introduction to the many remarkable quantum properties of Calabi-Yau sigma models discovered in the last few years, such as their relation with supersymmetric minimal models, the Landau–Ginzburg correspondence and mirror symmetry. A second book surveying these developments would still be a valuable contribution, though the relatively rapid progress that is occurring would undoubtedly make such a book difficult to write.

Computational Methods in Physics and Engineering

Samuel S. M. Wong
Prentice Hall, Englewood Cliffs, N. J., 1992. 677 pp. $48.00 hc ISBN 0-13-155953-2 Disk included.

Numerical calculation has played a continuous and vital role in physics since at least the time of Kepler, yet the undergraduate curriculum for physics majors often does not address the issue at all. A generation ago, extensive calculation was so tedious or expensive that it made sense to postpone education in numerical methods until a research project required them. But the drastic change in computer power, price, and accessibility now calls out for incorporating computation into the undergraduate curriculum. The question is where.

Computational Methods in Physics and Engineering, by Samuel S. M. Wong, claims to be "mainly concerned with the ways that computers may be used to advance a student's understanding of physics." It is designed for use either as a text in an undergraduate course or for independent study by seniors and graduate students.

The book presents a large number of mathematical and numerical methods that are met in the physics curriculum and required later in research; some techniques are explained in the context of a specific physics application. The book covers the traditional topics of numerical analysis—integration, interpolation and extrapolation, ordinary and partial differential equations, numerical linear algebra and least squares fitting (though there is almost nothing on solving nonlinear equations). In addition, there are chapters on special functions, an introduction to computing (which moves rapidly from "computer literacy" questions to factoring prime numbers) and very cursory chapters on graphics and computer algebra. There is an extensive chapter on Monte Carlo calculations with numerous applications to rather specialized topics, including percolation, matrix ensembles and path integrals.

For most of the topics and methods discussed, Wong begins with a mathematical explanation that leads to an algorithm, expressed in a "box" in steps that are not quite self-contained. A floppy disk that comes with the text contains Fortran programs implementing all the algorithms presented. This approach is very appropriate, as it permits the text to discuss algorithms in conceptual terms while the working program lets the student explore the method and see all the details explicitly. References to further theoretical treatment are given for many methods, but references to suitable programs and libraries would have been helpful. Two numerical analysis packages, EISPACK and LINPACK, are mentioned in the introduction, but not LAPACK, which is an updated replacement for both of them. The introduction also mentions NETLIB, a repository for many useful numerical analysis programs. But no internet address is given, which will certainly make it harder for the unsophisticated network user to find this important source of material for further calculational techniques.

In writing (or reviewing) an undergraduate textbook, many issues need to be resolved. One must aim at a certain level of prerequisite knowledge, and decide between covering many topics briefly or fewer topics in a more leisurely fashion, and whether to lay a broad basis preparatory to more advanced methods or to present the methods explicitly. Wong has chosen to present a large number of diverse methods explicitly. While the foundation of each is discussed, I think more emphasis should have been placed on explaining the methods. In the treatment of many topics, I found it slow going to understand what the fundamental approach was. An extreme case was the treatment, under the section called "extrapolation," of "Richardson's deferred approach to the limit." I was confused about where extrapolation fit into this approach—apparently so was the author, because his program for implementing this method contains an extrapolation subroutine but never calls it!

I also think there is a problem in the level of presentation. For while the preface implies that the book is aiming at a junior level course, topics such as Clebsch–Gordon coefficients, critical phenomena and hydrogenic wave functions seem to aim at a higher level. I would prefer to see a book with fewer methods and topics and clearer explanations, aimed at a lower level of physics applications but at the same mathematical level.

JOEL A. SHAPIRO
Rutgers University

The Monte Carlo Method in Condensed Matter Physics

Edited by K. Binder
Springer-Verlag, New York, 1992. 392 pp. $59.50 hc ISBN 0-387-54369-4

Monte Carlo methods have grown tremendously in importance since their first serious use 50 years ago. Recent progress in statistical mechanics has come in the form of greater and more widespread understanding of the crucial importance of finite-size scaling of Monte Carlo data. In addition, specialists have developed new algorithms that in some cases can ameliorate the universal problem of computations slowing down near critical points. *The Monte Carlo Method in Condensed Matter Physics*, edited by Kurt Binder, surveys recent progress and the state of the art in a number of areas of condensed matter physics. In most of the 12 chapters there is a very brief overview of the subject in question, followed by a catalog of recent work with many hundreds of references to the original literature.

Chapter 1, written by Binder, has a good discussion of the sources of error in the context of a finite computational budget. Chapter 4 covers histogram techniques and algorithms to beat critical slowdown. These algorithms are very promising, although the fact that they are not (yet) adaptable for vector processors is a significant limitation. Also there are recent suggestions that these methods are sensitive to extremely small imperfections in random-number generators. Other chapters are more oriented toward computational techniques used for specific physical systems or situations, such as quantum spins, random growth, classical fluids, quantum fluids, macromolecules, percolation, interfaces and wetting, and glasses.

Like the software used in Monte Carlo methods, the current hardware situation is rather remarkable. Giant vector-processing mainframes are teetering on the brink of extinction, barely able to compete with small scalar workstations, which have grown faster and cheaper at a tremendous pace. At the same time, parallel-processing machines are beginning to proliferate. The authors of chapter 3 provide a nice overview of parallel architectures and cheerfully inform us that "in addition to this raw increase in computer power, however, the study of parallelism can bring a fresh view of physical processes with it." While this is undoubtedly true, we cannot ignore the current great difficulties in finding the fresh view needed to create efficient parallel algorithms. As a measure of the disarray on the hardware side of things, witness chapter 2 by David Landau, that extensively discusses vectorization schemes that work only on the Cyber 205, a machine that, as the author delicately puts it, has no "line of succession."

This is not a book from which beginners can learn Monte Carlo techniques, although it does contain several chapters that are nominally introductory tutorials. The student with a thorough grounding in modern techniques of statistical physics such as finite-size scaling and the renormalization group (which can be obtained from Nigel Goldenfeld's excellent new book, *Lectures on Phase Transitions and the Renormalization Group* (Addison Wesley, Reading, Mass., 1992)) and some grounding in the basics of Monte Carlo techniques will find the present book an excellent reference in learning state of the art computational techniques in a variety of areas.

STEVEN M. GIRVIN
Indiana University

Macromolecular Crystallography with Synchrotron Radiation

John R. Helliwell
Cambridge U.P., New York, 1992. 595 pp. $165.00 hc
ISBN 0-521-33467-5

There is an audible "aha!" in biology labs whenever the atomic-level structure of an important biological macromolecule becomes known. The thinking of an entire subspecialty of biology changes, and research programs are rapidly redirected to exploit the new information. This has happened often enough in recent years so that the structure community, consisting largely of x-ray crystallographers, cannot possibly keep up with the demand for new structures. Enter the synchrotron radiation source. The ability to measure diffraction data faster—by orders of magnitude—and to measure data that are