Local Error-- Numerical Analysis (computer science)

Just show how the local error is 28% (show all work... the part marked in red box).

Local error I believe you would need to use local truncation error (Taylor Series)

# Example 1: Euler's Method

Solve numerically:  $\frac{dy}{dx} = -2x^3 + 12x^2 - 20x + 8.5$ 

From x=0 to x=4 with step size h=0.5

initial condition: (x=0; y=1)

Exact Solution:  $y = -0.5x^4 + 4x^3 - 10x^2 + 8.5x + 1$ 

Numerical

Solution:  $y_{i+1} = y_i + f(x_i, y_i) \Delta x$ 

y(0.5) = y(0)+f(0, 1)0.5 = 1+8.5\*0.5 = 5.25(true solution at x=0.5 is y(0.5) = 3.22 and  $\epsilon_t = 63\%$ )

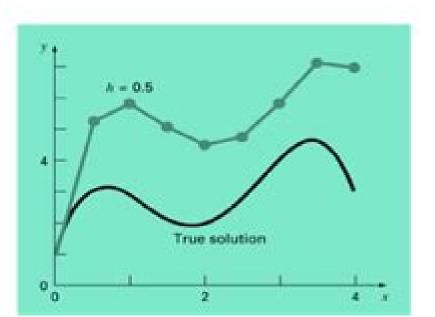
$$y(1) = y(0.5)+f(0.5, 5.25)0.5$$
  
= 5.25+[-2(0.5)<sup>3</sup>+12(0.5)<sup>2</sup>-20(0.5)+8.5]\*0.5  
= 5.25+0.625 = 5.875

(true solution at x=1 is y(1) = 3 and  $\varepsilon_t = 96\%$ )

$$y(1.5) = y(1)+f(1, 5.875)0.5 = 5.125$$

.....

x	Yeuler	Ytrue	total error (%)	local error (%)
0	1	1	NA	NA
0.5	5.25	3.218	63.1	63.1
1	5.875	3	95.8	28
1.5	5.125	2.218	131	1.41
2	4.5	2	125	20.5



# **Numerical Analysis For Computer Science**

Michael Oberguggenberger, Alexander Ostermann

#### **Numerical Analysis For Computer Science:**

Numerical Computation 1 Christoph W. Ueberhuber, 2012-12-06 This book deals with various aspects of scientific numerical computing No at tempt was made to be complete or encyclopedic The successful solution of a numerical problem has many facets and consequently involves different fields of computer science Computer numerics as opposed to computer algebra is thus based on applied mathematics numerical analysis and numerical computation as well as on certain areas of computer science such as computer architecture and operating systems Applied Mathemalies I I I Numerical Analysis Analysis Algebra I I Numerical Computation Symbolic Computation I Operating Systems Computer Hardware Each chapter begins with sample situations taken from specific fields of application Abstract and general formulations of mathematical problems are then presented Following this abstract level a general discussion about principles and methods for the numerical solution of mathematical problems is presented Relevant algorithms are developed and their efficiency and the accuracy of their results is assessed It is then explained as to how they can be obtained in the form of numerical software The reader is presented with various ways of applying the general methods and principles to particular classes of problems and approaches to extracting practically useful solutions with appropriately chosen numerical software are developed Potential difficulties and obstacles are examined and ways of avoiding them are discussed The volume and diversity of all the available numerical software is tremendous Numerical Analysis David Ronald Kincaid, Elliott Ward Cheney, 2009 This book introduces students with diverse backgrounds to various types of mathematical analysis that are commonly needed in scientific computing The subject of numerical analysis is treated from a mathematical point of view offering a complete analysis of methods for scientific computing with appropriate motivations and careful proofs In an engaging and informal style the authors demonstrate that many computational procedures and intriguing questions of computer science arise from theorems and proofs Algorithms are presented in pseudocode so that students can immediately write computer programs in standard languages or use interactive mathematical software packages This book occasionally touches upon more advanced topics that are not usually contained in standard textbooks at this level **Numerical Analysis in Modern Scientific Computing** Peter Deuflhard, 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 Mathe matical Sciences AMS series which will focus on advanced textbooks and research level monographs Numerical Analysis and Scientific Computation Jeffery J. Leader, 2004 This text is intended for a first course in Numerical Analysis taken by students majoring in mathematics engineering computer science and the sciences This text emphasizes the mathematical ideas behind the methods and the idea of mixing methods for robustness The optional use of MATLAB is incorporated throughout the text Mathematics, Numerical Analysis and Applications Mariano Mateos, Pedro Alonso, 2017-08-03 The first part of this volume gathers the lecture notes of the courses of the XVII Escuela Hispano Francesa held in Gij n Spain in June 2016 Each chapter is devoted to an advanced topic and presents state of the art research in a didactic and self contained way Young researchers will find a complete guide to beginning advanced work in fields such as High Performance Computing Numerical Linear Algebra Optimal Control of Partial Differential Equations and Quantum Mechanics Simulation while experts in these areas will find a comprehensive reference guide including some previously unpublished results and teachers may find these chapters useful as textbooks in graduate courses The second part features the extended abstracts of selected research work presented by the students during the School It highlights new results and applications in Computational Algebra Fluid Mechanics Chemical Kinetics and Biomedicine among others offering interested researchers a convenient reference guide to Analysis for Computer Scientists Michael Oberguggenberger, Alexander Ostermann, 2018-10-24 these latest advances This easy to follow textbook reference presents a concise introduction to mathematical analysis from an algorithmic point of view with a particular focus on applications of analysis and aspects of mathematical modelling The text describes the mathematical theory alongside the basic concepts and methods of numerical analysis enriched by computer experiments using MATLAB Python Maple and Java applets This fully updated and expanded new edition also features an even greater number of programming exercises Topics and features describes the fundamental concepts in analysis covering real and complex numbers trigonometry sequences and series functions derivatives integrals and curves discusses important applications and advanced topics such as fractals and L systems numerical integration linear regression and differential equations presents tools from vector and matrix algebra in the appendices together with further information on continuity includes added material on hyperbolic functions curves and surfaces in space second order differential equations and the pendulum equation NEW contains experiments exercises definitions and propositions throughout the text supplies programming examples in Python in addition to MATLAB NEW provides supplementary resources at an associated website including Java applets code source files and links to interactive online learning material Addressing the core needs of computer science students and researchers this clearly written textbook is an essential resource for undergraduate level courses on numerical analysis and an ideal self study tool for professionals seeking to enhance their analysis skills Numerical Analysis Using Sage George A. Anastassiou, Razvan A. Mezei, 2015-04-11 This is the first numerical analysis

text to use Sage for the implementation of algorithms and can be used in a one semester course for undergraduates in mathematics math education computer science information technology engineering and physical sciences. The primary aim of this text is to simplify understanding of the theories and ideas from a numerical analysis numerical methods course via a modern programming language like Sage Aside from the presentation of fundamental theoretical notions of numerical analysis throughout the text each chapter concludes with several exercises that are oriented to real world application. Answers may be verified using Sage The presented code written in core components of Sage are backward compatible i e easily applicable to other software systems such as Mathematica Sage is open source software and uses Python like syntax. Previous Python programming experience is not a requirement for the reader though familiarity with any programming language is a plus Moreover the code can be written using any web browser and is therefore useful with Laptops Tablets iPhones Smartphones etc All Sage code that is presented in the text is openly available on SpringerLink com

**NUMERICAL ANALYSIS** Vinay Vachharajani, 2018-06-01 Description This book is Designed to serve as a text book for the undergraduate as well as post graduate students of Mathematics Engineering Computer Science COVERAGE Concept of numbers and their accuracy binary and decimal number system limitations of floating point representation Concept of error and their types propagation of errors through process graph Iterative methods for finding the roots of algebraic and transcendental equations with their convergence methods to solve the set of non linear equations methods to obtain complex roots Concept of matrices the direct and iterative methods to solve a system of linear algebraic equations Finite differences interpolation and extrapolation methods cubic spline concept of curve fitting Differentiation and integration methods Solution of ordinary and partial differential equations SALIENT FEATURES Chapters include objectives learning outcomes multiple choice questions exercises for practice and solutions Programs are written in C Language for Numerical methods Topics are explained with suitable examples Arrangement Logical order clarity detailed presentation and explanation of each topic with numerous solved and unsolved examples Concise but lucid and student friendly presentation for derivation of formulas used in various numerical methods Table Of Contents Computer ArithmeticError Analysis Solution of Algebraic and Transcendental Equations Solution of System of Linear Equations and Eigen value Problems Finite Differences Interpolation Curve Fitting and Approximation Numerical Differentiation Numerical Integration Difference Equations Numerical Solution of Ordinary Differential Equations Numerical Solution of Partial Differential Equations Appendix I Case Studies Applications Appendix II Synthetic Division Bibliography Index Computer Science Numerical Analysis and Computing National Physical Laboratory (Great Britain), 1972 **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 Numerical Methods Anne Greenbaum, Tim P. Chartier, 2012-04-01 A rigorous and comprehensive introduction to numerical analysis Numerical Methods provides a clear and concise exploration of standard numerical analysis topics as well as nontraditional ones including mathematical modeling Monte Carlo methods Markov chains and fractals Filled with appealing examples that will motivate students the textbook considers modern application areas such as information retrieval and animation and classical topics from physics and engineering Exercises use MATLAB and promote understanding of computational results The book gives instructors the flexibility to emphasize different aspects design analysis or computer implementation of numerical algorithms depending on the background and interests of students Designed for upper division undergraduates in mathematics or computer science classes the textbook assumes that students have prior knowledge of linear algebra and calculus although these topics are reviewed in the text Short discussions of the history of numerical methods are interspersed throughout the chapters The book also includes polynomial interpolation at Chebyshev points use of the MATLAB package Chebfun and a section on the fast Fourier transform Supplementary materials are available online Clear and concise exposition of standard numerical analysis topics Explores nontraditional topics such as mathematical modeling and Monte Carlo methods Covers modern applications including information retrieval and animation and classical applications from physics and engineering Promotes understanding of computational results through MATLAB exercises Provides flexibility so instructors can emphasize mathematical or applied computational aspects of numerical methods or a combination Includes recent results on polynomial interpolation at Chebyshev points and use of the MATLAB package Chebfun Short discussions of the history of numerical methods interspersed throughout Supplementary materials available online **Introduction to Numerical Computation in Pascal** DEW/JAMES, 2013-06-29 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 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 Numerical Methods for Mathematics. Science, and Engineering John H. Mathews, 1992 A modern computer oriented approach to numerical analysis that shows how the mathematics of calculus and linear algebra are implemented in computer algorithms Computer output is displayed in tables and used to develop topics of computer accuracy pitfalls in computational methods and error estimation

**Numerical Analysis** Larkin Ridgway Scott, 2011-04-18 Computational science is fundamentally changing how technological questions are addressed The design of aircraft automobiles and even racing sailboats is now done by computational simulation. The mathematical foundation of this new approach is numerical analysis which studies algorithms for computing expressions defined with real numbers Emphasizing the theory behind the computation this book provides a rigorous and self contained introduction to numerical analysis and presents the advanced mathematics that underpin industrial software including complete details that are missing from most textbooks Using an inquiry based learning approach Numerical Analysis is written in a narrative style provides historical background and includes many of the proofs and technical details in exercises Students will be able to go beyond an elementary understanding of numerical simulation and develop deep insights into the foundations of the subject They will no longer have to accept the mathematical gaps that exist in current textbooks For example both necessary and sufficient conditions for convergence of basic iterative methods are covered and proofs are given in full generality not just based on special cases The book is accessible to undergraduate mathematics majors as well as computational scientists wanting to learn the foundations of the subject Presents the mathematical foundations of numerical analysis Explains the mathematical details behind simulation software Introduces many advanced concepts in modern analysis Self contained and mathematically rigorous Contains problems and solutions in each chapter Excellent follow up course to Principles of Mathematical Analysis by Rudin Introduction to Numerical Analysis Devi Prasad, 2005 An Introduction to Numerical Analysis is designed for a first course on numerical analysis for students of Science and Engineering including Computer Science The text contains derivation of algorithms for solving engineering and science problems and also deals with error analysis It has numerical examples suitable for solving through computers The special features are comparative efficiency and accuracy of various algorithms due to finite digit arithmetic used by the computers Numerical Methods for Equations and Its Applications Ioannis K. Argyros, 2012 This monograph is intended for researchers in computational sciences and as a reference book for an advanced numerical functional analysis or computer science course The goal is to introduce these powerful concepts and techniques at the earliest possible stage The reader is assumed to have had basic courses in numerical analysis computer programming computational linear algebra and an introduction to real complex and functional analysis Although the book is of a theoretical nature with optimization and weakening of existing hypotheses considerations each chapter contains several new theoretical results and important applications in engineering in dynamic economics systems in input output system in the solution of nonlinear and linear differential equations and optimization problem A Brief Introduction to Numerical Analysis Eugene E. Tyrtyshnikov, 2012-12-14 A logically organized advanced textbook which turns the reader into an active participant by asking questions hinting giving direct recommendations comparing different methods and discussing pessimistic and

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#### **Table of Contents Numerical Analysis For Computer Science**

- 1. Understanding the eBook Numerical Analysis For Computer Science
  - The Rise of Digital Reading Numerical Analysis For Computer Science
  - Advantages of eBooks Over Traditional Books
- 2. Identifying Numerical Analysis For Computer Science
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
- 3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Numerical Analysis For Computer Science
  - User-Friendly Interface
- 4. Exploring eBook Recommendations from Numerical Analysis For Computer Science

- Personalized Recommendations
- Numerical Analysis For Computer Science User Reviews and Ratings
- Numerical Analysis For Computer Science and Bestseller Lists
- 5. Accessing Numerical Analysis For Computer Science Free and Paid eBooks
  - Numerical Analysis For Computer Science Public Domain eBooks
  - Numerical Analysis For Computer Science eBook Subscription Services
  - Numerical Analysis For Computer Science Budget-Friendly Options
- 6. Navigating Numerical Analysis For Computer Science eBook Formats
  - o ePub, PDF, MOBI, and More
  - Numerical Analysis For Computer Science Compatibility with Devices
  - Numerical Analysis For Computer Science Enhanced eBook Features
- 7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Numerical Analysis For Computer Science
  - Highlighting and Note-Taking Numerical Analysis For Computer Science
  - Interactive Elements Numerical Analysis For Computer Science
- 8. Staying Engaged with Numerical Analysis For Computer Science
  - o Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Numerical Analysis For Computer Science
- 9. Balancing eBooks and Physical Books Numerical Analysis For Computer Science
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Numerical Analysis For Computer Science
- 10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
- 11. Cultivating a Reading Routine Numerical Analysis For Computer Science
  - Setting Reading Goals Numerical Analysis For Computer Science
  - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Numerical Analysis For Computer Science

- Fact-Checking eBook Content of Numerical Analysis For Computer Science
- Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
  - Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
- 14. Embracing eBook Trends
  - Integration of Multimedia Elements
  - Interactive and Gamified eBooks

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