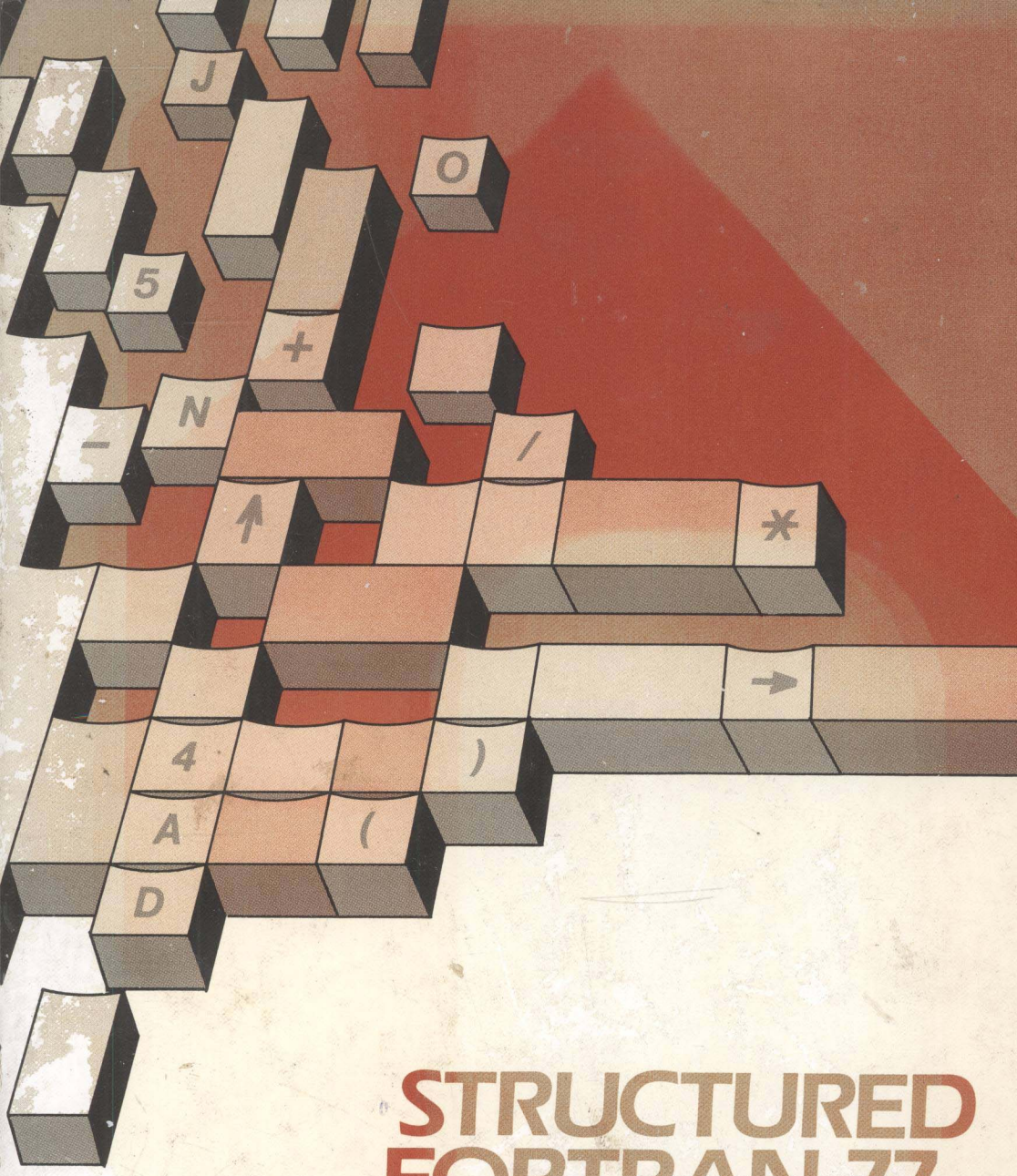

STRUCTURED FORTRAN 77 FOR ENGINEERS AND SCIENTISTS

D.M.ETTER

STRUCTURED FORTRAN 77

for Engineers and Scientists

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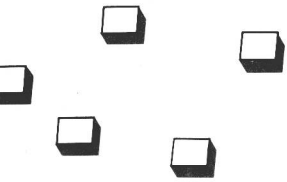

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PREFACE

The techniques, examples, and problems in this book were developed with the following objectives:

1. To acquaint students with the capabilities of computers and the types of problems that computers can solve.
2. To teach the fundamentals of FORTRAN 77 so that students can use the computer to solve problems they encounter in both academic and nonacademic environments.
3. To establish good problem-solving techniques that can be applied to any problem, whether computer-related or not.
4. To use practical, real-world engineering and science problems while accomplishing the first three objectives.

This book assumes no prior experience with computers; it therefore begins with an introductory chapter that explains many terms associated with them. This chapter also introduces the process of converting a problem solution described in English into a solution understandable by a computer. The presentation of FORTRAN statements begins with Chapter 2, using the language version established in 1977 (and thus called FORTRAN 77). By the end of Chapter 3, simple, yet complete, programs have been written.

It is recommended that the material in this book be covered sequentially, and it is reasonable to expect to cover all nine chapters in one semester or two quarters. Typically, this material is presented at the freshman level in a university curriculum, and, although calculus is not required, a knowledge of basic algebra and trigonometry is assumed.

A number of features distinguish this from other FORTRAN books:

Engineering and Science Applications Over 300 examples and problems represent a wide range of engineering and science applications. Such topics as laser mirror alignment, radioactive decay, economics of timber management, and solar energy data analysis are included. Many of the solved problems contain sample data and corresponding output from an actual computer run.

Complete FORTRAN 77 Coverage Complete coverage of FORTRAN 77 makes this not only a suitable book for the first-time computer user but also one that can be a valuable reference for the sophisticated user. In addition, only standard FORTRAN 77 statements and structures are used so that all programs and statements are compatible with FORTRAN 77 compilers.

Motivational Problems as Chapter Openers Each chapter is opened with a specific problem that cannot reasonably be solved with the FORTRAN statements presented up to that point. Hence, motivation is established to develop new elements of the language in order to solve the described problem. After the new topics are covered, the introductory problem is then solved.

Structured Programming Approach The most important new feature of FORTRAN 77 is the addition of a new control structure (IF-THEN-ELSE) that allows us to write structured programs—programs that flow smoothly from top to bottom. The importance of this top-down flow is emphasized repeatedly. All program loops are implemented as iteration loops (DO loops) or WHILE loops, thus avoiding the stray GO TO statements that defeat the objectives of structured programming.

Stepwise Refinement As we develop algorithms (the ordered steps to solve a problem), we start with a general solution and refine it until we arrive at an algorithm detailed enough to convert into FORTRAN 77. Both flowcharts and pseudocode are used to describe the algorithms.

Style/Technique Guide Each chapter after the introductory chapter contains a "Style/Technique Guide" to promote good programming habits that stress readability and simplicity. Although there are entire books devoted to programming style and technique, this topic is included in each chapter with the premise that developing good style and technique is an integral part of learning the language.

In addition to this special section at the end of each chapter, a number of examples in the text have multiple solutions, thereby exposing the student to different approaches for solving the same problem. If one of the solutions has better style or technique than the others, this is pointed out in the accompanying discussion.

Debugging Aids Each chapter after the introductory chapter also contains "Debugging Aids," a section which outlines efficient methods for locating and correcting program errors that are relevant to the programming techniques described in the chapter. With guidance from this section, the student learns consistent methods for spotting and avoiding the common errors associated with each new FORTRAN statement.

In addition to this special section at the end of each chapter, a number of examples in the text include an incorrect solution to a problem, along with the correct solution. The incorrect solution is used to highlight the more common errors, thus helping the student avoid making the same mistakes.

Large Number of End-of-Chapter Problems Over 250 problems are included for end-of-chapter review and practice. These problems vary in degree of difficulty, with the more challenging problems marked with an asterisk. Solutions to nearly half of the problems are included at the end of the text. These problems are identified by printing the problem number in color. Many of the problems include data to use when testing the programs on the computer.

Emphasis on Interactive Processing While both batch processing and time-sharing processing are discussed, emphasis is placed on time-sharing processing with interactive terminals. The use of data files is presented in Chapter 3 and included in many examples in the remainder of the book. Conversational computing is also presented in several examples and problems.

I/O Flexibility List-directed I/O is presented first, immediately followed by a complete description of formatted I/O. Instructors can have the student skip the formatted I/O sections entirely if they want to use only list-directed I/O. However, if a good understanding of formatted I/O is desired, it is important to present it early so that it can be reinforced in the remainder of the book. While I/O is formatted in the examples and problems, students using list-directed I/O need only ignore the FORMAT statements.

Use of a Second Color Few computer language books have had the opportunity to use an additional color for emphasis and clarity. Pedagogically, the use of color in emphasizing certain statements within a computer program is especially significant. Without using arrows or lines or other distracting symbols, we can clearly emphasize every use of a new statement or point out the differences in two similar program segments.

New Computer Print Characters This is one of the first computer language textbooks to use the new typeface that duplicates the dot matrix characters of computer printouts. This special typeface allows us to identify each line that represents a complete FORTRAN statement or computer output with a clarity that is not possible when merely photocopying actual computer output.

Student Aids Several features of this book were designed specifically to aid the student. Each chapter summary is followed by a list of key words from the chapter. In all, over 200 key words have been selected to assist in identifying important terms. Appendix A contains a summary of all FORTRAN 77 statements along with references to the location in the text of the initial presentation of each statement. Appendix B contains a table of all FORTRAN 77 intrinsic functions, their definitions, and their input arguments. A Glossary contains the definitions of over 100 common computer-related terms in addition to the index references.

Instructor Aids An Instructor's Supplement is available to instructors by request to the publisher. This supplement contains class notes, viewgraphs that use new examples, sample test questions and solutions, new computer projects, and complete solutions to the end-of-chapter problems.

ACKNOWLEDGMENTS

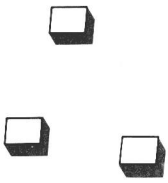
This book is the product of many semesters of teaching and incorporates many creative thoughts from my students. I would especially like to express my appreciation to Barbara Johnston, Jim Krone, Donna O'Shay, Bernie Clifford, Richard Owen, and Rick Nichols for their contributions. I would also like to thank the following reviewers who provided helpful suggestions: Ronald Danielson, University of Santa Clara; William Holley, Oregon State University; John Goda, Georgia Institute of Technology; Lee Maxwell, Colorado State University; Joyce Blair, Eastern Kentucky University; John R. Zimmerman, University of Delaware; Susanne M. Shelley, Sacramento State University; Ted Wagstaff, Georgia Institute of Technology; Glen Williams, Texas A&M; Edward T. Ordman, New England College (Henniker, NH); Elizabeth Unger, Kansas State University; Joe Jefferis, Wright State University (OH); Robert Aiken, University of Tennessee; Enrique A. Gonzales, University of Lowell (MA); William Harlow, University of Cincinnati. Most of all, I would like to thank my sponsoring editor, Susan Newman, for her support, encouragement, and confidence in me. Finally, I must also thank Barbara Myers and Donna Kelly for the meticulous typing and retyping of the several drafts of this book.

D. M. ETTER

BRIEF CONTENTS

DETAILED CONTENTS

Chapter 1 ends with a Summary and Key Words; Chapters 2–9 end with a Summary, Key Words, Debugging Aids, Style/Technique Guides, and Problems.



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