STRUCTURED COBOL

FUNDAMENTALS AND STYLE

SECOND EDITION

TYLER WELBURN

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SECOND EDITION

TYLER WELBURN

To my children, Brent, Veronica, and Keith

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Second edition

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PREFACE

In the preface to the first edition of this book, I wrote the following: "COBOL—like the English language—is a dynamic language that is continuously changing and evolving. Similarly, computers, information systems, and data processing are dynamic fields that are also undergoing continual change.

"This text utilizes the most current COBOL program design and coding techniques together with contemporary business computer system concepts. It offers a solid foundation for beginning COBOL students to build upon as their knowledge and skills develop and grow along with the exciting field of computer technology."

Since those words were written very early in this decade, the COBOL language has been affected by three major developments: (1) the proliferation of microcomputer usage, (2) the increased use of on-line applications, and (3) the promulgation and impending adoption of a new version of the ANS COBOL language standards (commonly called COBOL-8X at the time this is being written).

Goals for the Second Edition

In preparing the second edition, I have sought to include applicable new information about the trends mentioned above—but not at the expense of straying from the ANS COBOL orientation. As a result, appropriate new material pertaining to the 8X standards is incorporated into the text. Unfortunately, COBOL does not yet have standard screen-handling syntax—on-line and microcomputer applications use special implementor-dependent syntax. Thus, this text presents an up-to-date version of the standard language and can be used successfully with any COBOL compiler.

This book has been designed to coordinate with the follow-on companion volume that I wrote after the first edition was published: *Advanced Structured COBOL: Batch, On-Line, and Data-Base Concepts.*

Key Strengths Retained

Response from users of the first edition has been gratifying. In preparing the second edition, I have made a special effort to maintain—and improve—the qualities and features that instructors and students found useful.

Text Organization

The COBOL syntax is presented within the framework of commonly encountered business-system program models. Concepts are developed step by step—proceeding from the simple to the more complex. Each program category builds upon and adds to the knowledge, techniques, and skills developed in the previous one.

Systems concept	*Chapter*	*COBOL coding syntax*	*Program type*	*Program name*
	1	Overview	Read-and-print	EMP-LIST
Data concepts	2	IDENTIFICATION DIVISION ENVIRONMENT DIVISION DATA DIVISION	Read-and-print	EMP-RPT
	3	PROCEDURE DIVISION OPEN PERFORM MOVE READ Nonnumeric literals PERFORM/UNTIL CLOSE STOP Figurative constants WRITE ADVANCING integer	Read-and-print (continued)	EMP-RPT
	4	PICTURE BLANK WHEN ZERO MOVE Numeric literals JUSTIFIED RIGHT Data-name qualification		
Record and report design	5	ADD SUBTRACT MULTIPLY DIVIDE COMPUTE ROUNDED ON SIZE ERROR	Read-calculate-and-print Read-calculate-and-print with totals	CHGACCT TCHGACCT
	6	GO TO PERFORM/THRU		LABELS
	7	REDEFINES VALUE ACCEPT/FROM DATE ACCEPT/FROM DAY ACCEPT/FROM TIME READ/INTO ADVANCING identifier ADVANCING PAGE WRITE/FROM	Read-calculate-and-print with headings and totals	PAYROLL

Figure P.1. Text progression and integration.

The programs presented here also serve as a ready reference for each application type, and they introduce students to the fact that several traditional application-program categories exist. This permits students to analyze programming tasks in relation to program type and to use common approaches rather than to "reinvent the wheel" for each program. Further, with this method of presentation, coding is never divorced from practical application. The specific integration of concepts, coding, and program models is presented in Figure P.1.

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Systems concept	*Chapter*	*COBOL coding syntax*	*Program type*	*Program name*
	8	IF		
Data validation	9	INSPECT BLOCK CONTAINS	Data validation	DATA-VAL
Sorting and control breaks	10	USAGE	Control break (single-level) Control break (multiple-level)	S-CTLBRK M-CTLBRK
	11	SORT RELEASE RETURN MERGE	Sort	SRT-ONLY SRT-PRE SRT-P-P SRT-POST
Table handling	12	OCCURS Subscripts INDEXED BY SET PERFORM/VARYING SEARCH KEY	Table processing	
Multiple-level table handling	13	SEARCH/VARYING PERFORM/VARYING/AFTER	Table loading	STOCK-ST

Appendixes

A Report Writer feature

B OTHER COBOL CLAUSES AND STATEMENTS
REMARKS (COBOL-68)
OCCURS/DEPENDING ON
RENAMES
ACCEPT
DISPLAY
ALTER
EVALUATE (COBOL-8X)
EXAMINE (COBOL-68)
GO TO/DEPENDING ON
Case Structure
INITIALIZE (COBOL-8X)
INSPECT/CHARACTERS
MOVE/CORRESPONDING
ADD/CORRESPONDING
SUBTRACT/CORRESPONDING
NOTE (COBOL-68)
PERFORM/TIMES
STRING
UNSTRING
COPY

C System-names

D Program interruptions for IBM OS and DOS systems

E Complete COBOL-74 language formats

F Complete COBOL-8X language formats

Figure P.1. (continued)

System Concepts Chapters

Five chapters (labeled A, B, C, D, and E) are included to teach business systems concepts along with the coding. They contain no coverage of the COBOL language per se but instead discuss background information on data concepts, record and report design, data validation, sorting and control breaks, and table handling.

ANS COBOL Orientation

This text is designed for users of American National Standard COBOL—either the 1968, 1974, or soon-to-be-adopted 198X version. Even though it has not yet been formally approved by the American National Standards Organization at the time that this is being written, the 198X standards have already been implemented in the COBOL compilers offered by a number of major vendors.

Although the text is not oriented toward a specific hardware or compiler vendor, commonly encountered IBM extensions to ANS COBOL are identified and covered.

To simplify identification of the respective ANSI standards in the text, the 1974 American National Standard COBOL is referred to as COBOL-74; the soon-to-be-adopted standard is called COBOL-8X.

Programming Style Conventions

Over the years, through trial and error, COBOL installations and programmers have developed programming style conventions. The establishment and use of such conventions significantly aid program readability and maintainability. In this text, therefore, applicable style considerations are presented along with the syntactical coding rules to provide an introduction to proper coding form. Through presentation of these style conventions, students can quickly learn sound coding practices that might otherwise take years to acquire.

Comprehensive Program Design Documentation

For each text program, a structure chart is presented and the detailed logic is shown in both pseudocode and program flowchart form. (The abbreviated sort programs presented in Chapter 11 omit the detailed logic diagrams, however.)

Structure charts are provided to show overall program organization and module definition. A relaxed, English-like pseudocode is used to make comprehension of the detailed logic easier for the beginning programming student. Since many students are familiar with and feel comfortable with flowcharts, the logic is also shown in program flowchart form.

Clearly Identified Coding Formats and Examples

Whenever COBOL language entries are introduced in the text, they are accompanied by the language format (sometimes shown in a simplified form). The language formats are presented in a shaded box for easy identification.

When an example is first shown, it is hand lettered on a coding sheet grid so that students can easily visualize how the entry will look in relation to the COBOL coding line. (A convention used in the coding examples is that when there is a stand-alone example—that is, when the coding example does not apply to a program presented in the text—a data-name is prefixed by XX-, IN-, or OUT-; a procedure-name is prefixed by 999-.)

Complete Programs

Thirteen complete programs—one for each of the major application program types mentioned above—are included. They are shown in a reduced typesize so that they will fit on a single page or on facing pages. This format gives readers a view of the program as a whole without the need to flip pages. As a result, students can more easily grasp the coding interrelationships and thereby more quickly comprehend the program logic.

Portions of the programs are often extracted and discussed in more detail within the body of the text.

Combination Tutorial/Reference Approach

Students often react to COBOL textbooks in one of two ways. Typically, either they feel that the text is a good reference manual but doesn't really explain how to write certain types of programs, or they claim that the book explains things well but is difficult to use as a reference. This text blends tutorial and reference features. Whenever a subject is presented, it is fully covered in one place. However, to guard against information overload, topics are covered on a step-by-step basis and are integrated with programming examples.

Extensive End-of-Chapter Material

At the end of each chapter, a chapter summary is presented. Appropriate chapters also contain COBOL language element summaries and style summaries.

Exercises appear after the summaries. Terms for definition and review questions are provided for each chapter. Some chapters also contain syntax/debug exercises.

Range of Programming Assignments

At the conclusion of most chapters, there are four programming assignments that relate directly to the material covered within the chapter. The assignments are arranged in order of increasing complexity. The first is the easiest and quickest to code; the fourth is the most difficult.

Complete test data-sets are available for use with the programming assignments. (An order blank is located in the Instructor's Guide.)

Numerous Illustrations and Examples

Over 500 figures illuminate the text. The figures include illustrations, diagrams, programming specifications, design documentation, and coding examples.

Comprehensive Instructor's Guide

A comprehensive Instructor's Guide is available for instructors using this text. Together with a number of other aids, the Guide contains the following: (1) chapter objectives, (2) teaching tips, (3) answers to exercises, (4) test questions, and (5) order blanks for other supplemental materials.

Quick-Reference Material on Inside Covers

A mock-up of the IDENTIFICATION and ENVIRONMENT divisions is presented on the inside front cover together with a checklist of other items that vary with the compiler and computer system being used. This page can be filled in at the beginning of the course and then used as (1) a reminder of the format for coding the first two COBOL divisions and (2) a reference whenever installation-dependent entries must be coded.

For easy reference, the COBOL reserved word list and the format notation legend appear on the inside back cover.

Expanded and Updated Material

In preparing this revision, I have reconsidered every sentence and figure of the original text in an effort to present the material in as clear and understandable a manner as possible. Similarly, each topic was reassessed for relevance, and additional topic area candidates were considered. Areas in which significant new material appears are discussed below.

COBOL-8X Differences

At the end of each chapter, applicable ANS-8X differences are presented within a shaded block. This facilitates (1) an integrated approach for those who are using an 8X-compiler or who otherwise wish to teach the new standards and (2) visual separation of the material for those using a 74-compiler.

Expanded Table-Processing Coverage

The table-processing material (Chapter 12 in the first edition) has been separated into two chapters (Chapters 12 and 13) in this edition. Chapter 13 contains expanded material on multiple-level tables.

The Report Writer Feature

Although the COBOL Report Writer feature is not available for all compilers, a number of instructors have requested coverage of the subject. A module on Report Writer is thus included as Appendix A.

COBOL Programming Perspectives

Certain nonstandard COBOL coding practices and considerations have evolved over the years. For the second edition I have devised capsule discussions—named "COBOL Programming Perspectives"—to explain not only *what* but *why* such special conventions are sometimes practiced within a data-processing installation. Topics covered include the following:

- Initial-character printer forms control
- Quotation mark delimiters for nonnumeric literals
- Decimal-point handling in commercial data-processing systems
- Arithmetic-sign representation
- COMPUTE statement intermediate results
- System date handling
- Printer page-skipping considerations
- ADVANCING phrase mnemonic-name option
- Effect of arithmetic signs upon class tests
- Record-blocking considerations
- COBOL sorts versus stand-alone sorts
- Choice of table-lookup driver
- Subscripts versus indexes

New Programming Assignments

Forty new programming assignments are provided. As in the first edition, the assignments for each chapter offer a range of complexity. Each assignment is fully documented so that it contains explicit instructions for the student.

In the early chapters (before Chapter 6), record layouts are presented in tabular form to provide the student with experience in constructing record layout forms, preparing print charts, and specifying PICTURE character-strings. In the later chapters (after Chapter 6), record layout diagrams and print charts are provided in the assignments.

System-Names for Selected Compilers

Syntax for COBOL system-names varies from one compiler to another. To provide helpful additional reference material, implementor-dependent system-names are presented in Appendix C.

Expanded Supplemental Material for Instructors

In addition to the Instructor's Guide, supplemental materials, including worked solutions and test data for the programming assignments, are being developed. Adopters of the textbook will be notified when they are available.

Enhancements to the Text

Certain enhancements have been made to the text presentation. I believe that they, together with the other new material, have resulted in a book that is easier to use—for both instructors and students.

Chapter/Topic Organization

Each numbered chapter contains a preliminary overview discussion, following which the chapter material is organized into topics. Such topic organization clearly identifies the subject of each text segment. This permits easy identification of material that the instructor might choose to skip or cover in a different sequence.

Clearer Format

A number of design and typographical improvements have been made in the new edition. For example, topic outlines are listed at the beginning of each topic, and key terms appear in bold type.

Quick Index On the inside front cover, a quick index to important COBOL syntax and language elements is provided.

Career Profiles Brief career profiles of computer software professionals are presented on the opening pages of the systems chapters. Each profile describes the job responsibilities of a representative position related to COBOL programming. These vignettes add a touch of interest and enlightenment about contemporary job duties in the information-systems field.

Expanded End-of-Chapter Material Exercises have been added to the systems chapters. Additional summary and exercise material has also been inserted in most of the numbered chapters.

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