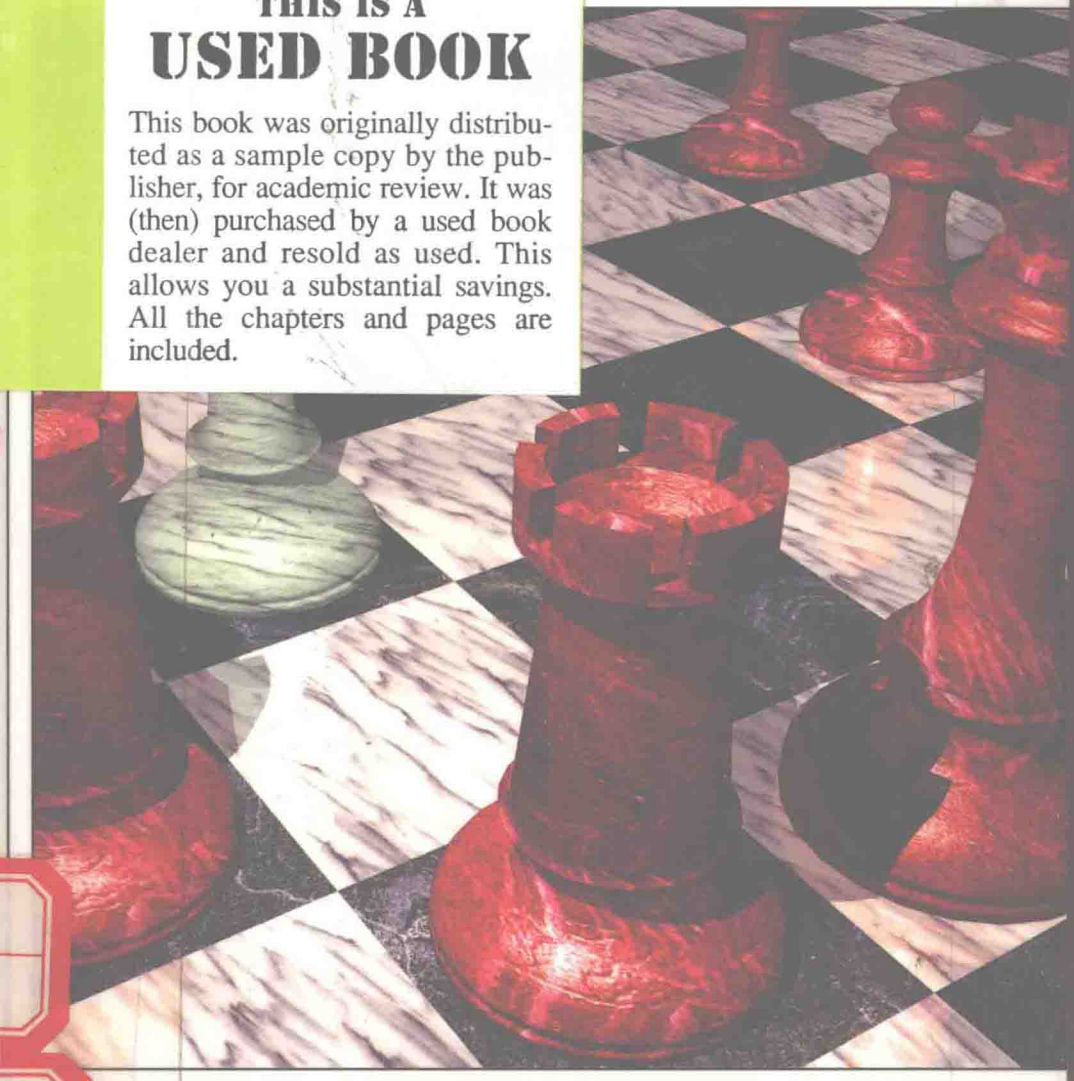
C++ FOR PASCAL PROGRAMMERS

SECOND EDITION



IRA POHL

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Second Edition

Ira Pohl

University of California, Santa Cruz

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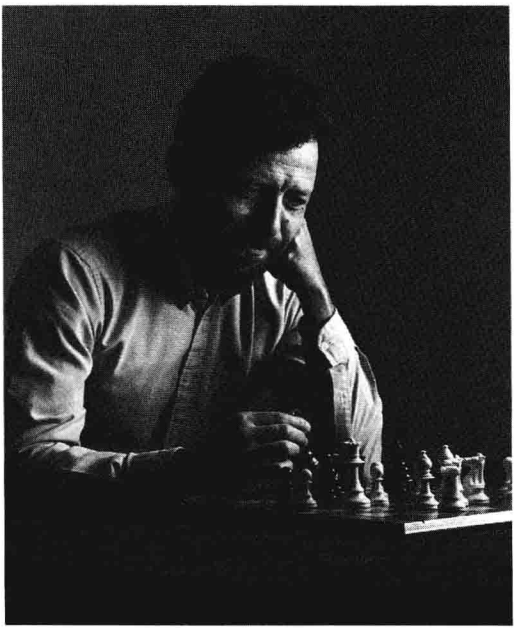
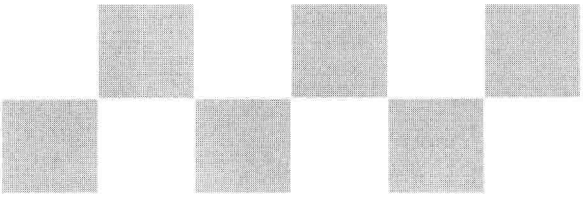


About the Author

Ira Pohl, Ph.D., is a professor of Computer and Information Sciences at the University of California, Santa Cruz. He has two decades of experience as a software methodologist and is an international authority on C and C++ programming. His teaching and research interests include artificial intelligence and programming languages. Professor Pohl has lectured extensively at UC Berkeley, the Courant Institute, Edinburgh University, Stanford, the Vrije University in Amsterdam, and Auckland University in New Zealand. He is the author of the best-selling *Object-Oriented Programming Using C++*, and *C++ for C Programmers,* Second Edition, and coauthor, with Al Kelley, of *A Book on C: Programming in C,* Second Edition; and *C By Dissection,* Second Edition. When not programming, he enjoys riding bicycles in Aptos, California, with his wife Debra and daughter Laura.



Preface

This book is intended as an introduction to programming in C++ for the programmer or student already familiar with Pascal. It uses an evolutionary teaching process with Pascal as a starting point and C++ as a destination. The book is written to allow the reader to stop and use the language facilities up to that point in the text.

Pascal is the major teaching language for beginning computer science students. Designed by Niklaus Wirth in 1970, it is a small, powerful language, popular with both the academic community and the personal computer community. Many efficient and fast compilers exist for it, which indeed was one of its design goals. Pascal lacks some key features that limit its use in the professional community, where C is the dominant language.

C++, invented at Bell Labs by Bjarne Stroustrup in the mid-1980s, is a powerful modern successor language to C. C++ adds to C the concept of **class**, a mechanism for providing user-defined types also called **abstract data types**. It supports **object-oriented** programming by these means and by providing inheritance and run-time type binding. C is the present; C++ is the future.

By carefully developing working C++ programs, using the method of **dissection**, this book presents a simple and thorough introduction to the programming process in C++. Dissection is a technique for explaining new elements in a program that the student is seeing for the first time. It highlights key points in the many examples of working code that are used to teach by example.

This book is intended for use in a first course in programming in C++. The audience is expected to know Pascal or have enough programming experience to follow this tutorial. It can be used as a supplementary text in an advanced programming course, data structures course, software methodology course, comparative language course, or other courses where the instructor wants C++ to be the language of choice. Each chapter presents a number of carefully explained programs. Many programs and functions are dissected.

All the major pieces of code were tested. A consistent and proper coding style is adopted from the beginning. The style standard used is one chosen by professionals in the C++ community.

Pascal is a language of roughly the same size and utility as C. For the Pascal programmer who wants C experience, this book could be used in conjunction with *A Book on C, Second Edition* by Al Kelley and Ira Pohl (Redwood City, California: Benjamin/Cummings, 1990). As a package, the two books offer an integrated treatment of the C and C++ programming languages and their use that is unavailable elsewhere.

Each chapter contains:

Dissections. A program particularly illustrative of the chapter's themes is analyzed by dissection. Dissection is similar to a structured walk-through of the code. Its intention is to explain to the reader newly encountered programming elements and idioms.

Summary. A succinct list of points covered in the chapter are reiterated as helpful review.

Exercises. The exercises test the student's knowledge of the language. Many exercises are intended to be done interactively while reading the text. This encourages self-paced instruction by the reader. The exercises also frequently extend the reader's knowledge to an advanced area of use.

The book incorporates:

An Evolutionary Approach. The Pascal programmer is introduced to equivalent concepts in the C++ programming language. By learning how individual elements of a Pascal program translate into C++, the Pascal programmer can immediately gain a facility with the C++ programming language. Chapter 1, "An Overview of C++ and Object-Oriented Programming," provides an introduction to C++'s use as an object-oriented programming language. Chapter 2, "Native Types and Statements," shows the parallels between programming in Pascal and C++ with regard to data types, expressions, and simple statements. Chapter 3, "Functions and Pointers," continues with similarities between functions and complex data types . The middle chapters show how classes work. Classes are the basis for abstract data types and object-oriented programming. Again, the student starts from the perspective of Pascal and moves to C++. The later chapters give advanced details of the use of inheritance, templates, and exceptions. At any point in the text the programmer can stop and use the new material.

Teaching by Example. The book is a tutorial that stresses examples of working code. Right from the start the student is introduced to full

working programs. An interactive environment is assumed. Exercises are integrated with the examples to encourage experimentation. Excessive detail is avoided in explaining the larger elements of writing working code. Each chapter has several important example programs. Major elements of these programs are explained by dissection.

Data Structures in C++. The text emphasizes many of the standard data structures from computer science. Stacks, safe arrays, dynamically allocated multidimensional arrays, lists, trees, and strings are all implemented. Exercises extend the student's understanding of how to implement and use these structures. Implementation is consistent with an abstract data type approach to software.

Object-Oriented Programming. The reader is led gradually to the object-oriented style. Chapter 1, "An Overview of C++ and Object-Oriented Programming," discusses how the Pascal programmer can benefit in important ways from a switch to C++ and object-oriented programming (OOP). Object-oriented concepts are defined, and the way in which these concepts are supported by C++ is introduced. Chapter 4, "Classes," introduces classes, which are the basic mechanism for producing modular programs and implementing abstract data types. Class variables are the objects being manipulated. Chapter 7, "Inheritance," develops inheritance and virtual functions, two key elements in this paradigm. Chapter 10, "OOP Using C++," discusses OOP and the **Platonic** programming philosophy. This book develops in the programmer an appreciation of this point of view.

Turbo Pascal 7.0 Equivalence. Where appropriate, C++ code is given with equivalent Pascal code. This gives the experienced Pascal programmer immediate access to idiomatic C++ code. Wirth's Pascal has largely been superceded by commercially developed, extended Pascals that have many additional features, such as modules and OO extensions. Borland International's Turbo Pascal 7.0 has many OO features, and is among the most widely used. Where Turbo Pascal is specifically mentioned, we show equivalent code for OO features of C++.

ANSI C++ language and *iostream.h*. For an existing, widely used language, C++ continues to change at a rapid pace. This book is based on the most recent standard: the ANSI C++ Committee language documents. A succinct informal language reference is provided in Appendix D, "Language Guide." Chief additions include templates and exception handling. The examples use the *iostream.h* I/O library. This has replaced the older *stream.h* used in the first edition and *stdio.h* used in the C community. Use of the *iostream.h* library is described in Appendix E, "Input/Output."

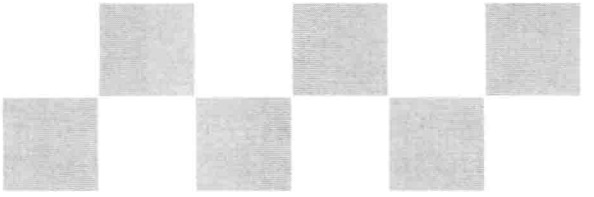
Industry- and Course-Tested. It is the basis of many on-site professional training courses given by the author, who has used its contents to train professionals and students in various forums since 1986. The various changes in the new edition are course-tested, and reflect considerable teaching and consulting experience by the author. In its first edition, the book won a UNIXWORLD commendation for the professional programmer migrating to C++.

Acknowledgments

My special thanks go to my wife, Debra Dolsberry, who encouraged me throughout this project. She acted as book designer and technical editor for this second edition. She developed appropriate formats and style sheets in FrameMaker 4.0 and guided the transition process from the first edition that was developed in troff. She also implemented and tested all major pieces of code. Her careful implementations of the code and exercises often led to important improvements. Stephen Clamage of TauMetric Corporation provided wonderfully insightful comments on language detail. Other reviewers who specifically commented on this edition were: Douglas Campbell, Brigham Young University; Blayne Mayfield, Oklahoma State University; and Henry Ruston, Polytechnic University. William Engles of the University of Wisconsin described an improved shuffling routine for the poker example.

The first edition had help, inspiration, and encouragement from, Nan Borreson, Borland International; Skona Brittain; Al Conrad; Steve Demurjian; Samuel Druker, Zortech Limited; Robert Durling; Bruce Eckel; Daniel Edelson; Gene Fisher; Robert Hansen, Lattice, Incorporated; John Hardin, Hewlett-Packard, Incorporated; Al Kelley; Jim Kempf, Sun Microsystems, Incorporated; Ellen Mickanin; Laura Pohl, Cottage Consultants; and Linda Werner. The first edition editors were Alan Apt and Mark McCormick. The second edition was developed with J. Carter Shanklin. Finally, I thank Bjarne Stroustrup for inventing such a powerful language and encouraging others to help teach it.

Ira Pohl
University of California, Santa Cruz



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