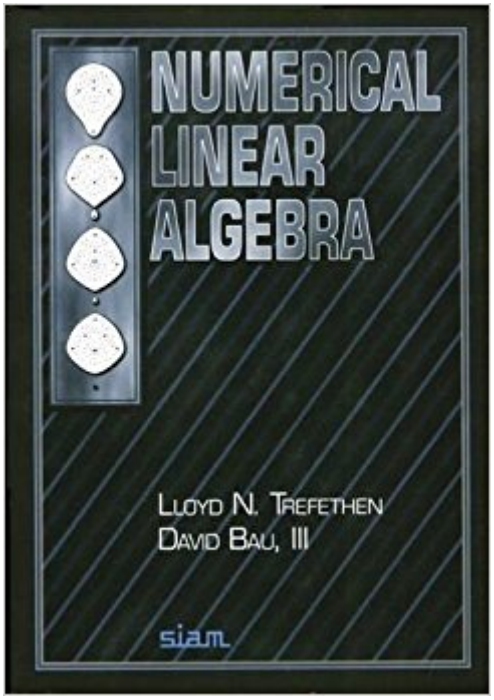
Numerical Linear Algebra



Synopsis

This is a concise, insightful introduction to the field of numerical linear algebra. The clarity and eloquence of the presentation make it popular with teachers and students alike. The text aims to expand the reader's view of the field and to present standard material in a novel way. All of the most important topics in the field are covered with a fresh perspective, including iterative methods for systems of equations and eigenvalue problems and the underlying principles of conditioning and stability. Presentation is in the form of 40 lectures, which each focus on one or two central ideas. The unity between topics is emphasized throughout, with no risk of getting lost in details and technicalities. The book breaks with tradition by beginning with the QR factorization - an important and fresh idea for students, and the thread that connects most of the algorithms of numerical linear algebra. Contents: Preface; Acknowledgments; Part I: Fundamentals. Lecture 1: Matrix-Vector Multiplication; Lecture 2: Orthogonal Vectors and Matrices; Lecture 3: Norms; Lecture 4: The Singular Value Decomposition; Lecture 5: More on the SVD; Part II: QR Factorization and Least Squares. Lecture 6: Projectors; Lecture 7: QR Factorization; Lecture 8: Gram-Schmidt Orthogonalization; Lecture 9: MATLAB; Lecture 10: Householder Triangularization; Lecture 11: Least Squares Problems; Part III: Conditioning and Stability. Lecture 12: Conditioning and Condition Numbers; Lecture 13: Floating Point Arithmetic; Lecture 14: Stability; Lecture 15: More on Stability; Lecture 16: Stability of Householder Triangularization; Lecture 17: Stability of Back Substitution; Lecture 18: Conditioning of Least Squares Problems; Lecture 19: Stability of Least Squares Algorithms; Part IV: Systems of Equations. Lecture 20: Gaussian Elimination; Lecture 21: Pivoting; Lecture 22: Stability of Gaussian Elimination; Lecture 23: Cholesky Factorization; Part V: Eigenvalues. Lecture 24: Eigenvalue Problems; Lecture 25: Overview of Eigenvalue Algorithms; Lecture 26: Reduction to Hessenberg or Tridiagonal Form; Lecture 27: Rayleigh Quotient, Inverse Iteration; Lecture 28: QR Algorithm without Shifts; Lecture 29: QR Algorithm with Shifts; Lecture 30: Other Eigenvalue Algorithms; Lecture 31: Computing the SVD; Part VI: Iterative Methods. Lecture 32: Overview of Iterative Methods; Lecture 33: The Arnoldi Iteration; Lecture 34: How Arnoldi Locates Eigenvalues; Lecture 35: GMRES; Lecture 36: The Lanczos Iteration; Lecture 37: From Lanczos to Gauss Quadrature; Lecture 38: Conjugate Gradients; Lecture 39: Biorthogonalization Methods; Lecture 40: Preconditioning; Appendix: The Definition of Numerical Analysis; Notes; Bibliography; Index. Audience: Written on the graduate or advanced undergraduate level, this book can be used widely for teaching. Professors looking for an elegant presentation of the topic will find it an excellent teaching tool for a one-semester graduate or advanced undergraduate course. A major contribution to the applied mathematics literature, most researchers in the field will consider it

a necessary addition to their personal collections.

Book Information

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Customer Reviews

I have used Numerical Linear Algebra in my introductory graduate course and I have found it to be almost the perfect text to introduce mathematics graduate students to the subject. I like the choice of topics and the format: a sequence of lectures. Each chapter (or lecture) carefully builds upon the material presented in previous chapters, providing new concepts in a very clear manner. Exercises at the end of each chapter reinforce the concepts, and in some cases introduce new ones. Ã¢â ¬Â¦The emphasis is on the mathematics behind the algorithms, in the understanding of why the algorithms work. Ã¢â ¬Â¦The text is sprinkled with examples and explanations, which keep the student focused. --Daniel B. Szyld, Department of Mathematics, Temple University.Just exactly what I might have expected--an absorbing look at the familiar topics through the eyes of a master expositor. I have been reading it and learning a lot. --Paul Saylor, University of Illinois at Urbana-ChampaignThis is a beautifully written book which carefully brings to the reader the important issues connected with the computational issues in matrix computations. The authors show a broad knowledge of this vital area and make wonderful connections to a variety of problems of current interest. The book is like a delicate soufflÃƒÂ© --- tasteful and very light. --Gene Golub, Stanford University.

This is a concise, insightful introduction to the field of numerical linear algebra. The authors' clear,

inviting style and evident love of the field, along with their eloquent presentation of the most fundamental ideas in numerical linear algebra, make it popular with teachers and students alike.

Face it, most math textbooks are awful: boring to read, not much insight, little more than a compendium of definitions, theorems, proofs, and examples. Trefethen and Bau is an exception to that rule. Indeed, the field of numerical linear algebra is unusual in having available several top-notch textbooks: Golub and Van Loan, Stewart's two volumes, Saad's books on iterative methods, Demmel's introduction, Watkins' undergraduate level treatment, and T&B. All of these are excellent (and any student in numerical analysis should delve into all of them) but to my tastes T&B and Stewart are the standouts for insight and simply being fun to read.If you're a student using T&B in a course, to use it effectively you need to understand that T&B is a book to be read carefully for understanding; it's not a typical textbook suited only for "mining" for examples and solutions to homework problems. My students have sometimes complained -- accurately -- that T&B is short on details and worked examples, and many of the proofs are just sketches. But that's a feature, not a bug: you can learn much by filling in the missing steps. This is book for reading, so take the time to read it, to think about what you've read, and to fill in the gaps; it's worth it. If you need some worked examples, Watkins has them in great detail and would be a good supplement to T&B (though see the caveat below).The only minor gripe I have about T&B is that the order of topics (QR before LU before Cholesky) is unusual, which makes it a little awkward to coordinate with other books such as Watkins which do Cholesky before LU before QR.

This book is the best I have found for studying computational linear algebra. It is clearly written and well thought out. It might not be the best introduction to the subject, and something like Strang's Linear Algebra book is probably a better place to start out. The first few chapters are more of a review of an introductory linear algebra course, and assume that one has already seen standard topics like the definition of vector spaces, subspaces, spanning sets, linear independence, etc. However, for those who have taken a 1 quarter or semester course in linear algebra, this is the perfect place to go next.

Wonderful book, gives me a starting point for understanding most basic algorithms I come across as a user of linear algebra software.

I am a second year PhD student in Operations Research and for long I had been looking for a book

in linear algebra to help me learn it myself (as I see that I need it no matter what research I want to do. It’s just a good tool to know). One of my friends recommended this book to me, I got it and I am very happy with it. The book is great in different ways:-it is in the form of short lectures and for me who wants to learn linear algebra step by step, this is a perfect approach. You will have a 5-6 page lecture so whenever you start, you are set to finish that lecture.-It gives you intuition and understanding about what is really happenning geometrically which is amazing. To me, it is very important to have the "feeling" of what is happening because it is only then that you can think about bringing your real problem in this framework.-The examples in lectures clarify the subject while exercises give you a chance to learn even more.If you are new to linear algebra or know it but want to refresh your mind on intuitions and systematic thinking, I highly recommend this book.

This book will teach you nothing if you expect it to tell you everything. Just like Rudin’s Analysis textbook, this book needs to be read slowly and thoughtfully. Often times he will forego a proof and move on. Your job will be to stop and prove it yourself. At one point he proves something with just one word "(SVD!)" The problems listed in the book have solutions online as many universities use this text.

Just what I needed

Great book

I am reviewing the book by Trefethen not by Demmel. There has been some confusion about these two books.Many people commented that this book is logic and easy to read. Compared with some other books, this is true. However, the perquisite for this book is a sound understanding of linear algebra. Without that, you will need to be a math genius to find this book easy to read. So, this is an excellent book for your (at least my) first exposure to numerical linear algebra. It picks up about 40 important topics and cover them in such details that are not too overwhelming.With the above positive side, I wish the author could expand the book and cover more topics or some topics in greater details. This book is good for an one semester course (Note that it has only just more than 300 pages for the main content). Many books are easily enough for two courses if not more. So, as a text book, this is excellent. But as a reference, you will need another book to go with it. Unfortunately, other books are not so easy to read.By the way, for CG method the book is not excellent. You will need the article by Jonathan Richard Shewchuk. You can find it online. This is

the best for CG.

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