



# Introduction to Scientific Computing: A Matrix-Vector Approach Using MATLAB (2nd Edition)

By Charles F. Van Loan

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Unique in content and approach, this book covers all the topics that are usually covered in an introduction to scientific computing--but folds in graphics and matrix-vector manipulation in a way that gets readers to appreciate the *connection* between continuous mathematics and computing. *MATLAB 5* is used *throughout* to encourage experimentation, and each chapter focuses on a different important theorem--allowing readers to appreciate the rigorous side of scientific computing. In addition to standard topical coverage, each chapter includes 1) a sketch of a “hard” problem that involves ill-conditioning, high dimension, etc.; 2) at least one theorem with both a rigorous proof and a “proof by MATLAB” experiment to bolster intuition; 3) at least one recursive algorithm; and 4) at least one connection to a real-world application. The book revolves around examples that are packaged in 200+ M-files, which, collectively, communicate all the key mathematical ideas and an appreciation for the subtleties of numerical computing. Power Tools of the Trade. Polynomial Interpolation. Piecewise Polynomial Interpolation. Numerical Integration. Matrix Computations. Linear Systems. The QR and Cholesky Factorizations. Nonlinear Equations and Optimization. The Initial Value Problem. For engineers and mathematicians.

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## **Editorial Review**

From the Publisher

This book presents a unique approach for one semester numerical methods and numerical analysis courses. Well organized but flexible, the text is brief and clear enough for introductory numerical analysis students to "get their feet wet," yet comprehensive enough in its treatment of problems and applications for higher-level students to develop a deeper grasp of numerical tools.

From the Back Cover

Unique in content and approach, this piece covers all the topics that are usually covered in an introduction to scientific computing—but folds in graphics and matrix-vector manipulation in a way that gets readers to appreciate the connection between continuous mathematics and computing. *Matlab 5* is used throughout to encourage experimentation, and each chapter focuses on a different important theorem—allowing users to appreciate the rigorous side of scientific computing. In addition to standard topical coverage, each chapter includes 1) a sketch of a "hard" problem that involves ill-conditioning, high dimension, etc.; 2) at least one theorem with both a rigorous proof and a "proof by MATLAB" experiment to bolster intuition; 3) at least one recursive algorithm; and 4) at least one connection to a real-world application.

## **FEATURES/BENEFITS**

- **NEW—Upgraded to a MATLAB 5 level.**
- **NEW—Approximately 60 new problems.,**
- **NEW—New sections on structure arrays, cell arrays, and how to produce more informative plots (Ch. 1).**
- **NEW—A brief treatment of trigonometric interpolation (Ch. 2)**—A follow-up FFT solution to the problem is provided in Ch. 5).
- **NEW—A brief discussion of sparse arrays (Ch. 5).**
  - Permits a limited study of sparse methods for linear equations and least squares in Chs. 6 and 7.
- **NEW—Block matrix material**—Now enriched with the use of cell arrays (Chs. 6-7).
- **NEW—Orbit problem solutions**—Now make use of simple structures (Ch. 8).
  - Simplifies the presentation.
- **NEW—More detailed coverage of "ode23" (Ch. 9).**
- **NEW—Website**—Provides solutions to half the problems.
  - Additional coverage of graphics.
- **Numerical linear algebra**—Permeates the entire presentation, beginning in Ch. 1. (This is a get-started-with-MATLAB tutorial, but is driven by examples that set the stage for the numerical algorithms that follow.)
- **One important theorem covered per chapter.**
  - **Motivational examples and related homework problems using MATLAB.**
    - Allows users to get a personal feel for algorithm strengths and weaknesses without the distraction of debugging the syntax of a compiled higher level language.
  - **An abundance of examples, packaged in 200+ M-files**—The book revolves around examples that are packaged in 200+ M-files, which, collectively, communicate all the key mathematical ideas and an appreciation for the subtleties of numerical computing.

- **Snapshots of advanced computing**—In sections that deal with parallel adaptive quadrature and parallel matrix computations. Treatment of recursion includes divided differences, adaptive approximation, quadrature, the fast Fourier transform, Strassen matrix multiplication, and the Cholesky factorization.

#### About the Author

Charles F. Van Loan has been at Cornell University since 1975, where he is a Professor of Computer Science and the Joseph C. Ford Professor of Engineering. He is a SIAM Fellow and the author of *Matrix Computations* (with G. H. Golub; Johns Hopkins, 1996), *Introduction to Scientific Computing: A Matrix-Vector Approach Using MATLAB* (Prentice Hall, 1999), *Computational Frameworks for the Fast Fourier Transform* (SIAM, 1992), *Handbook for Matrix Computations* (with T. F. Coleman; SIAM, 1988), and *Introduction to Computational Science and Mathematics* (James and Bartlett, 1996).

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