A Structured Programming Approach to Data

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Preface

Much of current programming practice is basically empirical and *ad hoc* in approach. Each problem is tackled without relation to those that have gone before; experiences are made and stored as a series of fragments. Now, under the pressure of events, this unsatisfactory state of affairs is coming to an end. Programming is becoming a technology, a theory known as *structured programming* is developing. The purpose of a theory is to categorise and explain existing practice, thus enabling it to be improved through the development of new and sharper techniques. The resulting experiences have then to be fed back into the theory so that the process of enrichment may continue. This dialectical relationship between theory and practice is essential to a healthy programming technology. The lack of such a relationship in the 1950s and 60s and the accompanying software crisis certainly confirm the converse of this proposition.

My aim in writing this book has been to explain the current state of the theory of structured programming, so that it may be used to improve the reader's practice. The book deals with two facets of programming — how to design a program in terms of abstract data structures and how to represent the data structures on real and bounded computers. The separation between program design and data structure representation leads to more reliable and flexible programs. The introduction and use of an abstract programming language as the notation for expressing both program design and the structure of data ensures, as far as is possible, that the description is machine and language independent. The reader can use the notation (or his own personal variant) for the design of structured programs whatever the actual language to be used. The ease of this task depends largely on the suitability of the language for structured programming. Some languages, such as BASIC, are clearly quite inadequate for the task owing to the paucity of their semantics. Other languages such as Pascal and its derivatives, embody in practical and tested form, the theory of structured programming. Of necessity, therefore, I have adopted a Pascal-like notation.

The book constitutes a second-level self-contained text on the role of data structuring in programming and therefore assumes a knowledge of the basic concepts of programming in a high-level language. It has evolved from the second-year undergraduate lecture course on 'Data Structures' that I have given at UMIST over the past six years. It presents as a coherent whole the ideas of Dijkstra, Hoare and Wirth on structured programming together with the earlier

work of Knuth on data structures. It is hoped that the book will prove useful to all computation and computer science students doing a further course on programming, as well as to the professional programmer in commerce or industry. It is to be emphasised, however, that the ideas discussed in this book are meant to be put into use and tested in the everyday programming activity of the reader. Without interaction with practice they are dead and meaningless.

I have included four sets of exercises covering all the material in the book and have attempted to avoid questions that can be answered by direct quotation from the text. The exercises generally relate to material in more than one chapter and have been grouped accordingly. Life seldom presents us with clear-cut exercises of the form given here; it is therefore to real life that the reader should look for meaningful practice of the concepts discussed in this book.

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DEREK COLEMAN