors and error handling using try-except, try-except-else statements. Multiple exceptions and user-defined exceptions are discussed in this chapter.

Chapter 17 titled “Debugging and Testing” focuses on Python tools like Pdb which is helpful in debugging programs. The chapter also deals with Python testing tools like docTest, Unittest, and Pytest. The chapter ends with profiler tools like cProfile.

Chapter 18 is about File handling. This chapter provides a general overview of files and file handling. This chapter also assists in recognizing the differences between the processing of text, Excel, and binary files using Pickle.

Chapter 19 titled “Introduction to GUI”, covers not only the graphic user interface (GUI), but also the process of designing a GUI in Python, in addition to a wide range of graphical user interface components known as widgets.

Chapter 20 titled, “Introduction to data analytics with python”, introduces data analytics. This chapter provides an overview of the fundamentals of data science. Python tools like NumPy, Pandas, Matplotlib, and Scikit-Learn are explained in this chapter.

Chapter 21 titled, “Database and Parallel programming”, focuses on the concepts behind the database. CRUD operations of SQLite are discussed in this chapter. The chapter provides a working knowledge of asynchronous programming, threads, their interactions, and multiprocessing functionality.

Chapter 22 titled, “Networks and Security” introduces networks and security. It also provides an overview of networking and socket, the process of web scraping, and finally, the cryptographic algorithms are presented.

Appendix 1 provides information about the Installation of Python, Path, Directory, and File Handling commands. Appendix 2 deals with the Installation of an Anaconda Edition. Appendix 3 offers Third-party Python Packages, Virtual Environment, and pip commands. Appendix 4 provides information about the Python package Turtle and finally Appendix 5 deals with the Optimization, Speed Gains in Python, and Cython and annotations.

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Dr. J. Indumathi, a polymath, has taught and researched for over 33 years.

At present, she is serving as a Professor in the Department of Information Science and Technology at Anna University, Guindy campus, Chennai. ISMS (Information Security Management System) Lead Auditor, Project Management Professional (PMP), Privacy Lead Assessor, Information Privacy Manager, Information Privacy Professional/Europe, Network Defense Architect (CNDA), and Test Manager, are a few of her value-added credentials. She is a Fellow of bodies like the Institution of Engineers (I.E), I.E.T.E, etc., including life member of professional organizations, such as the IEEE, ACM, CSI, High Tech Crime Investigation Association, ISSA, IAAP. She serves as an expert in international technical committees, editorial advisory boards, and review boards.



Apart from routine academic work, she has conducted many continuing technical edification programmes. She has given technical invited talks, plenary talks, keynotes, and chaired conference sessions worldwide; besides the talks on television/radio like EduSat Anna University, Doordarshan, and All India Radio. She has undertaken and accomplished efficaciously, several project consultancy services and her pooled rich experience has set up an imperturbable empire; providing Consultancy services to various categories of organizations such as Government, Industry, Academic, Public Welfare, Police, and Judiciary. Owing to her noteworthy, illustrious, Consultancy works, she was honored with an Active Consultant Award, in addition to other 78 awards. She has guided several M. Tech projects, B.E/B.Tech projects successfully and guided research scholars for their Ph.D. In toting

up to the above she served several other positions till 2018 which includes, the First Lady Secretary for Tamil Nadu Engineering Admissions/ Tamil Nadu Common Admissions.

Dr. J. Indumathi has half a dozen granted patents and over 156 scientific papers in reputable journals. Her expertise spans diverse cutting-edge technologies. Being a privacy researcher and activist, she works at the intersection of Technology, Law, and Policy. She has a zeal for investigation, and research and has innovated and improvised expansive projects which have made a milestone in the perfection of the lifestyle of humankind.



Mr. V.M. Hariharan is presently CEO of Vels Infoway, an MSME-based IT company. He has worked across 34 international IT projects. He also has 4 years of teaching experience as part of TechZ Academy. He is presently working on a skill development project which provides an e-platform for students and academicians to learn professional skills. His expertise includes topics like Data Analytics, Machine Learning, Deep Learning, and DevOps.