Introduction to Computing

Introduction to Computing

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First published 1990

Published by
MACMILLAN EDUCATION LTD
Houndmills, Basingstoke, Hampshire RG21 2XS
and London
Companies and representatives
throughout the world

British Library Cataloguing in Publication Data
Mett, Percy

Introduction to computing.

1. Computer systems

I. Title

004

ISBN 978-0-333-39336-9 ISBN 978-1-349-08039-7 (eBook)

DOI 10.1007/978-1-349-08039-7

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Preface

This is a book, not about computers, but about computing—the science of using the computer. The study of computing as a science in schools and colleges has grown dramatically in recent years. From a position as a Cinderella subject on the periphery of the curriculum, it has developed into a mainstream area of study examined by all the public examining bodies both in the GCSE and in the Advanced Level GCE examinations. The increase in the number of candidates taking the subject has not been matched by up-to-date textbooks to provide adequate instruction in the subject. It is the aim of this book to fill this void by providing a main text which gives a broad coverage of the new Advanced level syllabuses.

Despite a massive increase in popularity among candidates, A-levels in Computing fail to command a positive image. Universities and Polytechnics continue to prefer candidates with traditional A-levels for admission to degree courses in Computer Science, rather than those with A-levels in Computing. The reason is not hard to find. The emphasis in A-level courses has been on the wrong topics and the wrong methods. The Alvey Report stated (page 62): “Universities in fact are having to give remedial education to entrants with A-level computer science. Uncorrected, the explosion in home computing with its 1950s and 60s programming style will make this problem even worse.”

The new syllabuses which the GCE Boards introduced in the mid-1980s have gone some way towards redressing the balance. However, the main improvement will come from the use of proper design methods in the development of software. This important message is put across in the first four chapters of this book. Software development—including design—is still a much neglected topic in the teaching of the subject, and early exposure is required to ensure that students appreciate its importance. Left to their own devices, students are quick to acquire bad programming habits; it is preferable to inculcate in them the correct techniques at the earliest possible stage.

Hardware topics are not introduced until later on. Those used to earlier textbooks on Computing may find this approach unusual. However, the subject is Computing rather than Computers—our interest in computers stems only from their role in Computing.

The A-level syllabuses do not presuppose any previous knowledge of the subject. This book aims to be intelligible as a first course in Computing. It does not, however, teach any programming language as such. This has to be covered by a parallel course, using a language that is locally available.

The first three chapters introduce the use of program control structures as design tools. The method of top-down stepwise refinement is taught with the aid of structure diagrams, followed by a more general look at software design and program development in chapter 4. These topics include program correctness, maintainability and efficiency. The operation of the hardware, including peripheral devices, is discussed in chapter 5. The function of the hardware is specified in terms of its machine instruction set; this is most easily taught by way of assembly language, in chapter 6. Binary arithmetic is left until this point, as its main relevance is at this level of the computer hierarchy.

The organisation of data is an important topic which spans chapters 7 to 9. The methods used to access data have been influenced by the choice of storage media available. A continuous thread is woven through the hardware and software aspects so as to present a coherent picture. Operating systems and other systems software which, together with the hardware, make up the complex machine described indiscriminately as a computer, form the subject matter for chapter 10.

In chapter 11 we discuss communication, at both the human-computer and the computer-computer levels. This discussion includes a brief introduction to networks. The final chapter looks at some of the ways in which the computer is currently put to use and the social issues raised thereby.

Readers familiar with traditional texts will notice a complete absence of that so-called programming tool, the flowchart. I make no apology for its omission. Far from aiding program design, flowcharts hamper it, forcing the programmer to think in terms of the computing device and not the problem. A more useful design tool, the structure tree, is introduced early on to aid high-level programming. Flowcharts have their uses in the documentation of complex programs, but these are beyond the scope of this book.

No single text can hope to cover fully the whole of a two-year course, especially in such a wide-ranging subject as Computing. The contents of this text do, however, address most of the major topics common to the several syllabuses of the various examining boards. In addition, a number of subsidiary topics are included; the selection and the depth of coverage of each reflects the author's view of how the subject should be taught. This book is not intended, though, to constrain the teacher, who will undoubtedly wish to amplify certain topics and introduce further examples from his or her own experience. A Bibliography of other source material is included to provide additional background reading for instructors.

The defining occurrence of each important technical term is indicated by the use of **bold** typeface; as well as highlighting the defining context, this will enable rapid identification of key terms for revision purposes. Less significant technical words are indicated in *italics*, which are also used for occurrences of technical terms before they have been defined.

Within each chapter there is to be found a number of exercises, to be worked as they are encountered. These exercises are mostly designed to give practice in newly taught techniques; consequently, the frequency of their appearance is not uniform throughout the book. Solutions to these exercises are given at the end of the chapter. It must be emphasised that the solutions offered are usually not unique. Particularly in the case of programming exercises, there may be many equally valid alternatives. In certain chapters there are *activities* for the reader. These are either

exercises of an extended nature, or practical activities to gather information in a particular context. Instructors may wish to select such activities as are suitable for their pupils. Further exercises are included at the end of each chapter; many of these have been taken from recent A-level papers.

The teaching material is in no way tied to a specific computer, and is usable in conjunction with any hardware. In those cases where it is necessary to illustrate a point with a program fragment, this is usually done in BBC BASIC, which is accessible to most educational institutions. An appendix provides the conversion to RM BASIC for other schools and colleges. Where necessary, programming features are illustrated in Pascal. Any serious student of programming will have to learn a language like Pascal, in the long term, in order to implement the design philosophy which this book sets out to teach.

Acknowledgements

A number of people have been most helpful to me in the writing and production of this book. I should particularly like to place on record my thanks to Professor Manny Lehman of Imperial College, London, and Professor Frank Sumner of the University of Manchester for advice on the content of the book and for their comments on the drafts. I hope that no errors remain, but if any do the responsibility for them remains my own. I should also like to thank Doreen Tucker of the Faculty of Mathematics Word Processing Unit at the Open University for assistance in typing various drafts of the manuscript, and Malcolm Stewart of Macmillan Education for constant encouragement in seeing this book through.

My most special thanks go to my wife Judith, and to my children who are waiting eagerly to see this text in print, having so frequently heard that 'Daddy is busy on his book'.

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