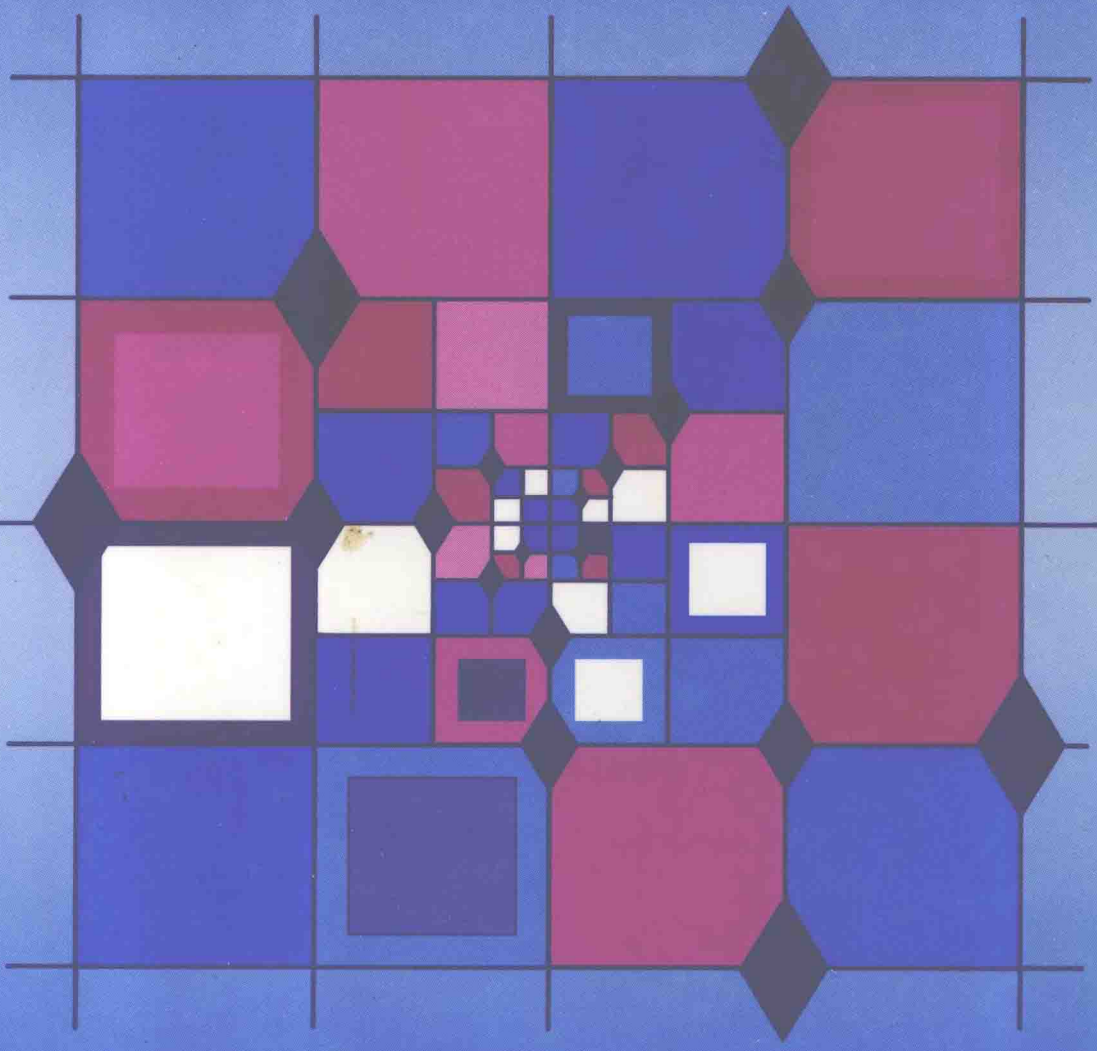
Structured Assembler Language for IBM Computers



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Structured Assembler Language for IBM Computers

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Preface

As a student of computer science, you probably learned programming through a high-level language, such as Pascal, BASIC, FORTRAN, or COBOL. You also realize that much of the application programming in the business world is done in high-level languages. You might then wonder, "Why should I study assembler language?"

Benefits of Assembler Language

Assembler language provides a broad understanding of machine functions and processing techniques that cannot be matched through any other source. It offers alternative choices of instructions for data manipulation and calculations. It helps you to understand why certain file and data definitions cause more efficient operations than others do. You may find that subprograms written in assembler language can be called from high-level languages to perform specific tasks not otherwise possible.

Through assembler language you can gain a detailed understanding of address modification, register operations, table handling, and other functions common to many languages. Moreover, you can learn to analyze object code and diagnose storage dumps, both valuable tools in debugging.

Some people contend that assembler language should be avoided because programs must be rewritten every time the hardware is changed. But the IBM family of computers starting with the System/360 and progressing through the 370, 3030, 3080, and 4300 series—as well as a large group of IBM-compatible computers—has used the same assembler language for over 20 years. Although the language has been expanded, programs written in the 1960s can usually be run with few or no changes on hardware that has changed dramatically over the years. Few high-level languages have been so stable.

Shortcomings of Other Textbooks

Many assembler textbooks have certain shortcomings that I have tried to overcome here. They present too much detail early in the text, before the student has an opportunity to assimilate and apply it. They wait too long to provide enough information to produce a complete program. They show too few complete programs—and these usually appear late in the book. They depend

on artificial tools, such as special housekeeping and input/output macros, and often ignore the use of disk files entirely.

But the most serious omission in many assembler books is lack of attention to the principles of structured programming. Students who have learned proper structure in their introductory courses are perplexed at the disregard of proper branching and modular design they often find in their assembler texts.

Features of This Book

This book employs many techniques to design and write correct programs. Structured programming is demonstrated and practiced throughout. Initially, each program is shown in flowchart form, pseudocode, and assembler language. Later the flowcharts are eliminated.

A new method is introduced by which each type of program structure—sequence, repetition, and selection—is clearly identified by the use of names such as IF, THEN, ELSE, ENDIF, DOWHILE, ENDDO, REPEAT, and UNTIL. Consistent use of these names helps to ensure proper structure.

Page heading subroutines are introduced with the first program and other subroutines are emphasized throughout as ways to improve and extend modular structure.

Programs begin with simple character operations and gradually move on to decimal arithmetic, editing, binary arithmetic, address modification, and table handling. Later chapters, which may be omitted without loss of continuity, deal with subprograms, advanced register operations, macro definitions, and floating-point numbers.

No special non-system macros are used. File definitions and processing macros for both DOS and OS are provided as a model that can be used for each of the programs.

Data types and machine instructions are introduced only as needed and are immediately utilized in examples and sample programs. Detailed summaries are presented in appendixes.

Early sample programs are based on the same data set to give continuity and relevance.

File creation and processing are covered with sequential, indexed sequential, and VSAM files. Sample programs illustrate each form of processing for each type of file.

Organization of the Text

The book contains 18 chapters and five appendixes. The intent is always to work from familiar concepts and material to new ones. The first seven chapters should be taken in sequence. Chapter 1 reviews basic hardware and software concepts, with special emphasis on structured program development. Chapter 2 covers types of assembler language statements, file and data definitions in both DOS and OS, and procedural instructions to permit develop-

ment of a complete program utilizing a heading subroutine. Chapter 3 develops more complex program logic while continuing to work with data in character form.

Chapters 4 and 5 introduce packed decimal numbers, arithmetic operations, and editing. Standards modules are developed for reading records and printing lines.

Chapter 6 introduces more technical material on base-displacement addressing, machine instruction formats, the condition code and branching, and input/output channels.

Chapter 7 covers techniques to avoid errors in programs and detect those that do occur. Output from the assembler and linkage editor is examined, and detailed analysis of a core dump is explained.

Chapter 8 presents control break processing, with single-level and multiple-level totals. This chapter may by studied in sequence or deferred until later, when magnetic tape and disk files are covered.

Chapters 9 and 10 deal with operations on binary numbers, address modification, and table handling. Conversion between decimal and binary numbers, arithmetic operations, shifting within registers, and creating and searching tables are treated in detail.

Chapter 11 shows subroutines and subprograms as means of expanding modular structure of programs. Chapter 12 explains macro definitions and conditional assemblies as ways to simplify programming for definitions and routines that are frequently used.

Chapter 13 presents advanced logical operations for working on individual bits within a byte, translating data from one coding structure to another, or scanning strings of characters. This chapter can be studied immediately after Chapter 10 if desired.

Chapters 14 and 15 discuss sequential files on magnetic tape and disk. Topics include fixed-length and variable-length records, blocked records, volume and file labels, disk track capacity, and processing techniques.

Chapters 16 and 17 cover indexed sequential and VSAM files. Either or both may be omitted without affecting any of the book's other contents.

Chapter 18 concludes the text with a discussion of floating-point data, arithmetic operations, and conversion from fixed-point to floating-point data.

Each chapter contains a statement of objectives, numerous illustrations, and (except for Chapter 1) one or more complete illustrative programs. Each chapter concludes with a summary, a list of terms for review, questions for discussion, exercises, and programming problems.

The appendixes include a glossary, a summary of machine instructions, the IBM System/370 reference summary, data for programming problems, and answers to exercises.

Supplemental Materials

An instructor's manual is available with teaching suggestions and a large bank of test questions.

The following IBM publications will provide valuable additional information:

A22-6821 System/360 Principles of Operation
GA22-7000 System/370 Principles of Operation
GA22-7070 IBM 4300 Processors Principles of Operation
GC24-5099 OS/VS1 JCL Reference
GC24-5103 OS/VS1 Supervisor Services and Macro Instructions
GC33-4010 OS/VS-DOS-VS-VM-370 Assembler Language
GC33-4021 OS/VS-VM/370 Assembler Programmer's Guide
GC33-4024 Guide to the DOS/VSE Assembler
GC33-5372 DOS/VS Data Management Guide
GC33-5373 DOS/VS Supervisor and I/O Macros
G320-5774 VSAM Primer and Reference

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Alton R. Kindred

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