Among the applications, the chapter on sorting is by far the longest. First serial sorting methods are described and evaluated. Then various internal sorting methods are discussed and compared with regard to scan length, number of stages, number of transpositions, and storage requirements.

The material in the book was developed to a large extent in a graduate course at Harvard, and should be of interest to anyone studying general programming languages. Numerous problems are included to provide the necessary "finger exercises" and at the same time stimulate interest in programming techniques. The practical usefulness of the language appears limited since in its present form, it cannot be implemented on a computer.

Charlotte Froese, University of British Columbia

Ordinary Differential Equations, by Garrett Birkhoff and Gian-Carlo Roba. Ginn and Co., Boston, 1962. viii + 318 pages. $8.50.

Differential Equations, by H. S. Bear. Addison-Wesley, Reading, Mass., 1962. viii + 207 pages. $7.50.

Differential Equations, by C. W. Leininger. Harper, New York, 1962. x + 271 pages. $6.00.

These three new texts on ordinary differential equations typify three levels of approach to this subject, those of the mathematician, the applied mathematician, and the engineer, respectively. Thus Birkhoff and Rota begin their preface by stating "the theory of differential equations is distinguished for the wealth of its ideas and methods", and in the course of their book fully justify this ambitious and scholarly remark. Bear, however, "has given more than the usual emphasis to the mathematical explanations, in the conviction that there is little value in learning techniques by rote", and finally, Leninger asserts "that very few (texts) seem to be written for the student whose preparation is limited to the usual beginning course in engineering calculus".

An outstanding feature of Birkhoff and Rota is the great variety and diversity of the material treated, together with the brevity, lucidity, and simplicity with which the leading mathematical ideas are presented. A highly civilized combination of rigour and thoroughness with informality has been achieved. As the authors state at the outset, they have preferred to sacrifice superficial generality rather than breadth. Since the subject lends itself well to the development of many extensions of theorems by means of exercises, this is sound

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pedagogy. The book requires more maturity than is usually assumed for a first course, but it could be used for this purpose with sufficiently able students.

The chapter headings are: First order differential equations, Second order linear equations, Power series solutions, Linear equations with constant coefficients, Existence and uniqueness theorems, Plane autonomous systems, Approximate solutions, Efficient numerical integration, Regular singular points, Sturm-Liouville systems, and Expansions in eigenfunctions.

The authors have achieved a distinctive and valuable contribution to the text-book literature of this subject.

Turning to the text by Bear, we find two chapters on First order equations, two on linear equations, one on each of the Laplace transform, Picard's existence theorem, and systems of equations. There are innumerable examples and particular cases, and the explanations are very detailed. The book would be suitable for a short introductory course with students of intermediate ability, or as a supplement to a more ambitious and less detailed text.

The book of Leininger contains three introductory chapters on calculus and series, two chapters on first order equations, and single chapters on second order equations, existence of solutions, Laplace transform, series solutions, and applications. The author has taken some trouble to state clearly certain elementary points of difficulty, and has not always succeeded in simplifying matters. However, the book does, on the whole, achieve its stated object. Many minor theorems are stated in detail (unfortunately not in italicized print), and there are many worked examples. There is much emphasis upon the Laplace transform. Most engineering students in Canadian universities are given more training in calculus than is assumed in this book.

G. F. D. Duff, University of Toronto

Ordinary Differential Equations, by L. S. Pontryagin. Translated from the Russian by Leonas Kacinskas and Walter B. Counts. Addison-Wesley, 1962.

There are many people, both students and working scientists, who have learned calculus, linear algebra and an introduction to differential equations, but who have found that they need a deeper understanding of differential equations. This book by Pontryagin will make excellent reading for these people, particularly if their main interest is in non-linear equations and stability. Some topics, such as solutions in series, numerical methods, and boundary value

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