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Book Reviews

The Art of Computer Programming, Volume 1. By Donald E. Knuth. Addison-Wesley Publishing Company, Reading, Mass. (1968). 634 pp. $19.50.

For the past several years books on computer programming have flooded the technical market. The typical book on computer programming is an introduction, which includes some incomplete and inaccurate statements about the history of computing, a chapter on motivation, a description of a computer, and an elementary introduction to programming. These books are largely "user's manuals" with hard covers, and thousands of computer programmers could write one.

Knuth's work is a significant contribution to the creation of a professional base for computer programming. *The Art of Computer Programming* is the title of a seven-volume set of books, to have the following titles: Volume 1, *Fundamental Algorithms;* Volume 2, *Seminumerical Algorithms;* Volume 3, *Sorting and Searching;* Volume 4, *Combinatorial Algorithms;* Volume 5, *Syntactic Algorithms;* Volume 6, *Mathematical Linguistics;* Volume 7, *Compilers.*

While it is clear from these titles that the author has professional programmers in mind as his primary audience, it is also clear from the contents of the first volume in the series that no one who takes programming seriously can afford to miss becoming acquainted in some detail with Knuth's work. Although much of the material presented will be new to most programmers, this is not an introduction to programming in the usual sense. Rather, it is intended for readers who are experienced in programming, readers who want and need to advance their professional capabilities. The exceptional quality of this book will asure its wide use as a text in programming classes.

The first volume contains just two chapters: "Basic Concepts" and "Information Structures." The chapter on basic concepts covers algorithms, some mathematical preliminaries, a description of a computer (MIX) designed especially for this study, and basic programming techniques. The chapter on information structures covers linear lists, trees, multilinked structures, and dynamic storage allocation. Knuth writes with a lucid style and he is careful to present the historical and bibliographic background for his material, which lends interest and perspective. There are over 800 exercises, which are a major part of the material, and the answers to these exercises alone comprise 141 out of a total of 634 pages. The exercises are graded by time for solution and mathematical difficulty, varying from those which the reader should be able to answer immediately if he has understood the text, to the research problem which has not yet been solved satisfactorily. The exercises are unusual in that the author has obviously spent as much or more time on them as he has on the text; this is a pleasant contrast to many books in which the exercises seem to be appended as a hasty afterthought. The only typographical error this reviewer found occurs on page 122, where the second index register is referred to as "1I2" rather than its correct designation, "rI2."

The use of the MIX machine language rather than some currently available language implies the need to program a MIX simulator for executing the programs specified in the exercises. While the value of the book is not wholly dependent upon the availability of a MIX simulator, its value would certainly be enhanced thereby, and some readers may hesitate to spend $19.50 on a book whose contents are not fully available to them.

Finally, Knuth is one of the all-too-rare writers of serious technical works who is unafraid to spice his work with humor. For example he introduces the history and bibliography of the information structure called "trees" with the following: "Trees have of course been in existence since the third day of creation and perhaps earlier, and through the ages tree structures (especially family trees) have been in common use." The last numbered page contains the explanation, "Any inaccuracies in this index may be explained by the fact that it has been prepared with the help of a computer . . . ."

If succeeding volumes in this series are equal in quality to the first one, this may well be the definitive work on computer programming which has been needed so badly and which has been so long in coming.

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About the Reviewer: Mr. Worlton is a coordinator of automatic data processing at the Los Alamos Scientific Laboratory where he has been a staff member since graduate studies at Utah State University. His interests are in the history of computing, computer architecture, and the evaluation and comparison of computer systems.

Plutonium Handbook, Volume I. O. J. Wick, Ed. Gordon and Breach, Science Publishers, New York (1967). 520 pp. $15.50 (professional ed.). $26.00 (reference ed.).

Since its discovery in 1941, plutonium has evolved from a laboratory curiosity to a major factor in the nuclear future of the world—both as a weapon material and as a major source of energy for electric power generation. The amount of activity in research, development, and engineering concerning plutonium and its applications has been expanding at an enormous rate over the past two decades. These efforts have led to a widely diversified literature concerning this material, and *Plutonium Handbook* has been prepared to collect the pertinent information into one source reference. According to the Editor, "The *Plutonium Handbook* is written to provide information on the broad

range of topics of concern in the use of plutonium and to provide a first reference to its technology." In the reviewer's opinion this volume admirably fulfills the stated goals.

The book is divided into seven sections: physics, metallurgy and ceramics, chemistry, chemical separations, fabrications and utilization, analysis and inspection, and health and safety. Volume I is concerned with the first three topics.

The technology of plutonium is introduced by a brief (27 pages) physics section covering properties of the various plutonium isotopes and nuclear reactions. Although short, this section will serve the majority of needs of technologists for basic physics data. Examples of subjects covered are plutonium production, α decay, spontaneous fission, slow and fast neutron cross sections, fission-product yields, etc.

The metallurgy and ceramics section, which constitutes over one-half the volume, is quite extensive and very detailed. This section concerns itself with physical and mechanical properties, solid-state reactions, corrosion and oxidation, alloying behavior, refractory compounds, metallography, and laboratory techniques. All subsections are extensively referenced, covering work through the early 1960's, and except for rare occasions, the topics are so well covered that the original papers need not be consulted. This section contains a wealth of technical data on plutonium and its alloys and will be established as the authoritative reference in the field.

The chemistry section deals with the topics of chemical properties, compounds of plutonium, and solution chemistry. The section begins with a short treatment of the actinide theory and atomic size of plutonium. This introduction to the chemistry of plutonium is followed by a lengthy treatment of some of the common compounds of plutonium, e.g., halides, carbonates, nitrates, phosphates, oxides, etc. The volume is concluded by an extremely detailed and clear treatment of the complex solution chemistry of plutonium. In short, this section is an excellent reference on the chemistry of plutonium.

In summary, the first volume of the *Plutonium Handbook* is a tribute to the editor and the contributing authors. The volume is packed with useful information for scientists and engineers at the bench as well as management personnel involved with plutonium technology. This book is destined to be a "must" on the desk of those involved with handling this profoundly interesting man-made material.

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July 1, 1968

About the Reviewer: The reviewer of Plutonium Handbook *is Manager of the Biomedical Engineering Program at the Research and Development Center of General Electric Company, a responsibility undertaken following research in metallurgy and materials at Los Alamos Scientific Laboratory and Knolls Atomic Power Laboratory. Dr. Kirkbride received his graduate training in metallurgical engineering at Carnegie Tech. He reviewed Taube's book* Plutonium *in these columns a few years ago.*

Radiation Dosimetry: Fundamentals. 2nd ed., Vol. I. F. H. Attix and W. C. Roesch, Eds. 394 pp. $19.50.

This volume, the first of three in an expanded second edition of *Radiation Dosimetry* (G. J. Hine and G. L. Brownell, Eds., 1956), bears the subtitle *Fundamentals*. (Volumes II and III are devoted to *Instrumentation* and *Sources, Fields, Measurements and Applications*.) Its eight chapters treat the following subjects: 1) basic concepts of dosimetry, 2) microscopic energy distribution in irradiated matter, 3) x-ray and gamma-ray interactions, 4) charged particle interactions, 5) mathematical theory of radiation fields, 6) neutron interactions and penetration in tissue, 7) ionization, and 8) cavity-chamber theory. The book includes an appendix of physical constants and conversion factors as well as author and subject indexes.

As one who has long been a faithful user of "Hine and Brownell," this reviewer has only praise for the first volume of the new edition. As in the earlier book, the subjects are treated by recognized authorities—indeed, some chapters are written by individuals who did much to develop their subject to its present level. The editiors state that their goal has been to publish an up-to-date reference work for the radiation worker and, at the same time, to present the subjects in a clear manner for one new to radiation dosimetry. Both groups of users will profit from the great care with which terms are precisely defined and fundamental principles and concepts discussed.

This volume, like the first edition, goes beyond the exposition of the formal subject matter by including a large variety of graphs and numerical tables for practical use. It will, no doubt, like its predecessor, be a constant source of information for those of us who do numerical work and who also need rather constant reminding of the fine points and the not-so-fine points of the tools of our trade. This book has the rigor sought by the scholar who presses a statement (e.g., "absorbed dose is defined as . . . . ") through its various, logically implied ramifications, and it contains much numerical data for application to practical situations of radiation protection.

While comparing Volume I of the second edition of *Radiation Dosimetry* with the first edition of the work, this reviewer recognizes that the projected three-volume revision represents basically a new work rather than a revision of the older text. The scope of the second edition is vastly increased (33 chapters compared with 18 in the first edition) and the subject matter is treated, by and large, by different authors. Anyone who has used the first edition will certainly want to avail himself of this first volume of the second.

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About the Reviewer: James Turner, a member of the Health Physics Division at Oak Ridge National Laboratory and a contributor to these columns previously, is long experienced in the dosimetry of radiation. He did his graduate studies at Vanderbilt, has taught physics at several universities, and served the USAEC in its Division of Biology and Medicine at Headquarters. Dr. Turner is co-editor of the recently published Principles of Radiation Protection.