Computer Programming for Spatial Problems, by E. BRUCE MACDOUGALL, Macmillan, Toronto, 1976, vii + 158 pp., paper $12.95

Computer programming, the author observes, must be learned rather than taught. One suspects that many geographers would agree – those who have attempted to teach reluctant students ('I ran it twice and it did the same thing both times') only to see all retention disappear within a month, and those who have signed up for short courses without the sense of immediate necessity to complement oceans of good intent.

The book is thus as much a programmed work book as a text. The reader is taken through extensive examples, and provided with many additional exercises, and encouraged to try every example on the computer. The language is strictly FORTRAN, organized in a very deliberate sequence of priorities, with obscure and inessential statements left until the end. The book is realistically centred around IBM products, but the author is careful to use mainly industry-standard FORTRAN, and there is no reason why the book should not be used as an introduction to competitors' systems.

Although spatial problems can be written quite adequately in a standard language, they require special algorithms. Maps can be created by computer by exploiting particular features of the FORTRAN language which would not be as interesting to a student of, say, numerical analysis. The greater part of the book is concerned with mapping using a line printer, although there are smaller sections on such problems as measuring distance and finding the shortest path through a network. Plotters are described, but examples are not extensive because of the lack of standardization in software. But the student who works through the book and executes the examples will gain a thorough knowledge of the essentials of FORTRAN, obtained in an interesting context.

Computing occupies an even more controversial position in university education in geography than do mathematics and statistics. How much of each should a student encounter, and in which departments should they be taught? Geographers, after all, should not be in the business of training programmers, any more than training specialists in data base management, information system techniques, computer architecture, etc., although each field has its usefulness to research in geography. On the other hand, the use of machines is always more effective when the user has some degree of intelligent understanding of their operation. MacDougall has several excellent definitions of the ideal compromise between specialization and ignorance: the geographer should have enough understanding 'to have some sense of the appropriate use of computation,' or to 'describe his requirements to a professional programmer.' But the computer can be understood at a number of levels, from the electronics of computer architecture, through assembler and the common source languages, to the sophisticated abstractions of high-level task description and artificial intelligence. If only one can be chosen, FORTRAN is low enough in the hierarchy to give some understanding of computer architecture, and yet high enough to illustrate potential levels of abstraction. While many would claim that it is obsolete, it is still the language of research applications, and, after COBOL, the most compatible and generally acceptable, besides being the source language of many high-level statistical packages. By choosing FORTRAN, then, MacDougall provides the geographer with the simplest route to an elementary understanding of computing.

But should FORTRAN be taught within geography, or in computer science? Are the examples sufficiently different? Many of MacDougall's examples are of computer mapping, which, although highly identified with geography, must account for only a small proportion of computer applications in the average department, most of which are surely for routine statistical analyses. Can separate courses for geographers be justified given the similarities to applications in biology, and most of the social sciences? And are the spatial aspects of some computing problems sufficiently unique given a good grounding in FORTRAN?

The book raises another broader question. While a course in FORTRAN is arguably the best introduction to an understanding of computer applications in geography, it is no longer the most useful skill to acquire. MacDougall's second example is of a program to compute a mean and standard deviation. Ten years ago a researcher needing such a calculation might

have been driven to write such a program, but nowadays one would do so only for personal satisfaction, to find out how it is done. The most valuable skills for effective computer use in geographical research are familiarity and the ability to use a number of large statistical and cargographic packages; knowledge of how to master program documentation rapidly, prepare data according to input instructions, use peripheral machinery, and so on. The average non-specialist need never encounter a source language; in the event that a short program must be written to reformulate data for input, for example, there will always be consultants and professionals within reach. But FORTRAN itself is a necessary skill only for a small number of specialists in methodological research.

The subject matter of the book is not therefore a necessary skill for geographers. A course in SPSS, the batch or time-share environment, elements of the operating system and peripheral devices is much more useful as an introduction to effective computer use. But MacDougall provides a superbly balanced understanding of the workings of the computer for non-specialist geographers, and will be helpful in dispelling the black box syndrome among its users.

The book is excellently written and printed, and output is reproduced clearly and abundantly. Only one point seemed unnecessarily confusing. The two subscripts of a matrix have no meaning as 'rows' and 'columns' in computer memory, a point students often find difficult to grasp. MacDougall uses a convention of allocating the first subscript to 'row' and the second to 'column.' Unfortunately this is the opposite of the FORTRAN input convention, and the resulting complications take considerable explanation in the text.

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Spatial Analysis in Archaeology, by IAN HODDER and CLIVE ORTON, Cambridge University Press, New York, 1976, ix + 270 pp., cloth $19.50

Archaeology is an empirical science. The nature of the subject and the often inexact and incomplete data used demand this. The traditional roots of archaeology are in anthropology and history. However, in recent years, archaeologists have been borrowing increasingly from other disciplines. *Spatial Analysis in Archaeology* is an example.

Hodder, an archaeologist, and Orton, a statistician, have written this book in order 'to apply more rigorous quantitative techniques to the analysis of archaeological distributions' (p. 17). They discuss, in turn, point-pattern analysis, nearest-neighbor analysis, models for settlement patterns, regression analysis, trend-surface analysis, spatial autocorrelation, and other tests and measures of spatial association.

These methods require good data in order to be effective. The authors discuss a number of problems. There are difficulties with the quantitative methods and techniques themselves. In addition, different spatial processes may produce the same spatial form. Furthermore, not all data survive to the present; not all data are recovered. In the end, one must analyse imperfect data without knowing with certainty how complete or representative the sample is. The quantitative search for spatial patterns provides yet another means of speculation about the past. The computer may never replace the shovel or the trowel; but it may help increase our understanding of cultural patterns.

This book is recommended to cultural geographers interested in archaeology, to quantitative geographers who may learn from the application of their methods within a different intellectual context, and to those who follow the process of interdisciplinary exchange.

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