



Introduction to Numerical Computing

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Abstract

The main aim of this paper is to understand the information to numerical computing. In this paper we solve some examples of numerical computing. The numerical computational techniques are the technique by which mathematical problems are formulated and they can be solved with arithmetic operations. Those techniques are basically numerical methods. Numerical method supports the solution of almost every type of problems. The numerical methods are classified depending upon the type of the problem.

Keywords: Numerical computing; Roots of equation

Introduction to Numerical Computing

Numerical computing is an approach for solving complex mathematical problems using only simple arithmetic operations [1]. The approach involves formulation of mathematical models physical situations that can be solved with arithmetic operations [2]. It requires development, analysis and use of algorithms. Numerical computations invariably involve a large number of arithmetic calculations and, therefore, require fast and efficient computing devices [3]. The microelectronic revolution and the subsequent development of high, low cost personal computers have had a profound impact on the application of numerical computing methods to solve scientific problems [4].

Numerical Methods are Classified Basically Depending upon the Type of Problem

Numerical methods to find roots of equations

In many Engineering and Science application we come across some algebraic and transcendental equation [5].

Ex. Consider the equation:

$$F(x) = x^2 - 3x + 2$$

Such equation is satisfied at some specific value of x . These values are called roots of the equation. The solution of this equation can be obtained with the help of numerical methods [6].

System of Linear Algebraic Equation

Consider,

$$2x + 3y = 7$$

$$5x + 8y = 18.$$

The values of x and y in these equation can be obtained with help of numerical method [7].

Direct method become complex for no. of variables.

Numerical method are the best solution for large system. Such equation are generated in analysis of electronic ckts. Large structures etc. [8].

Floating Point Numbers

The term floating point is derived from fact that there is fixed no of digit before and after the decimal point i.e., the decimal point can float [9].

There are also representation in which number of digit before and after the decimal no is set called as fixed point representation [10].

In general, floating point representations are slower and less accurate. Than fixed point representation, but they can handled a large range of numbers [11].

Distinguish Between Analog Computing and Digital Computing

Analog computing

Analog refers to the principle of solving a problem by using a tool which operates in way analogues to the problem [12,13]. Many real life measurable quantities are analog in nature: time, temperature, pressure, and speed, for instance. The basic requirement in the application of analog computers is the writing down of differential equations describing the physical systems of interest [14,15].

Digital Computing

A digital computer is a computing device that operates on inputs which are discrete in nature [16,17]. The input data are numbers that may represents numeral, letters, or other special symbols. Digital computers are more accurate than analog computers. Digital computers are widely used for many different applications and are often called general purpose computer [18-20].

Characteristics of Numerical Computing

1. **Accuracy:** Every method of numerical computing introduces errors. They may be either due to using an appropriate in pace of an exact mathematical procedure or due to inexact representation and manipulation of numbers in the computer. These errors affect the accuracy of the results.
2. **Efficiency:** One more consideration in choosing a numerical method for solution of a mathematical model is efficiency.

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Received October 12, 2018; Accepted October 25, 2018; Published October 31, 2018

Citation: Dhene P (2018) Introduction to Numerical Computing. J Appl Computat Math 7: 423. doi: 10.4172/2158-9679.1000423

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Numerical Computing An Introduction

James S. Vandergraft



Numerical Computing An Introduction:

Numerical Computing Lawrence F. Shampine, Richard C. Allen, 1973 **Introduction to Scientific Computing and Data Analysis** Mark H. Holmes, 2023-07-11 This textbook provides an introduction to numerical computing and its applications in science and engineering. The topics covered include those usually found in an introductory course as well as those that arise in data analysis. This includes optimization and regression based methods using a singular value decomposition. The emphasis is on problem solving and there are numerous exercises throughout the text concerning applications in engineering and science. The essential role of the mathematical theory underlying the methods is also considered both for understanding how the method works as well as how the error in the computation depends on the method being used. The codes used for most of the computational examples in the text are available on GitHub. This new edition includes material necessary for an upper division course in computational linear algebra. **Numerical Computing** L. F. Shampine, R. C. Allen, 1963 **Theoretical Numerical Analysis** Peter Linz, 2019-06-12 This concise text introduces numerical analysis as a practical problem solving discipline. The three part presentation begins with the fundamentals of functional analysis and approximation theory. Part II outlines the major results of theoretical numerical analysis reviewing product integration, approximate expansion methods, the minimization of functions and related topics. Part III considers specific subjects that illustrate the power and usefulness of theoretical analysis. Ideal as a text for a one year graduate course, the book also offers engineers and scientists experienced in numerical computing a simple introduction to the major ideas of modern numerical analysis. Some practical experience with computational mathematics and the ability to relate this experience to new concepts is assumed. Otherwise no background beyond advanced calculus is presupposed. Moreover, the ideas of functional analysis used throughout the text are introduced and developed only to the extent they are needed.

Introduction to the Tools of Scientific Computing Einar Smith, 2022-10-27 The book provides an introduction to common programming tools and methods in numerical mathematics and scientific computing. Unlike standard approaches, it does not focus on any specific language but aims to explain the underlying ideas. Typically, new concepts are first introduced in the particularly user friendly Python language and then transferred and extended in various programming environments from C, C++, Julia and MATLAB to Maple and Mathematica. This includes various approaches to distributed computing. By examining and comparing different languages, the book is also helpful for mathematicians and practitioners in deciding which programming language to use for which purposes. At a more advanced level, special tools for the automated solution of partial differential equations using the finite element method are discussed. On a more experimental level, the basic methods of scientific machine learning in artificial neural networks are explained and illustrated. **Introduction to Numerical Analysis and Scientific Computing** Nabil Nassif, Dolly Khuwayri Fayyad, 2016-04-19 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

A Graduate Introduction to Numerical Methods Robert M. Corless, Nicolas Fillion, 2013-12-12 This book provides an extensive introduction to numerical computing from the viewpoint of backward error analysis The intended audience includes students and researchers in science engineering and mathematics The approach taken is somewhat informal owing to the wide variety of backgrounds of the readers but the central ideas of backward error and sensitivity conditioning are systematically emphasized The book is divided into four parts Part I provides the background preliminaries including floating point arithmetic polynomials and computer evaluation of functions Part II covers numerical linear algebra Part III covers interpolation the FFT and quadrature and Part IV covers numerical solutions of differential equations including initial value problems boundary value problems delay differential equations and a brief chapter on partial differential equations The book contains detailed illustrations chapter summaries and a variety of exercises as well some Matlab codes provided online as supplementary material I really like the focus on backward error analysis and condition This is novel in a textbook and a practical approach that will bring welcome attention Lawrence F Shampine A Graduate Introduction to Numerical Methods and Backward Error Analysis has been selected by Computing Reviews as a notable book in computing in 2013 Computing Reviews Best of 2013 list consists of book and article nominations from reviewers CR category editors the editors in chief of journals and others in the computing community

Introduction to Numerical Computations James S. Vandergraft, 2014-05-10 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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algorithms and interpretation of results In the 20 years since its original publication the modern fundamental perspective of this book has aged well and it continues to be used in the classroom This Classics edition has been updated to include pointers to Python software and the Chebfun package expansions on barycentric formulation for Lagrange polynomial interpretation and stochastic methods and the availability of about 100 interactive educational modules that dynamically illustrate the concepts and algorithms in the book Scientific Computing An Introductory Survey Second Edition is intended as both a textbook and a reference for computationally oriented disciplines that need to solve mathematical problems [A Gentle Introduction to Scientific Computing](#) Dan Stancu, Long Lee, 2022-05-01 Scientific Computation has established itself as a stand alone area of knowledge at the borderline between computer science and applied mathematics Nonetheless its interdisciplinary character cannot be denied its methodologies are increasingly used in a wide variety of branches of science and engineering A Gentle Introduction to Scientific Computing intends to serve a very broad audience of college students across a variety of disciplines It aims to expose its readers to some of the basic tools and techniques used in computational science with a view to helping them understand what happens behind the scenes when simple tools such as solving equations plotting and interpolation are used To make the book as practical as possible the authors explore their subject both from a theoretical mathematical perspective and from an implementation driven programming perspective Features Middle ground approach between theory and implementation Suitable reading for a broad range of students in STEM disciplines Could be used as the primary text for a first course in scientific computing Introduces mathematics majors without any prior computer science exposure to numerical methods All mathematical knowledge needed beyond Calculus together with the most widely used Calculus notation and concepts is introduced in the text to make it self contained The erratum document for A Gentle Introduction to Scientific Computing can be accessed here **Numerical Analysis in Modern Scientific Computing** Peter Deufhard, Andreas Hohmann, 2012-12-06 Mathematics is playing an ever more important role in the physical and biological sciences provoking a blurring of boundaries between scientific disciplines and a resurgence of interest in the modern as well as the classical techniques of applied mathematics This renewal of interest both in research and teaching has led to the establishment of the series Texts in Applied Mathematics TAM The development of new courses is a natural consequence of a high level of excitement on the research frontier as newer techniques such as numerical and symbolic computer systems dynamical systems and chaos mix with and reinforce the traditional methods of applied mathematics Thus the purpose of this textbook series is to meet the current and future needs of these advances and to encourage the teaching of new courses TAM will publish textbooks suitable for use in advanced undergraduate and beginning graduate courses and will complement the Applied Mathematical Sciences AMS series which will focus on advanced textbooks and research level monographs *Numerical Computing* Lawrence F. Shampine, 1973 *Scientific Computing - An Introduction using Maple and MATLAB* Walter Gander, Martin J. Gander, Felix Kwok, 2014-04-23 Scientific computing is the study of how to use

computers effectively to solve problems that arise from the mathematical modeling of phenomena in science and engineering. It is based on mathematics numerical and symbolic algebraic computations and visualization. This book serves as an introduction to both the theory and practice of scientific computing with each chapter presenting the basic algorithms that serve as the workhorses of many scientific codes; we explain both the theory behind these algorithms and how they must be implemented in order to work reliably in finite precision arithmetic. The book includes many programs written in Matlab and Maple. Maple is often used to derive numerical algorithms whereas Matlab is used to implement them. The theory is developed in such a way that students can learn by themselves as they work through the text. Each chapter contains numerous examples and problems to help readers understand the material.

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Numerical Computing with MATLAB Cleve B. Moler, 2004-01-01 This is a lively textbook for an introductory course in numerical methods, MATLAB, and technical computing, with an emphasis on the informed use of mathematical software. The presentation helps readers learn enough about the mathematical functions in MATLAB to use them correctly, appreciate their limitations, and modify them appropriately. The book makes extensive use of computer graphics, including interactive graphical expositions of numerical algorithms. It provides more than 70 M-files which can be downloaded from the text Web site www.mathworks.com/moler. Many of the numerous exercises involve modifying and extending these programs. The topics covered include an introduction to MATLAB, linear equations, interpolation, zeros and roots, least squares, quadrature, ordinary differential equations, Fourier analysis, random numbers, eigenvalues and singular values, and partial differential equations. Motivating applications include modern problems from cryptography, touch tone dialing, Google page ranking, atmospheric science, and image processing, as well as classical problems from physics and engineering.

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