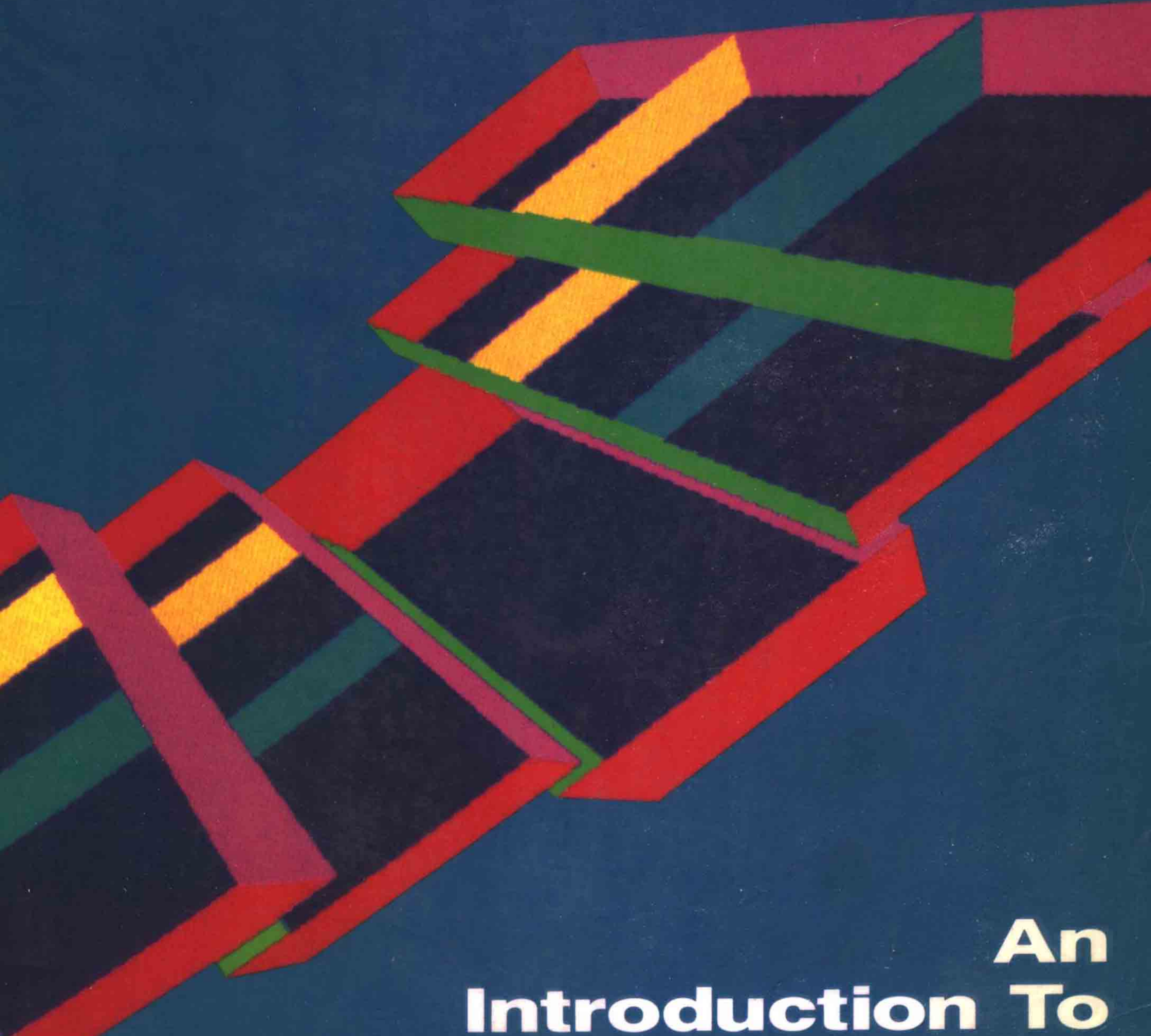
USING PASCAL



An Introduction To Computer Science I

DAVID D. RILEY

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DAVID D. RILEY

University of Wisconsin
La Crosse

BOYD & FRASER PUBLISHING COMPANY
BOSTON

PREFACE

Recent developments in computer hardware and software are driving a change in introductory computer science courses. These developments range from new computer workstations that provide a productive environment for software design to new programming languages that incorporate up-to-date facilities for software engineering. The introductory computer science course must mature along with the profession. New techniques for software development must be integrated into sound pedagogical experience.

ABOUT THIS BOOK

Using Pascal: An Introduction to Computer Science I is an examination of today's computer science fundamentals, consistent with the ACM's 1984 guidelines for a CS 1 course. This text recognizes that tomorrow's software designer will require knowledge that goes beyond mere familiarity with programming languages.

This text also reflects a philosophy that students' performance is closely related to the instructor's expectations. Student feedback, based on class testing of preliminary editions of this book, suggest that this presentation is both challenging and realistic.

Since many students entering college have some familiarity with programming in high-level languages, the organization of this text is based upon programming tools and techniques, rather than the features of some programming language. These tools include intelligent use of control structures, data structures, design, good programming style, and debugging technique.

DISTINGUISHING FEATURES

Development of Tools and Techniques

Every programmer needs a tool box. This book includes numerous tools for the developing software engineer. Among these tools are syntax diagrams, debugging techniques, assertions, procedure hierarchy charts, block structure diagrams, control flow diagrams, pseudolanguages, and numerous widely-used algorithms.

Attention to Programming Style and Design

To highlight the importance of good programming style many separate "Programming with Style" sections are sprinkled throughout the text. Each describes the **how** and the **why** of some aspect of competent program design. Issues of good algorithmic design are similarly highlighted in "Designing with Wisdom" sections appearing throughout the book.

Extensive Well-Chosen Examples

Many students learn by example. Therefore, the text includes numerous carefully selected examples, averaging over two complete programs per chapter with many other algorithms and procedures. The programs have all been compiled and executed. Each major concept is illustrated by one or more examples. Programmers often model their programs from examples drawn from texts. A concerted effort has been made to choose examples that not only support the material, but serve as good models for reference use as well.

Assertions

In this text assertions are introduced immediately and used throughout. Pre- and postconditions are included in procedures. Loop invariants are shown as a means for designing loops. Assertions are among the most important documentation and design tools currently available and represent a disciplined, precise approach to software development. Students find this approach both challenging and rewarding.

Problem Definition Form

A six-part problem definition form is used to illustrate the importance of precise and complete definitions. This form includes input specifications, output specifications, error handling, and a sample program execution. Major programming examples and programming project assignments are consistently presented in this form.

Terminology

The computer scientist needs an extensive vocabulary. Terms are boldfaced and listed at the end of every chapter. An extensive glossary at the end of the text includes the definitions of boldfaced as well as other important terms.

Exercises

Each chapter contains numerous student exercises and programming projects that form a review of the chapter. Selected answers appear in the back of the book for student review. The solutions to all unanswered exercises and projects are in the Instructor's Manual.

Class Tested

Preliminary versions of this text were successfully used in classes at the University of Wisconsin–La Crosse over two semesters. Student suggestions have resulted in important improvements in pedagogy and accuracy.

Standard Pascal

All programs have been written to conform to the ISO standard. They have also been compiled and executed using Turbo Pascal™ a product of Borland International. All changes that are necessary to conform to Turbo Pascal requirements are included as comments in the code.

Turbo Pascal

Special sections, entitled "For Turbo Users," highlight the significant features of Turbo Pascal. These sections are included throughout the text to point out differences between the ISO standard and Turbo and to present Turbo extensions to the language.

ANCILLARY MATERIALS

A comprehensive instructor's support package accompanies **Using Pascal: An Instroduction to Computer Science I**. These ancillaries are available upon request from Boyd & Fraser.

Instructor's Manual

Material in the Instructor's Manual follows the organization of the text. Chapters of the Instructor's Manual include

- Lecture Outline
- General Comments
- Chapter Goals
- Solutions to Exercises
- Programming projects solutions
- Quick Challenge Questions

Included in the Instructor's Manual is an extensive collection of 135 transparency masters. These masters include selected figures, tables, and program segments from the text.

ProTest

Boyd & Fraser's fourth generation test generating program. ProTest. has been designed specifically to accompany this text.

DATA ABSTRACTION AND STRUCTURE: AN INTRODUCTION TO COMPUTER SCIENCE II

Using Pascal: An Introduction to Computer Science I is the first of a pair of texts covering the ACM recommendations for CS 1 and CS 2. The second book, entitled **Data Abstraction and Structure: An Introduction to Computer Science II**, is also available from Boyd & Fraser. This second text explores the use of data abstraction in software design. The presentation includes abstract data types, external modules, generic data types, and object-oriented design. Numerous data structures, such as stacks, queues, sequences, strings, linked lists, and trees, are examined as strategies for implementing abstractions.

ORGANIZATION

The Programming Process

From the very first chapter programming is presented as a four-step process. Chapter 1 defines this process as

1) Problem definition
2) Algorithm design
3) Program coding
4) Program maintenance

The importance of problem definitions is emphasized in the first chapter and continually reinforced throughout the text.

An Introduction to the Complete Pascal Program

Chapter 2 focuses on data. Introductory data types are presented in terms of their domain and operations, consistent with modern forms for defining abstract data types. This chapter also presents syntax diagrams, a formalism used throughout the text to define language structures. The subset of Pascal presented within Chapter 2 is sufficient for students to write elementary programs.

Program Design Techniques

Chapter 3 is an introduction to software design. Several examples illustrate top down design using a careful stepwise refinement. This chapter also explores alternative pseudolanguages and begins the study of debugging issues that continues throughout the remainder of the book.

(Control) Structured Programming

Chapter 4 begins the examination of structured programming. The topics of sequential execution and abstraction (in the form of procedures with parameters) are presented. The focal point of this presentation is top down design using these control structures. This emphasis is continued in Chapter 5.

More Structured Programming

Chapter 5 completes the survey of control structures by examining selection (in the form of the **if** instruction) and repetition (the **while** instruction.) As in Chapter 4, this presentation concentrates on the use of these forms of control in top down design. The early presentation of the basic control structures from Chapters 4 and 5 allows ample opportunity for students to exercise their programming skills.

Logic and Programming

Programming is rooted in logic. The current trends in software engineering and new language design suggest that these roots are becoming even more important. Chapter 6 is a brief look at the direct application of logic to programming in a procedural language, such as Pascal. This chapter incorporates critical material often omitted from introductory computer science texts.

The Procedure

Chapter 7 expands upon the earlier presentation of procedures by including an extensive look at intelligent use of parameter passage and scope of variables in software design. Functions and built-in procedures are also discussed in this chapter.

Input and Output of Text Files

Chapter 8 concentrates on the topic of text I/O. This chapter examines both interactive I/O and files, using the standard procedures of Pascal.

More About Selection

Chapters 9 completes the presentation of selection control structures. This chapter looks at methods of combining **if** instructions, as well as the **case** instruction. An examination of how to choose from alternate selection structures is included.

More About Repetition

Chapter 10 covers repetition, including the **repeat** instruction. Loop invariants are presented, and a straight forward six-step procedure for using invariants to design loops is utilized.

Introduction to Data Abstraction

Chapter 11 is an introduction to data abstraction, using the **const** and **type** declarations. Subranges and enumerated types are presented.

Introduction to Structured Data: The One-Dimensional Array

The structures, algorithms and applications of one-dimensional arrays are examined in Chapter 12. Included in this presentation is the **for** instruction, buffering, searching, simple sorting, strings, and table driven code.

The Multidimensional Array

The discussion of arrays is expanded to included multidimensional structures in Chapter 13. This chapter also explores using arrays as functions and methods for debugging code with arrays.

The Record Data Structure

Chapter 14 completes this introduction to structured data by examining record structures. Significant topics of this chapter include arrays of records, sorting records, the **with** statement, and variant records.

More Programming Tools

The final chapter is a collection of five major topics: recursion, pointers and dynamic data, stacks, queues, and sets. Recursive procedures and functions are both examined. Recursion is also compared to repetition, as a form of control. The dynamic data facilities of Pascal are used to illustrate linked list structures. Linked lists implementations of stacks and queues are given.

ACKNOWLEDGEMENTS

Many people have played important roles in the development of this text including Boyd & Fraser: Boston, under the direction of President Tom Walker and the incomparable production crew in California, under the direction of Becky Herrington.

I am grateful to the following reviewers for their helpful suggestions: Gary Cutler, Peter J. Gingo, John M. Lloyd, Mike Michaelson, Allen Tucker, Terry A. Ward, John A. Wenzel, and Ron Willard. I also thank my colleagues at the University of Wisconsin-La Crosse who have contributed to this effort in countless ways.

A special acknowledgement is due to all of the people involved with the IBM University Program courses. Participation in the CSF2 and CSF3 courses shaped many of my beliefs regarding an introduction to this discipline. I thank the people who developed or maintain this educational material — Debra Baker, Tony Baxter, John Bentley, Elaine Rich, and Mary Shaw. I also thank those with whom I have taught these courses, especially Albert Baker. In addition, I must express my gratitude to Nancy Morrison who has made a significant contribution to the success of this program and who is responsible for my interest and involvement.

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