gradual, existing files being 'generalised' as and when the need arises, normally as a result of system integration.

Overall it is felt that the proposals bridge the gap between conventional programming and data base technology.

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References

Bowden, K. F., MacCallum, I. R., and Patience, S. P. (1971). Data Structures for General Practice Records, *Proc. IFIP Congress* 1971.

Coadsyl (1971). *Feature Analysis of Generalised Data Base Management Systems*, Section 7.4, May 1971.

Engles, R. W. (1972). A Tutorial on Data Base Organisation, *Annual Review Automatic Programming*, Vol. 7, Part 1, July 1972.

MacCallum, I. R. (1973). Interpreting Record Structures, proceedings of *Software 73*, Transcripta Books, London.

MacCallum, I. R., and Jones, P. E. (1975). Dynamic Record Structures for COBOL, Computer Science Memorandum CSM—13, (Copies available from Computing Centre, University of Essex).

Book reviews

Introduction to Optimization Methods, by P. R. Adby and M. A. H. Dempster, 1974; 204 pages. (*Chapman and Hall Limited*, £2·50)

The problem of optimization is usually regarded as finding **x** which minimises a nonlinear functional $f(\mathbf{x})$, sometimes subject to equality constraints $g(\mathbf{x}) = 0$ or inequality constraints $h(\mathbf{x}) \geq 0$.

The history of the development of the subject is bound up with the growing availability of adequate computational facilities. The main mathematical concepts were worked out a quarter of a century ago before computers really arrived on the scene. The Kuhn-Tucker theory dates from 1951. Conjugate gradients were first used practically about the same time. Levenberg's method for least squares problems goes back further to 1944. The subject never seems to have held much interest for pure mathematics. In the early literature, the names of those developing algorithms are those of chemical engineers, operational research scientists and others with large practical problems demanding solutions. Typical of this phase of development is Rosenbrock whose well known method appeared about 1960—his notorious valley function still survives as a test of the efficiency of new methods.

In the late 1950's numerical analysts became interested. Powell, one of the most prolific of writers on optimization, began publishing about 1962. Marquadt's celebrated algorithm appeared in 1963. In the mid 60's and early 70's there followed a veritable flood of papers introducing what were essentially computing variants of a relatively small number of basic methods. The flood has only recently abated. At its height the research was basically in the field of algorithmics and computing science. Many papers were concerned with the minutiae of computing tactics, few made a distinctive contribution to mathematical knowledge. (Not that this was a bad thing! Many practical people wanted practical answers quickly and economically). By now anyone wishing to write a text book on optimization has a problem of discriminating the really useful from a mass of techniques.

The book by Adby and Dempster sets out to be a typical primer—'suitable for undergraduate and postgraduate courses in mathematics, the physical and social sciences and engineering' as the preface says. After an introductory chapter, the second chapter covers the one dimensional problem, covering search methods and elementary approximate methods. Chapter 3 deals with methods for unconstrained multivariable problems. These three chapters are competently done.

Chapters 4 'Advanced methods' and 5 on 'Constrained optimization' take up some sixty per cent of the text. My personal view is that here the authors try to get too much in, and in places the text reads almost like a catalogue. There is much of value, but readers requiring an introductory text might be better served by a more critical account of a smaller number of variants of methods.

There are well explained algorithms for several of the methods described, and an excellent bibliography, plus a number of good examples. Teachers will find this quite a useful text to keep for delving into.

A. Young (Coleraine)

Simulation with GASP PL/I, by A. A. B. Pritsker and R. E. Young 1976; 335 pages. (*John Wiley*, £9·25)

This book is well presented and gives a good insight into the subject of simulation by practical example, as well as being a manual for GASP PL/I. It compares favourably with other books of this type.

The first two chapters provide a good introduction to simulation and would be suitable for initial reading on the subject. The text of part of the second and the third chapter seems somewhat redundant, as the tables and flowcharts provided, together with the excellent examples that follow later, give a good explanation of the language.

The examples, that comprise two thirds of the book, cover a range of discrete and continuous systems that amply demonstrate the flexibility of GASP PL/I.

There are some good exercises at the end of each chapter and the book also contains algorithms for the random deviate generators and the integration method used by the package.

A. Cunningham (Manchester)

Integral Equations Via Imbedding Methods, by Harriet H. Kagiwada and Robert Kalaba, 1974; 382 pages. (*Addison-Wesley/W. A. Benjamin*, hardcover US$19·50, paperback US$12·50)

In this book methods are developed for obtaining numerical solutions of Fredholm integral equations by converting them to a set of ordinary first order differential equations with given initial values. In most cases the upper limit of the integral in the integral equation is regarded as a variable which is the independent variable of the differential equations.

The first three chapters deal with degenerate and semi degenerate kernels. In the degenerate case, it is shown that if the kernel is expressed as a sum of M products then the integral equation is equivalent to $M^2 + M$ differential equations. The next two chapters deal with the cases of displacement and composite kernels and in chapter 6 the general linear equation is considered. In the latter case it is shown that if an N point quadrature formula is used, the integral equation is equivalent to N^2 differential equations. Nonlinear equations are similarly considered in chapter 7. In chapter 9 both linear and nonlinear equations whose kernels involve a parameter, which includes the eigenvalue problem, are considered. Some particular integral equations corresponding to problems in radiative transfer are solved in chapter 9, and there is a final short chapter dealing with a pair of dual integral equations occurring in potential theory.

The analysis in the book is set out clearly and in detail so that it is easily followed, although it tends to become tedious because of the repetitions with similar cases. The book is well produced and there are very few misprints. What is not convincingly demonstrated is that the method of replacing the integral equation by a set of ordinary differential equations is superior to the normal numerical methods of solving these integral equations.

V. E. Price (London)