

CHAPTER 2. INTEGRALS AS SUMS AND DERIVATIVES AS DIFFERENCES

approximate the integral over $[x_{j-1}, x_j]$ by the signed area of the rectangle of height $f(x_{j-1})$ and width h :

$$\int_{x_{j-1}}^{x_j} f(x) dx \simeq h f(x_{j-1}).$$

Putting the terms back together, we obtain the *rectangle method*:

$$\int_0^1 f(x) dx \simeq h \sum_{j=1}^N f(x_{j-1}).$$

(Insert picture here)

To understand the accuracy of this approximation, we need a detour through Taylor expansions. Given a very smooth function $f(x)$, it sometimes makes sense to write an expansion around the point $x = a$, as

$$f(x) = f(a) + f'(a)(x - a) + \frac{1}{2}f''(a)(x - a)^2 + \frac{1}{3!}f'''(a)(x - a)^3 + \dots$$

As a compact series, this would be written as

$$f(x) = \sum_{n=0}^{\infty} \frac{1}{n!} f^{(n)}(a)(x - a)^n,$$

where $n! = n \cdot (n - 1) \cdot \dots \cdot 2 \cdot 1$ is the factorial of n . The word “sometimes” is important: the formula above requires the function to be infinitely differentiable, and even still, we would need to make sure that the series converges (by means of the analysis of the previous chapter). The radius of convergence of the Taylor expansion is the largest R such that, for all x such that $|x - a| < R$, the series converges.

It is also possible to truncate a Taylor series after N terms, as

$$f(x) = \sum_{n=0}^{N-1} \frac{1}{n!} f^{(n)}(a)(x - a)^n + \frac{1}{N!} f^{(N)}(y)(x - a)^N, \quad (2.1)$$

where y is some number between x and a . The formula does not specify what the number y is; only that there exists one such that the remainder takes the form of the last term. In spite of the fact that y is unspecified, this is a much more useful form of Taylor expansion than the infinite series:

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Ginés Lifante



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Canadian Mathematical Bulletin ,1966 Catalogue for the Academic Year Naval Postgraduate School (U.S.),1958

Vibrations, Dynamics and Structural Systems 2nd edition Madhujit Mukhopadhyay,2023-06-14 This textbook is the student edition of the work on vibrations dynamics and structural systems There are exercises included at the end of each chapter **A Comparison of Explicit Time Integration Techniques for the Finite Element Shock Wave Equations** E. W. Miner,1983 Numerical studies of three explicit two step time integration techniques for the one dimensional finite element shock wave equations have been conducted One of these integration techniques the Godunov scheme is first order accurate in time while the other the Lax Wendroff scheme is second order accurate in time The results show that overall the best numerical solutions were obtained by the standard Godunov scheme with either linear or parabolic spatial element A central weighted first step Godunov time integration provided results nearly as good The results of the condensed mass matrix formulation were clearly not as good as the results for the full matrix Results for the Lax Wendroff time integration showed severe oscillations in the solution and consequently were not as good as the Godunov time integration The present finite element results compare quite favorably with results from standard finite difference methods Author **Integration of Equations of Parabolic Type by the Method of Nets** V. K. Saul'Yev,2014-07-10 International Series of Monographs in Pure and Applied Mathematics Volume 54 Integration of Equations of Parabolic Type by the Method of Nets deals with solving parabolic partial differential equations using the method of nets The first part of this volume focuses on the construction of net equations with emphasis on the stability and accuracy of the approximating net equations The method of nets or method of finite differences used to define the corresponding numerical method in ordinary differential equations is one of many different approximate methods of integration of partial differential equations The other methods and some based on newer equations are described By analyzing these newer methods older and existing methods are evaluated For example the asymmetric net equations the alternating method of using certain equations and the method of mean arithmetic and multi nodal symmetric method point out that when the accuracy needs to be high the requirements for stability become more defined The methods discussed are very theoretical and methodological The second part of the book concerns the practical numerical solution of the equations posed in Part I Emphasis is on the commonly used iterative methods that are programmable on computers This book is suitable for statisticians and numerical analysts and is also recommended for scientists and engineers with general mathematical knowledge **Computer Aided and Integrated Manufacturing Systems: Optimization methods** Cornelius T. Leondes,2003 This is an invaluable five volume reference on the very broad and highly significant subject of computer aided and integrated manufacturing systems It is a set of distinctly titled and well harmonized volumes by leading experts on the international scene The techniques and technologies used in computer aided and integrated manufacturing systems have produced and will no doubt continue to produce major annual improvements in

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Table of Contents Numerical Methods 2 Differences Integrat

1. Understanding the eBook Numerical Methods 2 Differences Integrat
 - The Rise of Digital Reading Numerical Methods 2 Differences Integrat
 - Advantages of eBooks Over Traditional Books
2. Identifying Numerical Methods 2 Differences Integrat
 - 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 Methods 2 Differences Integrat
 - User-Friendly Interface
4. Exploring eBook Recommendations from Numerical Methods 2 Differences Integrat
 - Personalized Recommendations
 - Numerical Methods 2 Differences Integrat User Reviews and Ratings
 - Numerical Methods 2 Differences Integrat and Bestseller Lists

5. Accessing Numerical Methods 2 Differences Integrat Free and Paid eBooks
 - Numerical Methods 2 Differences Integrat Public Domain eBooks
 - Numerical Methods 2 Differences Integrat eBook Subscription Services
 - Numerical Methods 2 Differences Integrat Budget-Friendly Options
6. Navigating Numerical Methods 2 Differences Integrat eBook Formats
 - ePub, PDF, MOBI, and More
 - Numerical Methods 2 Differences Integrat Compatibility with Devices
 - Numerical Methods 2 Differences Integrat Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Numerical Methods 2 Differences Integrat
 - Highlighting and Note-Taking Numerical Methods 2 Differences Integrat
 - Interactive Elements Numerical Methods 2 Differences Integrat
8. Staying Engaged with Numerical Methods 2 Differences Integrat
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Numerical Methods 2 Differences Integrat
9. Balancing eBooks and Physical Books Numerical Methods 2 Differences Integrat
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Numerical Methods 2 Differences Integrat
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Numerical Methods 2 Differences Integrat
 - Setting Reading Goals Numerical Methods 2 Differences Integrat
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Numerical Methods 2 Differences Integrat
 - Fact-Checking eBook Content of Numerical Methods 2 Differences Integrat
 - 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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