Learn C Programming from Scratch

A step-by-step methodology with problem solving approach

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Dedicated to

In recognition of your unwavering support, boundless encouragement, and enduring belief in my dreams, this book on C programming is dedicated to the pillars of my life – my beloved parents and cherished family members. Your love and guidance have been the foundation upon which I've built my journey in the world of programming.

With heartfelt gratitude and endless love,

Mohammad Saleem Mir

About the Author

Mohammad Saleem Mir is currently working as Senior Assistant Professor at Higher Education Department, J&K, India. He has more than 15 years of teaching experience. During the course of his journey as a Teacher, he has taught at Post graduate as well as under-graduate levels. He has taught in general all the subjects associated to computer Sciences but took lead when it came to guiding students through Programming subjects, with the aim of building strong analytical skills and inculcate logical and reasoning skills into the students. The author holds bachelor's degree in Sciences, Master's Degree in Computer Applications/ Sciences from Kashmir University besides being a Doctorate student. He is currently pursuing Ph. D in the fields of Machine Learning/ Artificial Intelligence/ Medical Sciences. He has published a number of research papers in national as well as international Journals, besides presenting his research in various conference. The author has delivered inspirational talks in various conferences/ Refresher courses and various Training Programmes conducted by various Universities and colleges. The author remains actively involved in technical seminars and workshops.

About the Reviewer

Srividya Richard, Sri is a passionate and a dedicated educator with a Masters of Engineering in Computer Science from Anna University. She considers herself as a self-confident and an enthusiastic person with a flair to logically conclude any given task with complete precision and accuracy. She is extremely goal oriented and an excellent team player.

She has a decade long experience in teaching Engineering graduates at a reputed institution. Her research interests lie in the area of Machine learning, Data Analytics, Artificial Intelligence. She has published many research articles in her areas of interests in refereed journals and conferences. Sri's love for technology and the English language has contributed immensely in reviewing and proofreading several articles that ranges from research thesis to books. During her academic career, Sri had the opportunity to mentor and execute several real time IT projects. She has also conducted various trainings and workshops and served as a committee member in organizing conferences and research seminars. The exposure to interdisciplinary projects and industry interactions has had a significant impact in honing her skills.

As an AI enthusiast, Sri is delighted to embark on the path of equipping professionals with AI skills. She looks forward to leveraging the expertise gained over the years to empower individuals for both personal and professional development.

Acknowledgement

This book is my first experience to pen down something for my esteemed readers. I sincerely hope they would appreciate it and let me know an honest review of the book. I would like to acknowledge with gratitude, the support and love of my family. They all kept me going, and conceiving this book would not have been possible without their support and encouragement.

I am also grateful to BPB Publications for their guidance and expertise in bringing this book to fruition. It was a long journey of revising this book, with valuable participation and collaboration of reviewers, technical experts, and editors.

Finally, I would like to thank all the readers who have taken an interest in my book and for their support in making it a reality. Your encouragement has been invaluable.

Preface

I feel grateful to share my knowledge, analyses, and conclusions to raise the level of curiosity with regards to programming among the students of computer sciences, at the end of the day, we all will be beneficiaries. When one chooses computer sciences as a career, it may be noted that programing is an indispensable part of computer sciences and one cannot be a good computer scientist unless (s)he is good (if not exceptional) programmer. Well begun is half done, as they famously say; beginning on a good note, knowing fundamentals of programming clearly and building a solid base as far taking up more advanced form of programming, later in your career, is concerned is important. For this very, reason, this book focuses on giving an insight into the fundamentals of programming beforehand, and a sincere effort has been made to cover major concepts in detail so that the readers are kept interested.

C is a foundational programming language and ought to be learned systematically. Getting measure of the features of C programming is very important. This book covers all the fundamental concepts, rest assured the readers would have a great time going through the book contents and would benefit from this book. The book is written in unpretentious manner. The target audience being programming beginners, who would be able to understand the concepts explained in the book quite easily. Each concept in the book is synchronously supplemented by coding examples to enhance clarity. The book has the following 10 chapters:

Chapter 1: Programming Methodology – In this Introduces you to the world of Programming Methodology, Problem Solving, Program Design etc.

Chapter 2: C Programming Fundamentals – This chapter would acquaint you to the basic structure of the C Programming language, coding environment, and the syntax and references to write C Programs.

Chapter 3: Control Statements – This chapter throws light on various control statements used in C programming.

Chapter 4: Functions – This chapter gives an account of perhaps the most important topic in programming languages that is, functions.

Chapter 5: Arrays – In this chapter, we will introduce arrays, multi-dimensional arrays, strings and more how we can work with them.

Chapter 6: Pointers – In this chapter, we will learn about pointers, a concept that is found difficult by the programming novices, but not anymore.

Chapter 7: Structures and Unions – In this chapter, we will learn to work with user defined data types like Structures and Unions.

Chapter 8 File Handling – In this chapter, we will learn about how to work with hard disk files and different associated operations with programming examples.

Chapter 9: C Preprocessors – In this chapter we will learn how to define and use Preprocessors in C and their importance.

Chapter 10: C Graphics – In this chapter we will see the other side of the C Output, first one being the Text mode. Graphics programming in C used to drawing various geometrical shapes using inbuilt C functions.

Code Bundle and Coloured Images

Please follow the link to download the
Code Bundle and the ***Coloured Images*** of the book:

https://rebrand.ly/9m5lv1u

The code bundle for the book is also hosted on GitHub at
https://github.com/bpbpublications/Learn-C-Programming-from-Scratch.
In case there's an update to the code, it will be updated on the existing GitHub repository.

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Chapter 1
Programming Methodology

Introduction

In this chapter, we will explore the fascinating world of computers and computing, gaining a comprehensive understanding of their principles and capabilities. Our primary focus will be on programming as we delve into various programming styles and methodologies. We will also explore the inner workings of computer systems, understanding their components and how they function together. Along the way, we will develop a strong foundation in algorithms, learning how to design and implement them effectively. To aid our understanding, we will utilize flowcharts as visual tools for representing and analyzing algorithms. By the end of this chapter, you will possess a deep knowledge of programming principles, problem-solving techniques, and the powerful role that computers play in solving real-world challenges. Let us embark on this exciting journey of exploration and discovery.

Structure

The chapter discusses the following topics:

- Programming methodology
- Computer as a problem-solving tool
- Computers and computing

- Computer system
- Programming styles
- Algorithms
- Flowcharts

Objectives

The objective of this chapter is to provide a comprehensive understanding of programming methodology, emphasizing the use of computers as problem-solving tools. It explores the concepts of computers and computing, delves into the components and functioning of computer systems, and explores various programming styles. The chapter aims to develop a solid foundation in algorithms, their design, and implementation. Additionally, it covers the use of flowcharts as visual tools for algorithm representation and analysis. By the end of the chapter, readers will have gained a deep knowledge of programming principles, problem-solving techniques, and effective use of computers in solving real-world challenges.

Programming methodology

Programming methodology refers to the systematic approach and techniques used in software development. It provides a framework for software engineers to follow while designing, coding, testing, and maintaining software applications.

A computer program is a set of related commands or instructions to solve a given computer problem. Programming is the process of conceptualizing and subsequently writing a computer program that is executed to produce the desired result. Programming involves conceptualizing and writing a program, compiling the program, executing the program, and debugging the program. A computer program aims to solve real-life problems ranging from simple to more complex ones. Programming methodology is the method to analyze real-life complex problems, provide software solutions, and control the associated activities of the software development process. Some popular programming methodologies include:

- **Waterfall methodology**: This is a sequential software development model that follows a set of steps in a linear fashion, each step building upon the previous one.
- **Agile methodology**: This iterative approach to software development emphasizes collaboration between developers and stakeholders, flexible planning, and adaptive delivery.
- **Scrum methodology**: This agile methodology is designed specifically for software development projects. It focuses on iterative, incremental delivery of working software, emphasizing teamwork, flexibility, and continuous improvement.

- **DevOps methodology**: This software development approach emphasizes collaboration between development and operations teams to ensure that applications are delivered quickly, reliably, and securely.

Each of these methodologies has its own advantages and disadvantages, and the choice of methodology depends on the specific needs and constraints of the software development project. The choice of the most appropriate methodology helps the software development team deliver a high-quality product that meets the needs of its users.

Problem-solving methodology and techniques

Computer problem-solving methodology is a systematic approach to identify, analyze, and resolve computer-related issues.

The steps involved in this methodology are:

1. **Define the problem**: Identify the issue and gather information about it, including error messages, symptoms, and the context in which the problem occurred.
2. **Analyze the problem:** Use critical thinking and troubleshooting techniques to understand the root cause of the issue.
3. **Formulate a hypothesis**: Develop a potential solution based on the information gathered in the previous step.
4. **Test the hypothesis**: Implement the proposed solution and check if it resolves the problem.
5. **Evaluate the results**: If the solution worked, document it and move on to the next problem. If it did not work, go back to *Step 3* and formulate a new hypothesis.
6. **Implement a permanent solution**: If a solution is found, implement it permanently to prevent future problems.
7. **Document the solution**: Document the solution, including the steps taken, the outcome, and any lessons learned, to help with future troubleshooting.

By following this methodology, computer problems can be solved efficiently and effectively.

Writing a good program is an expertise; hence, it needs to follow certain practices:

- **Meaningful names for identifiers**: Writing understandable, legible, and maintainable code in programming requires giving identifiers (such as variables, functions, classes, and more) meaningful names. Here are some suggestions for selecting identifiers with meaningful names:
    - **Assigning identifiers meaningful names:** We should assign identifiers meaningful names that appropriately reflect their function and intended use. Use descriptive names like **`num_students`** or **`current_date`** instead of ambiguous or general ones like **`x`** or **`temp`**.

- **Consistency in naming**: We should maintain consistency by using the same naming patterns across our source code.
- **Steer clear of acronyms**: They might make your code more difficult to read and comprehend. If an acronym is not well-known and frequently used in your programming community, do not use it.
- **Name classes and objects with nouns**: Classes and objects should be named with nouns since they reflect actual objects. For instance, `Student` should be the class name for a class representing a student.
- **Name functions and methods using verbs**: Verbs describe activities that may be taken; hence, they should be used to name functions and methods. For instance, the function `Sum` should compute the sum of two values.
- **Clarity of expression:** Expression represents a specified operation. Hence, they need to be clearly understood and depicted with no concession on clarity of expression.
- **Comments and indentations:** Comments are used for documentation purposes in a program. Comments (denoted by `//` for a single line comment) tend to guide a programmer through debugging; indentation is the ideal technique for writing a program in such a way that helps to understand the flow of a program.
- **Use of blank lines or blank spaces:** Blank lines are used to separate blocks of code that are long. The standard for the use of spaces in programming languages matches what we follow in normal English rules, meaning that symbols in C, like `=`, `+`, and more, should precede and follow with at least one space.
- **Depiction of statements**: Statements represent meaningful commands through which we perform operations in C. They should be put on separate lines. In case of a block of statements (explained later), which is denoted by `{`and`}`, the opening brace, `{`should appear on the line after the block-level statement, and the closing brace`}`, should appear after the last statement of the block-level statement. A block of statements is indented with relation to the braces.

Features of a good program

A good computer program should have the following features:

- **Usability**: The program should be easy to use and understand, with a clear and intuitive user interface.
- **Reliability**: The program should function as expected and not cause unintended consequences or errors.

- **Performance**: The program should be fast and responsive without significant lag or delay.
- **Scalability**: The program should be able to handle increasing demands and data processing requirements as the user base grows.
- **Security**: The program should have robust security measures to protect against hacking, data breaches, and other security threats.
- **Flexibility**: The program should allow users to customize and modify their settings and preferences to fit their needs.
- **Compatibility**: The program should work seamlessly with other software and hardware components without compatibility issues.
- **Support**: The program should have adequate documentation, training, and technical support to help users resolve any issues.

By having these features, a good computer program will provide a positive user experience, increase productivity, and provide long-term value to its users.

Reasons for using a structured, systematic approach to problem-solving:

- To ensure consistency
- To make everyone aware of how others are approaching the project.
- To keep the procedure objective and resistant to personal prejudices and impressions.
- To facilitate group decision-making
- To help a group follow the model rather than using different ways all at once by focusing on the six phases in the problem-solving model, which also helps define the agenda. A group can more easily agree by employing a process and facts to guide their judgments.
- To successfully resolve issues.

Computer as a problem-solving tool

Computers are information processing devices that transform information/data according to prescribed rules, organized in an *algorithm* implemented as a *program***.**

Algorithm: A precise, step-by-step method of doing a task in a finite amount of time.

How to use the computer as a problem-solving tool?

We need to:

- Analyze and describe the initial state and target stage of events with respect to input data.