attempting to learn topological vector space theory with a view to using its results in partial differential equations. He focuses attention on the set spec E of all continuous seminorms on a given locally convex space E, and by a systematic use of notions related to spec E is able to avoid all mention of any topologies on E save the initial one. A particular virtue of this approach is that the theorems which thus naturally emerge are rather close to the concrete theorems needed in partial differential equations, this correspondence being a good deal more marked than that commonly obtained by standard techniques. Part II consists of an application of these results to prove fairly well known results in partial differential equations, culminating with two chapters on the existence and approximation of solutions, for both the constant and non-constant coefficient case. This section of the book is not entirely self-contained, and depends partly on the book by Hormander.

The approach given in Part I seems an attractive one, and will no doubt become more widely used in time. The book is rather tersely written and readers meeting locally convex space theory for the first time may wish to consult books auch as those by Bourbaki and Köthe to gain a more rounded view of the subject. There are a number of rather obvious misprints and a few linguistic oddities; there is no index, but to compensate there is a summary of the main results in Part I and a glossary of terms used in partial differential equations. D. E. EDMUNDS

COPSON, E. T., *Metric Spaces*, Cambridge Tracts in Mathematics and Mathematical Physics No. 57 (Cambridge University Press, 1968), 30s.

The author's aim is to provide a more leisurely approach to the theory of the topology of metric spaces than is normally given in textbooks on functional analysis. In this he has been eminently successful and has produced a very readable book, which could be used by undergraduates either as a text for a course of lectures or for private study. A minimum of classical analysis is assumed and the subjects studied include complete metric spaces, connected and compact sets. Applications to spaces of functions are given, such as Arzelà's theorem and Tietze's extension theorem.

Perhaps the most interesting chapter in the book is the one dealing with fixed point theorems and their applications to systems of linear equations, differential equations, integral equations, the implicit function theorem and other topics. This is a very valuable collection of results and illustrates admirably the power and use of abstract theorems on metric spaces. There is a short final chapter on Banach and Hilbert spaces. Numerous example for the student are included at the ends of the first eight chapters. R. A. RANKIN

SCHAFER, RICHARD D., *An Introduction to Nonassociative Algebras* (Academic Press Inc., New York and London, 1966), x+166 pp., 64s.

This is an expanded version of the lectures given in Oklahoma State University in the summer of 1961. The author disclaims any intention of writing a comprehensive treatise on the subject. "Instead," he says, "I have tried to present here in an elementary way some topics which have been of interest to me, and which will be helpful to graduate students who are encountering nonassociative algebras for the first time." He is kind to such students by his sensible practice of quoting, with substantiating references, certain "known" results which the student may profitably take for granted on a first reading. A conscientious reader would require to do a certain amount of background reading, and suggestions regarding this are included in the Preface.

Some previous acquaintance with abstract and linear algebra is assumed. The Introduction surveys very briefly, without proofs, the structure theory for finite-

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dimensional associative algebras and for finite-dimensional Lie algebras of characteristic zero. A second introductory chapter explains some basic concepts applying to arbitrary non-associative algebras; the associative and Lie multiplication algebras, trace forms and bimodules are discussed here. The three remaining chapters, forming the body of the book, deal with alternative algebras (presented in some detail), Jordan algebras and power-associative algebras. The exceptional simple Lie algebras are introduced *en passant* as derivation algebras of alternative and Jordan algebras.

This is a very useful addition to the literature and a good preparation for more specialized books. The author succeeds in keeping the level elementary and in assisting the reader to view the subject as a whole in perspective.

I. M. H. ETHERINGTON

HILDEBRAND, FRANCIS B., *Finite Difference Equations and Simulations* (Prentice Hall, 1968), ix+338 pp., 119s. 6d.

This book gives a useful account of the properties and solution of finite difference equations, and their application to the numerical solution of both ordinary and partial differential equations. It is therefore unfortunate that the title does not adequately describe the contents.

Only a basic knowledge of numerical work is assumed, such as that usually given in an elementary computer programming course, and although there is no emphasis on computers as such, the bias of the book is towards methods applicable to digital computers. It is assured however that the reader is familiar with the numerical methods of linear algebra and with the mathematical treatment of differential equations.

The book contains three approximately equal chapters. In the first, by introducing the theory of finite difference operators and drawing heavily on a knowledge of the solution of ordinary differential equations, the solution of finite difference equations is discussed, to more depth than is usual in a book of this kind. Most of the work is concerned with linear equations with constant coefficients, including both eigenvalue and boundary value problems, but there is some treatment of the general first order equation.

In the second chapter, the relationship of the differential operator to the difference operator is established, and this serves to introduce the numerical treatment of ordinary differential equations. Subsequently the standard numerical methods are presented and analysed for first and higher order equation, together with an adequate and satisfactory account of stability aspects. Finally, there is some treatment of boundary value and eigenvalue problems and some estimates of error bounds.

In the last chapter, on partial differential equations; the author concentrates exclusively on those of the second order, and therefore first gives their classification. This is followed by a discussion of the solution of the heat conduction equation by both explicit and implicit methods. These ideas are then applied to some non-linear parabolic equations and also briefly to the hyperbolic wave equation with appropriate emphasis on the different aspects of stability. There is a description of the methods of characteristics for the general solution of hyperbolic equations including two simultaneous first order equations. This chapter closes with a brief account of the Dirichlet problem for Poisson's equation, including curved boundaries, but with little discussion of the convergence of the various iterative methods.

The book is adequately provided with examples, and achieves a commendable balance between numerical results and theoretical aspects. It is therefore to be recommended as a first text book on this subject, particularly for students who have studied mathematics, and probably requires supplementation only in the field of partial differential equations.

D. C. GILLES