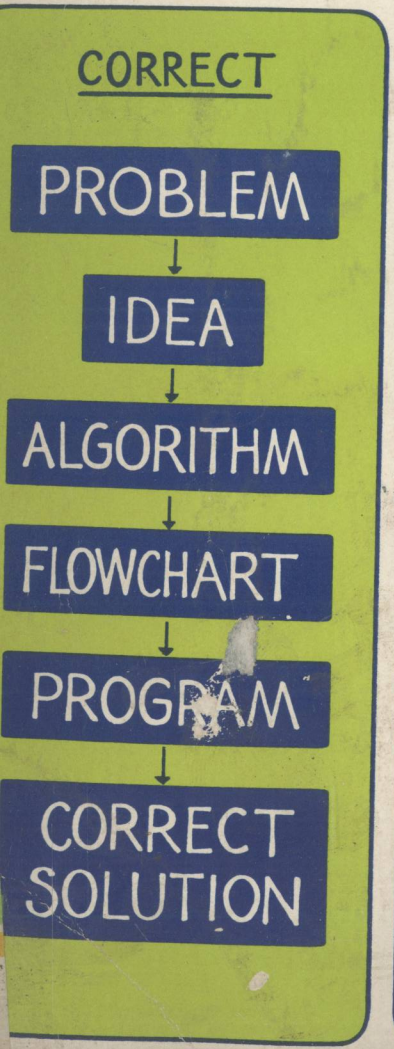
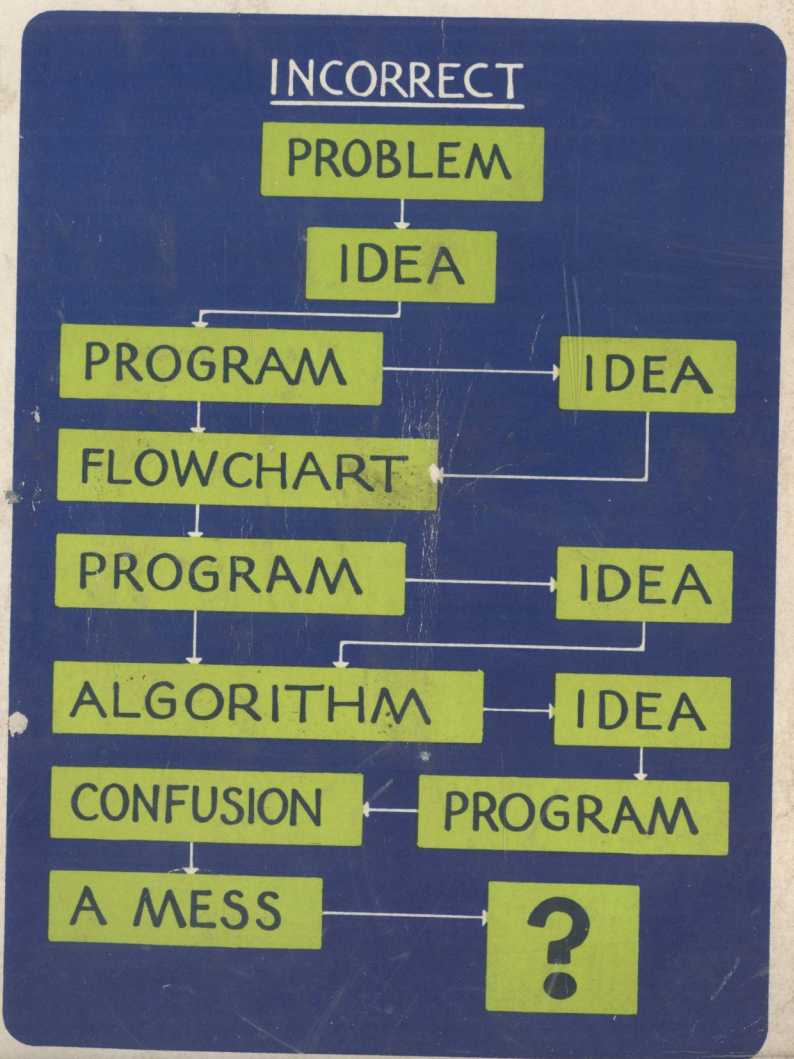
Donald D. Spencer

Problem Solving with FORTRAN





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Problem Solving with FORTRAN

To Sherrie

Preface

This book is intended for those people who would like to be able to use computers to solve problems and help in making decisions. Thus, it is written for students and for practitioners.

The book is designed for the beginning course in computer programming, assuming one course in algebra as the minimal mathematical level of the reader. The pedagogical goal throughout is to keep the material as understandable as possible. Many photographs, diagrams, flowcharts, and cartoons are used to illustrate specific concepts, techniques, and equipment. Although the computer field is burdened with highly esoteric terminology, the attempt here is to keep technical terms to a minimum.

The basic programming language of the book is FORTRAN (FORmula TRANslation). However, the logic approach to solving a problem is independent of any particular language. The treatment of the FORTRAN language is brief and to the point. No attempt has been made to state the differences between different dialects and implementations of FORTRAN. These should be studied from the relevant manuals. The FORTRAN language used in this book is a subset of the FORTRAN IV language and is included in all versions of FORTRAN.

The key objectives of the text are twofold. The reader is given the opportunity to learn how to take a problem and solve it on the computer in the following two steps:

- *Problem formulation.* The reader learns how to formulate a problem and how to devise the algorithm and flowchart for solving the problem by computer.
- *Problem solution by computer.* The reader learns how to express the problem-solving process in a computer language and to obtain a meaningful solution on the computer.

The reader will note that the book begins with the immediate introduction of FORTRAN programming. Most educators agree that it is important to begin work with the computer as soon as possible—preferably immediately after the first class meeting. The interest of the student is then usually so strong that he or she is motivated to proceed with additional related topics as quickly as possible. After the reader is introduced to FORTRAN, he or she then explores the areas of algorithm development, flowcharting, advanced FORTRAN, and problem solving.

Perhaps a novel feature of this book is the inclusion of a large number of problems from many diversified areas: mathematics, engineering, business, physics, chemistry, education, statistics, game playing, number theory, accounting, and others. Problems were purposely chosen to illustrate that FORTRAN programming can be used to solve a variety of moderate-size problems. All of the solved problems in this book are accompanied by flowcharts. The 23 problems for reader solution in Chapter 8 also include accompanying flowcharts. Chapter 9 includes 55 problems for reader solution. The reader's learning process will be greatly enhanced if his or her study is supported by doing the many review exercises contained in each chapter, and if careful attention is paid to the examples and solved problems.

Appendix A includes a short discussion of keypunching a source deck, which should be helpful to readers who are unfamiliar with keypunching their own programs. Appendix B contains a description of program flowcharting symbols. A short glossary of terms is included in Appendix C. The book also includes a bibliography. An instructor's manual is available, containing answers to review exercises and teaching suggestions.

I wish to thank the IBM Corp., Burroughs Corp., Federal Aviation Agency, and Sperry Rand Corp, who supplied me the photographs used in the book and David Lynas for his imaginative cartoons. I also wish to thank my wife, Rae, for pounding the keys of the IBM Selectric, and Sue Collings for keypunching and executing the FORTRAN programs on a computer.

I welcome the reader to a world of reward and accomplishment in his or her encounter with this amazing tool—the computer.

DONALD D. SPENCER

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APPENDICES

Problem Solving with FORTRAN

Chapter 1

It is estimated that over 20 percent of the total output of goods and services in the U.S. is devoted to reports, statistical information, billing, payroll, and other paper work. Computer systems, such as the one shown here, have helped business people to improve these administrative functions. (Courtesy *IBM Corp.*)

Problem-Solving Process

This chapter is designed to give you a general overview of problem solving with computers. We will begin with a discussion of computer applications and what part they play in modern society. The basic components of a computer system are introduced and the relationships between them are briefly discussed.

Computers are capable of performing large numbers of operations at very high speeds with very little human involvement. However, a computer has to be told exactly *what operations to perform and in what order to perform them. These sets of instructions are called* computer programs. *A program is a series of instructions written in a coded form that the computer is able to translate into its own language. In this chapter, the process of preparing programs is discussed in general terms, the specifics being covered in Chapters 2, 3, 4, and 6.*

1.1 IMPORTANCE OF COMPUTERS

In the United States alone, there are several hundred thousand computers solving problems in almost every area of human activity. The computer is reshaping century-old ways of doing things. This machine, man's most remarkable invention, is invading every area of society, opening up vast new possibilities by its extraordinary feats of rapid manipulation. It has made it possible to multiply by millions of times the capa-