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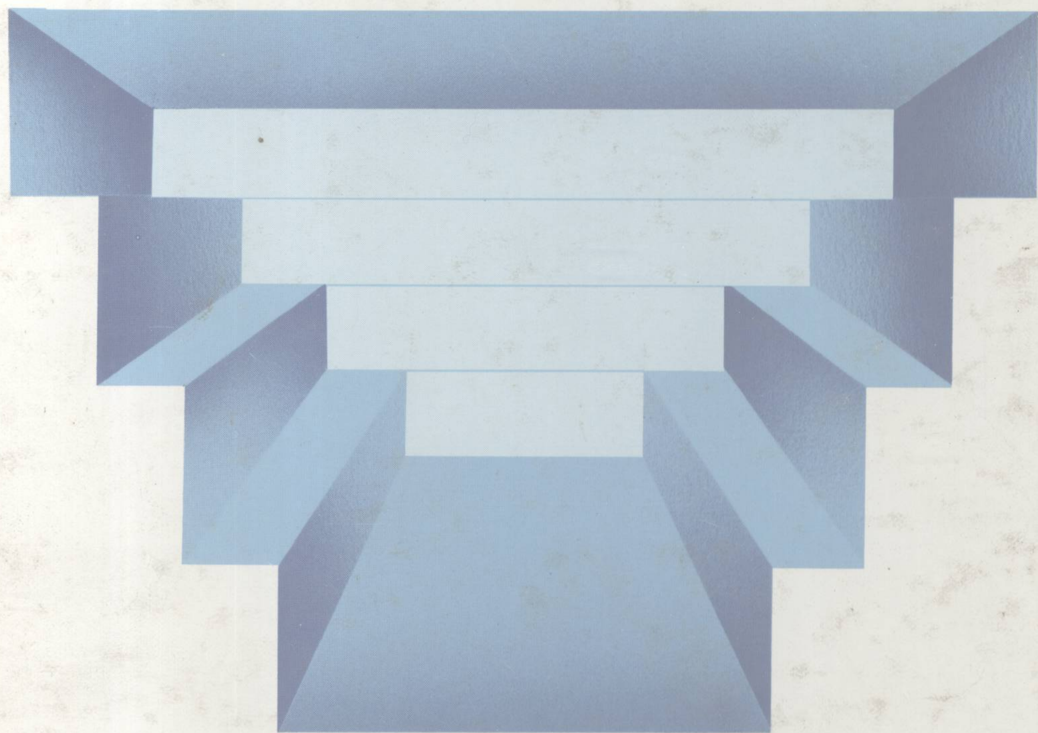

LEARNING TO PROGRAM IN STRUCTURED COBOL PARTS 1 AND 2

A YOURDON BOOK

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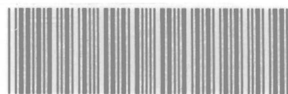
Learning to Program in Structured COBOL

Parts 1 and 2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FOREWORD

Learning to Program in Structured COBOL is intended for people with no previous knowledge of computers, who want to learn to program in COBOL, the most widely used computer language. Parts 1 and 2 of the *Learning to Program* series incorporate the methods and styles of "structured" programming, which have been shown to be more productive than traditional programming techniques.

Learning to Program in Structured COBOL, Part 1 can be used as a stand-alone introduction to structured programming or it can be used in conjunction with the more advanced concepts and features that are presented in Part 2. Both are complete texts and can be used effectively with other structured programming texts; however, Parts 1 and 2 were designed to be used together as a teaching unit and are complementary in content and approach as well as style and format.

The books can be used either for self-study or as the texts for an industrial or college course. If you are an instructor, please read the following Notes for Instructors, which discuss possible uses of this book and its companion volume as basic texts. If you plan to use either or both of the books to study COBOL on your own, you will find the frequent questions and exercises helpful, especially if you work them *before* checking the answers provided.

We have tried to make your learning easy, thorough, and fun. If you actually can run some of the exercise programs on a computer, you will enhance your learning, and find it fascinating to build a realistic commercial data processing system.

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NOTES FOR INSTRUCTORS

One of the objectives of each book in this series is to serve as the text for a three-week full-time training course or a one-semester college course for people with little or no prior exposure to data processing.

Apart from teaching COBOL entirely in the context of structured programming, the course design incorporates several well-established educational techniques that have not, so far as we know, been applied in this area before. They are

- the concept of COBOL as a foreign language
- the concept of the spiral curriculum
- the concept of the "theory/practice sandwich"

COBOL as a foreign language

Teaching a foreign language using a grammar is not as effective as teaching via a set of syntactic structures. That is, it is better to learn a language by learning basic conversational exchanges, such as "Have you got an X? Yes, I have an X," rather than to learn "I have, you have, he has, she has. . . ." If we view COBOL in this light, we see that the standards manual and manufacturers' reference manuals are *grammars* of COBOL; they set forth the rules of the language in a formal way, exploring all the options of each statement, however obscure and rarely used. Many texts and courses explain the reference manual, but essentially follow the same pattern. In this text and in courses based on it, we use the four structures — process, decision, loop, and CASE — as the building blocks and teach the language with a structural rather than a grammatical orientation.

Regarding COBOL as a foreign language also suggests that we minimize the history and geography of the "country" concerned. While we do not question that a well-rounded professional should know the history of data processing from Hollerith to HISAM, we believe that history is irrelevant and confusing to the beginner, because it is of no help in performing his central task of solving problems with code. Likewise, while a profes-

sional COBOL programmer should know enough about the architecture of the hardware to appreciate the implications of alternative coding techniques, the beginner needs only a very simple model of main storage and common peripherals. We have taken pains to concentrate initially on the production of readable, changeable code, rather than on any considerations of run-time efficiency; for example, binary representation is not discussed until Chapter 10, in Part 2.

The spiral curriculum

Usually, topics in a subject can be arranged in a linear order, one after another. However, this is difficult to do in teaching programming, because of the amount of interdependence between topics; the instructor is in the chicken-egg situation of not being able to teach topic A properly before the students know about topic B, and not being able to teach B before they know about A. The solution is to design a *spiral* curriculum in which all topics are treated several times at progressively increasing levels of detail. As you will see, Parts 1 and 2 develop five levels of the spiral:

Chapter 1:	brief explanation of the whole program development process, and a walkthrough of a simple COBOL program
Chapters 2,3,4,5,6:	establishment of the basic structures and language subset, with a thorough discussion of COBOL logic
Chapters 7,8,9,10:	use of auxiliary storage, a larger subset of the language, and internal data representation
Chapters 11,12:	use of tables and advanced input-output techniques, including buffering and blocking, and indexed and relative input-output

Chapters 13,14,15:	use of sorting and merging techniques, testing and debugging strategies, efficiency as well as optimization

The theory/practice sandwich

It is often a temptation for someone who is expert in a subject to teach theory at a more profound level than is desirable. This is partly because the more deeply one understands the theory behind a subject, the simpler it appears. So, the instructor may feel that the subject can be made simple to the learner by teaching the underlying theory at the same depth as the instructor understands it. This is a fallacy; the learner needs to start with familiar, concrete ideas and simple skills, and *then* learn abstract concepts. After a while, he can treat these abstract concepts as concrete things and then learn deeper-level concepts, and so on.

Introducing the subject of computer programming by teaching binary arithmetic is a case in point; it is true that, at a deep level, the computer is merely performing operations on binary strings, but that is no help to the beginner. The temptation to teach too much theory too early can be resisted by asking "What is the simplest act of mastery the learner can do next? What is the minimum theory he must know in order to do that act of mastery?" The idea behind the "theory/practice sandwich," then, is a curriculum that, within each spiral, has the structure

minimum theory

simple act of mastery

next item of minimum theory

next act of mastery

and so on.

The sequence of acts of mastery around which the book builds is

read a simple program

make a small modification to a program

write a card-to-print program

enhance the program to do some arithmetic

enhance the program to do complex logic

enhance the program to write a tape file

maintain the tape file

use the tape file to create an indexed disk file

use the indexed disk file in a simple accounting system

and so on.

Throughout the texts, specific program exercises, as well as the overall concepts, build on each other in such a way as to combine the maximum of learning with the minimum of coding and keypunching.

In addition, instructors may find it useful to refer to the suggested lesson plans and lecture notes for the first thirty sessions of a course (three hours per session), provided in Appendix B of Part 1.

Learning to Program in Structured COBOL Part 1

Ed Yourdon
Chris Gane
Trish Sarson

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1 Making the Computer Do What You Want

1.1 Clerks, computers, compilers, and COBOL

You probably have heard a lot about computers before picking up this book. Some of it may be alarming — for example, how computers are invading and taking over our lives. Some of it may be optimistic, as in the predictions of computers doing all of the boring work, leaving people a life of ease and leisure. Neither of these statements is true, of course, and by the end of the book we hope you will be in a position to make up your own mind about the meaning of computers (from a position of strength), because *you* will be giving the orders.

That is what being a programmer is all about: giving the orders to computers. Think of the computer as a clerk without any common sense, and think of yourself as the clerk's boss. Whatever you tell the clerk to do, he will do *exactly* that, incredibly fast, all the time drawing on a vast memory of what you and others have told him in the past. But, if you tell the computer to send out a check for $100,000 when you mean only $100, the computer will blindly obey and pay the $100,000.

The key requirement of your job as a programmer is to understand in practical terms what work people need done by the computer, and then to translate exactly those needs into code the computer can read and obey. Computers work by streams of coded electronic pulses, which we shall discuss in detail later in the book. Since these pulses, of course, are meaningless to humans, a variety of computer *language translators* have been developed, to transform commands in an English-like language

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