This book provides a very nice picture of the variety of problems which can be attacked by continuation and bifurcation methods as well as the corresponding theoretical and numerical approaches. The articles are well written and provide a useful source of information for anybody doing research in the field or just having an interest in the subject.

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9[65–02, 65F05, 65F10, 65N22].—JACK J. DONGARRA, IAIN S. DUFF, DANNY C. SORENSEN & HENK A. VAN DER VORST, *Solving Linear Systems on Vector and Shared Memory Computers*, SIAM, Philadelphia, 1991, x + 256 pp., 23 cm. Price: Softcover $19.75.

The last twenty years have seen a revolution in scientific computing as a result of the emergence of parallel and vector computers. Particularly within the last decade, as these machines have become widely available, there has been increasing interest in algorithms capable of achieving the full potential of such computers.

One of the most frequent and important problems in scientific computing is the solution of linear systems of equations, the topic of this book. Although the title limits the scope to shared memory machines, there is, in fact, much in the book of explicit or implicit relevance to distributed memory machines also.

A fairly long Chapter 1 sets the stage with a discussion of many hardware features such as pipelining, chaining, RISC and VLIW machines, cache and other memory organization issues, connection topologies for parallel machines, ending with a few programming techniques such as loop unrolling. This is followed by two short chapters, one surveying various past and current machines, and the second discussing such issues as data dependency and control flow graphs, load balancing, synchronization, and indirect addressing. Chapter 4 gives additional general background including Amdahl's law, speed-up and scaled speed-up, and Hockney's $n_{1/2}$ and r_∞ parameters with examples of these for various machines.

Chapter 5 begins the main subject matter with a treatment of various forms of LU decomposition for dense matrices, as well as related topics such as LDL^T decomposition for indefinite matrices and QR decomposition. The main theme is the necessity of proper data management on machines with hierarchical memories (registers, cache, etc.). This leads in a natural way, and through the use of performance examples, to the desirability of blocked forms of the decompositions in which operations are performed on submatrices as much as possible. Three block organizations of LU decomposition are considered and their characteristics compared. Throughout, there is discussion of the role of the BLAS (vector operations), level-2 BLAS (matrix-vector operations), and level-3 BLAS (matrix-matrix operations). Overall, this chapter gives a good background and motivation for the development of LAPACK, the project led by the first author to replace LINPACK and EISPACK by a collection of subprograms suitable for parallel and vector machines.

Chapter 6 considers direct methods for sparse systems, a topic associated with the second author. After a discussion of sparse data structures and the problems of fill and pivoting, various examples, using the code MA28, are given to show that hardware gather-scatter operations are not a cure for the indirect-addressing problem. Attention is then focused on the symmetric problem and the use of graph theory, especially cliques. Next, there is discussion of the frontal method with examples on CRAY machines, followed by the multi-frontal method and elimination trees with examples of parallelism. The chapter ends with a short survey of other approaches to parallelism.

Chapter 7 deals with iterative solution of sparse linear systems, an area associated with the last author. There is a review of primarily conjugate gradient type methods, especially for nonsymmetric systems (least squares formulations, biconjugate gradient, conjugate gradient squared, GMRES, etc.). A key part of any conjugate gradient method is matrix-vector multiplication, and there is an interesting discussion of efficient ways to do this, depending on the sparsity structure and the machine. Another key aspect of CG methods is preconditioning, and various possibilities (ILU, polynomial, approximate inverse, etc.) are reviewed along with their pros and cons on various architectures. The emphasis in this chapter is more on vector than parallel machines, but the last section deals with several parallel issues and examples.

The book ends with a glossary, instructions for obtaining software through NETLIB or from libraries such as NAG, and three other appendices on further hardware information, the BLAS, and operation counts for the BLAS and various decompositions. There is a bibliography of 173 titles.

Although each of the authors is well known for a particular research area, the book is well integrated, and relatively easy to read. Given the rate at which high-performance computer architecture is changing, much of the information in the book may have a relatively short lifetime, but hopefully at least some of the main principles of algorithm development will endure. All in all, the book is an excellent introduction to its subject matter and a welcome contribution to this field.

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10[33-01, 33C50, 41-01, 11-01].—THEODORE J. RIVLIN, *Chebyshev Polynomials: From Approximation Theory to Algebra and Number Theory*, 2nd ed., Wiley, New York, 1990, xiii + 249 pp., 24 $\frac{1}{2}$ cm. Price $49.95.

The Chebyshev polynomials are defined by $T_n(x) = \cos n(\arccos x)$. They were introduced by Chebyshev in the mid-nineteenth century, who sought the solution to the following problem: Find the polynomial of degree $n-1$ which best approximates x^n on $[-1, 1]$ in the uniform norm, or, equivalently, minimize the uniform norm of a monic polynomial of degree n on $[-1, 1]$. As is well known, the Chebyshev polynomials have an incredible number of remarkable properties in approximation theory and classical analysis. They are a prototype of orthogonal polynomials on $[-1, 1]$ (the Jacobi polynomials are