

Introduction To Numerical Programming A Practical Guide For Scientists And Engineers Using Python And Cc Series In Computational Physics

The book provides an introduction to common programming tools and methods in numerical mathematics and scientific computing. Unlike widely used standard approaches, it does not focus on any particular language but aims to explain the key underlying concepts. In general, new concepts are first introduced in the particularly user-friendly Python language and then transferred and expanded in various scientific programming environments from C / C ++, Julia and MATLAB to Maple. This includes different approaches to distributed computing. The fact that different languages are studied and compared also makes the book useful for mathematicians and practitioners trying to decide which programming language to use for which purposes.

An Introduction to Numerical Methods using MATLAB is designed to be used in any introductory level numerical methods course. It provides excellent coverage of numerical methods while simultaneously demonstrating the general applicability of MATLAB to problem solving. This textbook also provides a reliable source of reference material to practicing engineers, scientists, and students in other junior and senior-level courses where MATLAB can be effectively utilized as a software tool in problem solving. The principal goal of this book is to furnish the background needed to generate numerical solutions to a variety of problems.

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Specific applications involving root-finding, interpolation, curve-fitting, matrices, derivatives, integrals and differential equations are discussed and the broad applicability of MATLAB demonstrated. This book employs MATLAB as the software and programming environment and provides the user with powerful tools in the solution of numerical problems. Although this book is not meant to be an exhaustive treatise on MATLAB, MATLAB solutions to problems are systematically developed and included throughout the book. MATLAB files and scripts are generated, and examples showing the applicability and use of MATLAB are presented throughout the book. Wherever appropriate, the use of MATLAB functions offering shortcuts and alternatives to otherwise long and tedious numerical solutions is also demonstrated. At the end of every chapter a set of problems is included covering the material presented. A solutions manual to these exercises is available to instructors.

This book serves as a set of lecture notes for a senior undergraduate level course on the introduction to numerical computation, which was developed through 4 semesters of teaching the course over 10 years. The book requires minimum background knowledge from the students, including only a three-semester of calculus, and a bit on matrices. The book covers many of the introductory topics for a first course in numerical computation, which fits in the short time frame of a semester course. Topics range from polynomial approximations and interpolation, to numerical methods for ODEs and PDEs. Emphasis was made more on algorithm development, basic mathematical ideas behind the algorithms, and the implementation in Matlab. The book is supplemented by two sets of videos, available through the author's YouTube channel. Homework problem sets are provided for each chapter, and complete answer sets are available for instructors upon request. The second edition contains a

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set of selected advanced topics, written in a self-contained manner, suitable for self-learning or as additional material for an honored version of the course. Videos are also available for these added topics.

This book presents computer programming as a key method for solving mathematical problems. There are two versions of the book, one for MATLAB and one for Python. The book was inspired by the Springer book TCSE 6: A Primer on Scientific Programming with Python (by Langtangen), but the style is more accessible and concise, in keeping with the needs of engineering students. The book outlines the shortest possible path from no previous experience with programming to a set of skills that allows the students to write simple programs for solving common mathematical problems with numerical methods in engineering and science courses. The emphasis is on generic algorithms, clean design of programs, use of functions, and automatic tests for verification.

The new edition of an introductory text that teaches students the art of computational problem solving, covering topics ranging from simple algorithms to information visualization. This book introduces students with little or no prior programming experience to the art of computational problem solving using Python and various Python libraries, including PyLab. It provides students with skills that will enable them to make productive use of computational techniques, including some of the tools and techniques of data science for using computation to model and interpret data. The book is based on an MIT course (which became the most popular course offered through MIT's OpenCourseWare) and was developed for use not only in a conventional classroom but in in a massive open online course (MOOC). This new edition has been updated for Python 3, reorganized to make it easier to use for courses that cover only a subset of the

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material, and offers additional material including five new chapters. Students are introduced to Python and the basics of programming in the context of such computational concepts and techniques as exhaustive enumeration, bisection search, and efficient approximation algorithms. Although it covers such traditional topics as computational complexity and simple algorithms, the book focuses on a wide range of topics not found in most introductory texts, including information visualization, simulations to model randomness, computational techniques to understand data, and statistical techniques that inform (and misinform) as well as two related but relatively advanced topics: optimization problems and dynamic programming. This edition offers expanded material on statistics and machine learning and new chapters on Frequentist and Bayesian statistics.

The material presented in this volume provides an introduction to the numerical methods that are typically encountered and used in undergraduate science and engineering courses, and is developed in tandem with MATLAB, which allows rapid prototyping and testing of the methods. Provides an introduction to numerical methods for students in engineering. It uses Python 3, an easy-to-use, high-level programming language.

This book is published open access under a CC BY 4.0 license. This book presents computer programming as a key method for solving mathematical problems. This second edition of the well-received book has been extensively revised: All code is now written in Python version 3.6 (no longer version 2.7). In addition, the two first chapters of the previous edition have been extended and split up into five new chapters, thus expanding the introduction to programming from 50 to 150 pages. Throughout the book,

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the explanations provided are now more detailed, previous examples have been modified, and new sections, examples and exercises have been added. Also, a number of small errors have been corrected. The book was inspired by the Springer book TCSE 6: A Primer on Scientific Programming with Python (by Langtangen), but the style employed is more accessible and concise, in keeping with the needs of engineering students. The book outlines the shortest possible path from no previous experience with programming to a set of skills that allows students to write simple programs for solving common mathematical problems with numerical methods in the context of engineering and science courses. The emphasis is on generic algorithms, clean program design, the use of functions, and automatic tests for verification.

This textbook provides an introduction to constructive methods that provide accurate approximations to the solution of numerical problems using MATLAB.

Familiarize yourself with the basics of Python for engineering and scientific computations using this concise, practical tutorial that is focused on writing code to learn concepts. Introduction to Python is useful for industry engineers, researchers, and students who are looking for open-source solutions for numerical computation. In this book you will learn by doing, avoiding technical jargon, which makes the concepts easy to learn. First you'll see how to run basic calculations, absorbing technical complexities incrementally as you progress toward advanced topics. Throughout, the language is kept simple to ensure that readers at all levels can grasp the concepts. What You'll

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Learn Understand the fundamentals of the Python programming language Apply Python to numerical computational programming projects in engineering and science Discover the Pythonic way of life Apply data types, operators, and arrays Carry out plotting for visualization Work with functions and loops Who This Book Is For Engineers, scientists, researchers, and students who are new to Python. Some prior programming experience would be helpful but not required.

Praise for the First Edition ". . . outstandingly appealing with regard to its style, contents, considerations of requirements of practice, choice of examples, and exercises." —Zentrablatt Math ". . . carefully structured with many detailed worked examples . . ." —The Mathematical Gazette ". . . an up-to-date and user-friendly account . . ." —Mathematika An Introduction to Numerical Methods and Analysis addresses the mathematics underlying approximation and scientific computing and successfully explains where approximation methods come from, why they sometimes work (or don't work), and when to use one of the many techniques that are available. Written in a style that emphasizes readability and usefulness for the numerical methods novice, the book begins with basic, elementary material and gradually builds up to more advanced topics. A selection of concepts required for the study of computational mathematics is introduced, and simple approximations using Taylor's Theorem are also treated in some depth. The text includes exercises that run the gamut from simple hand computations, to challenging derivations and minor proofs, to programming exercises.

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A greater emphasis on applied exercises as well as the cause and effect associated with numerical mathematics is featured throughout the book. An Introduction to Numerical Methods and Analysis is the ideal text for students in advanced undergraduate mathematics and engineering courses who are interested in gaining an understanding of numerical methods and numerical analysis.

The book serves as a first introduction to computer programming of scientific applications, using the high-level Python language. The exposition is example and problem-oriented, where the applications are taken from mathematics, numerical calculus, statistics, physics, biology and finance. The book teaches "Matlab-style" and procedural programming as well as object-oriented programming. High school mathematics is a required background and it is advantageous to study classical and numerical one-variable calculus in parallel with reading this book. Besides learning how to program computers, the reader will also learn how to solve mathematical problems, arising in various branches of science and engineering, with the aid of numerical methods and programming. By blending programming, mathematics and scientific applications, the book lays a solid foundation for practicing computational science.

From the reviews: Langtangen ... does an excellent job of introducing programming as a set of skills in problem solving. He guides the reader into thinking properly about producing program logic and data structures for modeling real-world problems using objects and functions and embracing the object-oriented paradigm. ... Summing Up:

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Highly recommended. F. H. Wild III, Choice, Vol. 47 (8), April 2010 Those of us who have learned scientific programming in Python ‘on the streets’ could be a little jealous of students who have the opportunity to take a course out of Langtangen’s Primer.” John D. Cook, The Mathematical Association of America, September 2011 This book goes through Python in particular, and programming in general, via tasks that scientists will likely perform. It contains valuable information for students new to scientific computing and would be the perfect bridge between an introduction to programming and an advanced course on numerical methods or computational science. Alex Small, IEEE, CiSE Vol. 14 (2), March /April 2012 “This fourth edition is a wonderful, inclusive textbook that covers pretty much everything one needs to know to go from zero to fairly sophisticated scientific programming in Python...” Joan Horvath, Computing Reviews, March 2015

In the current times, computing is a very important skill to have. It is even better if you know the basics on which the computing and programming develops itself and the numerical approach that they involve. This is a field that is a subject of attention and study for several programming enthusiasts. This book, Introduction to Computer Programming and Numerical Methods, takes the readers through various such techniques that are used for programming and the numerical methods involved in them, to educate them about the fundamentals and starting point of computer programming. Introduction to Numerical Programming A Practical Guide for Scientists and Engineers

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Using Python and C/C++CRC Press

Numerical Analysis with Algorithms and Programming is the first comprehensive textbook to provide detailed coverage of numerical methods, their algorithms, and corresponding computer programs. It presents many techniques for the efficient numerical solution of problems in science and engineering. Along with numerous worked-out examples, end-of-chapter exercises, and Mathematica® programs, the book includes the standard algorithms for numerical computation: Root finding for nonlinear equations Interpolation and approximation of functions by simpler computational building blocks, such as polynomials and splines The solution of systems of linear equations and triangularization Approximation of functions and least square approximation Numerical differentiation and divided differences Numerical quadrature and integration Numerical solutions of ordinary differential equations (ODEs) and boundary value problems Numerical solution of partial differential equations (PDEs) The text develops students' understanding of the construction of numerical algorithms and the applicability of the methods. By thoroughly studying the algorithms, students will discover how various methods provide accuracy, efficiency, scalability, and stability for large-scale systems.

Traditional numerical analysis books concentrate either on the mathematical or programming aspects of numerical algorithms. This textbook is different inasmuch as it emphasizes the relevance of these techniques to the real world and the use of a widely

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available library of numerical software in their application. The book consists of 22 carefully graded projects which will lead the reader through the techniques typically taught as part of a first course in numerical analysis. Throughout the reader is presented with projects which reflect very real problems that occur in science and industry. At the same time, the reader becomes accustomed to using a good library of numerical software when writing their programs. It is a theme of this book that the use of a solid, robust and bug-free software library will improve computational results and minimize the effort of programming. By integrating the use of the NAG (Numerical Algorithms Group) FORTRAN library into the projects, students will develop experience and expertise in the use of a software library and, by practical example, be better prepared for working further with numerical analysis libraries. This lively and entertaining text will provide a valuable complement to more traditional numerical analysis books. Answers to exercises are included as well as full documentation of the relevant library routines used.

Makes Numerical Programming More Accessible to a Wider Audience Bearing in mind the evolution of modern programming, most specifically emergent programming languages that reflect modern practice, Numerical Programming: A Practical Guide for Scientists and Engineers Using Python and C/C++ utilizes the author's many years of practical research and tea

Assuming no prior background in linear algebra or real analysis, An Introduction to

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MATLAB® Programming and Numerical Methods for Engineers enables you to develop good computational problem solving techniques through the use of numerical methods and the MATLAB® programming environment. Part One introduces fundamental programming concepts, using simple examples to put new concepts quickly into practice. Part Two covers the fundamentals of algorithms and numerical analysis at a level allowing you to quickly apply results in practical settings. Tips, warnings, and "try this" features within each chapter help the reader develop good programming practices. Chapter summaries, key terms, and functions and operators lists at the end of each chapter allow for quick access to important information. At least three different types of end of chapter exercises — thinking, writing, and coding — let you assess your understanding and practice what you've learned.

MATLAB is a high-level language and environment for numerical computation, visualization, and programming. Using MATLAB, you can analyze data, develop algorithms, and create models and applications. The language, tools, and built-in math functions enable you to explore multiple approaches and reach a solution faster than with spreadsheets or traditional programming languages, such as C/C++ or Java. Programming MATLAB for Numerical Analysis introduces you to the MATLAB language with practical hands-on instructions and results, allowing you to quickly achieve your goals. You will first become familiar with the MATLAB environment, and then you will begin to harness the power of MATLAB. You will learn the MATLAB language, starting

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with an introduction to variables, and how to manipulate numbers, vectors, matrices, arrays and character strings. You will learn about MATLAB's high-precision capabilities, and how you can use MATLAB to solve problems, making use of arithmetic, relational and logical operators in combination with the common functions and operations of real and complex analysis and linear algebra. You will learn to implement various numerical methods for optimization, interpolation and solving non-linear equations. You will discover how MATLAB can solve problems in differential and integral calculus, both numerically and symbolically, including techniques for solving ordinary and partial differential equations, and how to graph the solutions in brilliant high resolution. You will then expand your knowledge of the MATLAB language by learning how to use commands which enable you to investigate the convergence of sequences and series, and explore continuity and other analytical features of functions in one and several variables.

This textbook teaches finite element methods from a computational point of view. It focuses on how to develop flexible computer programs with Python, a programming language in which a combination of symbolic and numerical tools is used to achieve an explicit and practical derivation of finite element algorithms. The finite element library FEniCS is used throughout the book, but the content is provided in sufficient detail to ensure that students with less mathematical background or mixed programming-language experience will equally benefit. All program examples are available on the

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Internet.

"Building on his highly successful textbook on C++, David Yevick provides a concise yet comprehensive one-stop course in three key programming languages, C++, Java and Octave (a freeware alternative to MATLAB). Employing only public-domain software to ensure straightforward implementation for all readers, this book presents a unique overview of numerical and programming techniques relevant to scientific programming, including object-oriented programming, elementary and advanced topics in numerical analysis, physical system modeling, scientific graphics, software engineering and performance issues. Relevant features of each programming language are illustrated with short, incisive examples, and the installation and application of the software is described in detail. Compact, transparent code in all three programming languages is applied to the fundamental equations of quantum mechanics, electromagnetics, mechanics and statistical mechanics. Uncommented versions of the code that can be immediately modified and adapted are provided online for the more involved programs. This compact, practical text is an invaluable introduction for students in all undergraduate- and graduate-level courses in the physical sciences or engineering that require numerical modeling, and also a key reference for instructors and scientific programmers"--

Our intention in this book is to cover the core material in numerical analysis normally taught to students on degree courses in computer science. The main emphasis is placed on the use of

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analysis and programming techniques to produce well-designed, reliable mathematical software. The treatment should be of interest also to students of mathematics, science and engineering who wish to learn how to write good programs for mathematical computations. The reader is assumed to have some acquaintance with Pascal programming. Aspects of Pascal particularly relevant to numerical computation are revised and developed in the first chapter. Although Pascal has some drawbacks for serious numerical work (for example, only one precision for real numbers), the language has major compensating advantages: it is a widely used teaching language that will be familiar to many students and it encourages the writing of clear, well structured programs. By careful use of structure and documentation, we have produced codes that we believe to be readable; particular care has been taken to ensure that students should be able to understand the codes in conjunction with the descriptive material given in the book.

Computer Science and Applied Mathematics: Introduction to Numerical Computations, Second Edition introduces numerical algorithms as they are used in practice. This edition covers the usual topics contained in introductory numerical analysis textbooks that include all of the well-known and most frequently used algorithms for interpolation and approximation, numerical differentiation and integration, solution of linear systems and nonlinear equations, and solving ordinary differential equations. A complete discussion of computer arithmetic, problems that arise in the computer evaluation of functions, and cubic spline interpolation are also provided. This text likewise discusses the Newton formulas for interpolation and adaptive methods for integration. The level of this book is suitable for advanced undergraduate students and readers with elementary mathematical background.

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This user-friendly reference for students and researchers presents the basic mathematical theory, before introducing modelling of key geodynamic processes.

Makes Numerical Programming More Accessible to a Wider Audience Bearing in mind the evolution of modern programming, most specifically emergent programming languages that reflect modern practice, Numerical Programming: A Practical Guide for Scientists and Engineers Using Python and C/C++ utilizes the author's many years of practical research and teaching experience to offer a systematic approach to relevant programming concepts.

Adopting a practical, broad appeal, this user-friendly book offers guidance to anyone interested in using numerical programming to solve science and engineering problems. Emphasizing methods generally used in physics and engineering—from elementary methods to complex algorithms—it gradually incorporates algorithmic elements with increasing complexity. Develop a Combination of Theoretical Knowledge, Efficient Analysis Skills, and Code Design Know-How The book encourages algorithmic thinking, which is essential to numerical analysis.

Establishing the fundamental numerical methods, application numerical behavior and graphical output needed to foster algorithmic reasoning, coding dexterity, and a scientific programming style, it enables readers to successfully navigate relevant algorithms, understand coding design, and develop efficient programming skills. The book incorporates real code, and includes examples and problem sets to assist in hands-on learning. Begins with an overview on approximate numbers and programming in Python and C/C++, followed by discussion of basic sorting and indexing methods, as well as portable graphic functionality Contains methods for function evaluation, solving algebraic and transcendental equations, systems of linear algebraic equations, ordinary differential equations, and eigenvalue problems Addresses

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approximation of tabulated functions, regression, integration of one- and multi-dimensional functions by classical and Gaussian quadratures, Monte Carlo integration techniques, generation of random variables, discretization methods for ordinary and partial differential equations, and stability analysis This text introduces platform-independent numerical programming using Python and C/C++, and appeals to advanced undergraduate and graduate students in natural sciences and engineering, researchers involved in scientific computing, and engineers carrying out applicative calculations.

Developed during ten years of teaching experience, this book serves as a set of lecture notes for an introductory course on numerical computation, at the senior undergraduate level. These notes contain the material that can be covered in a semester, together with a few optional sections for additional reading. Rather than surveying a large number of algorithms, the book presents the most important computational methods and emphasizes the underlying mathematical ideas. In most chapters, graphs and drawings are relied on, to build up intuition. The notes are written in a rather colloquial style, presenting the subject matter in the same form as it can be explained in a classroom. For instructors, this will minimize the amount of effort required to prepare their blackboard presentations. As prerequisites, the book only relies on standard calculus, an introductory course on matrices, and some basic computer programming skills. As a new feature, these notes are supplemented by two sets of videos from the author's Youtube channel. These videos contain a complete set of live lectures given in Spring 2015, together with a complete set of short tutorials, from 5 to 15 minutes each. A set of homework problems is included at the end of each chapter. Homework projects cover a variety of applications, in connection with population dynamics, engineering, mechanics, image

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reconstruction, etc. A complete set of solutions is available for instructors, upon request.

Python Programming and Numerical Methods: A Guide for Engineers and Scientists introduces programming tools and numerical methods to engineering and science students, with the goal of helping the students to develop good computational problem-solving techniques through the use of numerical methods and the Python programming language. Part One introduces fundamental programming concepts, using simple examples to put new concepts quickly into practice. Part Two covers the fundamentals of algorithms and numerical analysis at a level that allows students to quickly apply results in practical settings. Includes tips, warnings and "try this" features within each chapter to help the reader develop good programming practice. Summaries at the end of each chapter allow for quick access to important information. Includes code in Jupyter notebook format that can be directly run online.

This book is aimed at those in engineering/scientific fields who have never learned programming before but are eager to master the C language quickly so as to immediately apply it to problem solving in numerical analysis. The book skips unnecessary formality but explains all the important aspects of C essential for numerical analysis. Topics covered in numerical analysis include single and simultaneous equations, differential equations, numerical integration, and simulations by random numbers. In the Appendices, quick tutorials for gnuplot, Octave/MATLAB, and FORTRAN for C users are provided.

An elementary first course for students in mathematics and engineering. Practical in approach: examples of code are provided for students to debug, and tasks – with full solutions – are provided at the end of each chapter. Includes a glossary of useful terms, with each term supported by an example of the syntaxes commonly encountered.

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This text on numerical computing, presented through the medium of the C++ language, is designed for students of science and engineering who are seriously studying numerical methods for the first time. It should also be of interest to computing scientists who wish to see how C++ can be used in earnest for numerical computation. The mathematical prerequisites are those which an undergraduate student of science or engineering might be expected to possess after the earlier years of study: elementary calculus, linear algebra, and differential equations. In computing, a good knowledge, such as Basic, Fortran, or Pascal, is assumed, while a working knowledge of C would be an advantage. However, no prior knowledge of C++ is assumed. The language is developed in step with its numerical applications. Features of the language not used here are ignored. What remains, however, is a powerful framework for numerical computations and more than enough for an introductory text.

Designed for a one-semester course, Introduction to Numerical Analysis and Scientific Computing presents fundamental concepts of numerical mathematics and explains how to implement and program numerical methods. The classroom-tested text helps students understand floating point number representations, particularly those pertaining to IEEE simple an

Features a simplified presentation of numerical methods by introducing and implementing SAGE programs An Introduction to SAGE Programming: With Applications to SAGE Interacts for Numerical Methods emphasizes how to implement numerical methods using SAGE Math and SAGE Interacts and also addresses the fundamentals of computer programming, including if statements, loops, functions, and interacts. The book also provides a unique introduction to SAGE and its computer algebra system capabilities; discusses second and higher order

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equations and estimate limits; and determines derivatives, integrals, and summations. Providing critical resources for developing successful interactive SAGE numerical computations, the book is accessible without delving into the mathematical rigor of numerical methods. The author illustrates the benefits of utilizing the SAGE language for calculus and the numerical analysis of various methods such as bisection methods, numerical integration, Taylor's expansions, and Newton's iterations. Providing an introduction to the terminology and concepts involved, *An Introduction to SAGE Programming: With Applications to SAGE Interacts for Numerical Methods* also features: An introduction to computer programming using SAGE Many practical examples throughout to illustrate the application of SAGE Interacts for various numerical methods Discussions on how to use SAGE Interacts and SAGE Cloud in order to create mathematical demonstrations Numerous homework problems and exercises that allow readers to practice their programming skillset A companion website that includes related SAGE programming code and select solutions to the homework problems and exercises *An Introduction to SAGE Programming: With Applications to SAGE Interacts for Numerical Methods* is an ideal reference for applied mathematicians who need to employ SAGE for the study of numerical methods and analysis. The book is also an appropriate supplemental textbook for upper-undergraduate and graduate-level courses in numerical methods.

Introduction to Numerical and Analytical Methods with MATLAB for Engineers and Scientists provides the basic concepts of programming in MATLAB for engineering applications. Teaches engineering students how to write computer programs on the MATLAB platform Examines the selection and use of numerical and analytical methods through examples and cas

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"This book is appropriate for an applied numerical analysis course for upper-level undergraduate and graduate students as well as computer science students. Actual programming is not covered, but an extensive range of topics includes round-off and function evaluation, real zeros of a function, integration, ordinary differential equations, optimization, orthogonal functions, Fourier series, and much more. 1989 edition"--Provided by publisher.

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