Turing machines provides some "intuitive" grounds for seeing the "difference" between the classes P and NP. With the concise certificate formalism this kind of intuition is lost.

In summary, I would strongly recommend this book for combinatorial optimization researchers and students. The book should also be an excellent text for courses in such areas as combinatorial optimization, network algorithms or theory of algorithms. The core of any such course could be the unified treatment of network algorithms given in chapters 5, 6, 7, 9 and 10. Depending on the type of course and the background of the students, additional topics such as introductory material on linear programming (chaps. 1–4), complexity theory and approximation procedures (chaps. 8, 15, 16, 17, and 19) or other combinatorial optimization algorithms (chaps. 11–14 and 18) could also be added.

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Computer Simulation Using Particles. By R. W. HOCKNEY and J. W. EASTWOOD. McGraw-Hill, New York, 1981. xix + 540 pp., $49.50.

In past centuries, good physicists had to be (and were) good mathematicians. Perhaps we are now approaching an epoch in which progress and insight in physics requires competence with computers and numerics, more than, or as well as, competence in mathematics. Hockney and Eastwood's *Computer Simulation Using Particles* demonstrates how profitable a direct bridge between the basic laws of physics and advanced computers can be.

One may hope that the title of the book will attract physicists as well as computer addicts. But specifically numerical analysts—readers of this journal—should take note of this book. It provides an interesting change from the traditional preoccupation with the last bit to emphasis of the leading bits!

Many mathematical problems in the numerical analysis of physical systems arise from the fact that some of the physics has been left out—typically that a collection of discrete entities may have been replaced by a continuum. Going back to particles does not exactly resolve all such problems, but those that remain are very competently dealt with in this book.

The fact that each of the 10^5 or so computer particles "stands in" for some 10^{15} to 10^{25} real particles raises interesting new problems—such as particle shaping and mesh effects—which are covered in depth in Chapter 5.

One benefit of staying close to basic physics in a simulation is that the calculation remains evolutionary, so that time-stepping is relatively straightforward and efficient (see Chapter 4): the dynamics of the particle ensemble is essentially hyperbolic.

However, the static field problem remains elliptic, and it is laudible that the authors explore so thoroughly the available direct methods, in preference to time-expensive iterations (Chapter 6). Also they offer a surprising range of methods for dealing with awkward (infinite, curved) boundary conditions.

The great variety of applications should convince research contractors that large computers, or access to them, is worthwhile investment. Even areas which are traditionally considered as continuum dynamics (such as turbulent flow) seem to benefit by importing the particle model, i.e., cashing in on the perfect analogy between vortex interaction and charged particle motion in a magnetic field.

This reviewer has looked for any manifest deficiencies of this book. He could not find any. This is a remarkably good first shot at a new and rapidly expanding topic.

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Elements of Algebra and Algebraic Computing. By JOHN D. LIPSON. Addison-Wesley, Reading, MA, 1981. xvi + 342 pp., $34.50.

The author states: "This book is an outgrowth of a two-semester course in Applied Algebra given over the past several years in the Department of Computer Science, University of Toronto.... The book, like the course, is intended to offer students of computer science, applied mathematics, and engineering an alternative viewpoint to that of the traditional 'pure' treatments of modern algebra...."

The book is divided into three parts. Part one deals with mathematical foundations. The topics include elementary set theory, concept of relations, equivalence relations, partially ordered sets, concept of a function, composite functions, inverse functions, characteristic functions, decomposition theorem for functions, properties of integers, mathematical inductions, integers modulo m, greatest common divisors, and the existence and uniqueness of prime factorization. Part two deals with algebraic systems. The topics include groupoids, semigroups, monoids, groups, rings, integral domains, polynomials and formal power series, Euclidean domains, principal ideal domains, prime and maximal ideals, fields, field extensions and finite fields. Universal algebra concepts are used to deal with subgroups, subrings, etc., with homomorphisms, isomorphisms etc., and with the quotient structures. Part three deals with algebraic computing. The topics include complexity of polynomial arithmetic, complexity of integer arithmetic, computation of greatest common divisors of Euclid's algorithm over integers and over polynomials, Euclid's extended algorithm, inverses of elements in integers modulo m, Chinese remainder algorithms for the Euclidean domain, for integers and for polynomials, computation by a single homomorphic image as well as by multiple homomorphic images for integers, for polynomials and for polynomials with integral coefficients, fast Fourier transforms (FFT), forward transforms (fast multipoint evaluations), inverse transforms (fast interpolations), feasibility of mod p FFT's, algorithms for fast polynomial multiplication, for fast integer multiplication, for truncated power series, for fast power series inversion (Newton's method) and for polynomial root-finding over power series domains.

The book is quite well written. Algorithms and computations seem to be the main theme of the book. The author certainly has accomplished his intention. The universal algebra treatment is different from many elementary algebra books, but the author writes in such a way that is very easy to read. It should be a valuable textbook for applied algebra courses.

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Semi-Classical Approximation in Quantum Mechanics. By V. P. MASLOV and M. V. FEDORIUK. D. Reidel, Dordrecht, Holland, 1981. ix + 301 pp. Translated from the Russian by J. Neiderle and J. Tolar.

Consider a classical mechanical system of $2d$ degrees of freedom, with phase space $\mathbb{R}^{2d}$. The development of the system in time is governed by a Hamiltonian function $h(x, \xi)$ via the Hamiltonian equations of motion. An important role is played by the action