Book Review

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An Introduction to Computer Simulation Methods: Applications to Physical Systems (2nd. Edition)

Harvey Gould and Jan Tobochnik
Addison Wesley 1996, Massachusetts USA. (ISBN 0-201-50604-1)

I reviewed the first edition of this book in 1986, when I welcomed it as a valuable addition to the teaching of computational science. I am happy to report that the second edition continues the tradition. Though there have been significant changes, the basic philosophy of the book remains the same. It manages to combine the fun of computational physics with some valuable lessons.

What has changed? Firstly, the two volumes of the first edition have been combined into one, unifying the theme somewhat. Secondly, the text has been expanded and a useful new chapter on random processes has been added. The authors continue to present code in the form of True BASIC, which is probably a sound decision given the universal availability of BASIC, though it is emphasised that the programs are designed to be read and understood, as much as to be executed. (Readers are warned that the exercises involve adaptation and modification of the programs.) For readers addicted to FORTRAN and C, detailed advice on code conversion is provided in appendices. For those not addicted to typing, the code is available over the World Wide Web.

The scope of the book is much the same as before. Starting from simple physical problems (e.g. Newton's law of cooling) the book progresses through one dimensional motion, the two body problem, harmonic motion, chaotic sytems, probablity distributions, molecular dynamics, wave motion, electrodynamics, Monte Carlo methods, percolation, fractals, complexity, the microcanonical and canonical ensembles, and quantum systems. This is a wide perspective, but the authors strive to unify concepts by pointing out the similarities in the underlying equations. The text is not highly mathematical. The method of choice for solving many of the differential equations appearing in the book, is Euler's algorithm, but here and there throughout the text one encounters more familiar algorithms, where their relative merits are discussed. There is more emphasis on graphical presentation than in the previous edition, though at an elementary level.

Given the broad sweep of the subject matter it is inevitable that the topics are not dealt with at great length or to a great depth. One is not likely to become an instant expert in any of the areas the book deals with. But one should not dismiss the book lightly; it is well supplied with references and would form a very valuable teaching aid to any undergraduate course. It is richly supplied with exercises that will deepen understanding and stimulate new questions for further study. Its great strength is that it is soundly based in the philosophy that physics is best learned by experimentation, and the computer is one of the best experimental tools available. Good computational practice and an understanding of the techniques employed are essential disciplines on the road of discovery. The prize is new insight into physical systems. I like the fact that one can make valuable headway into a new subject area from a standing start and I would be tempted to look first in this book if I were confronted with an unfamiliar computational challenge.