Numerical Analysis (The Bisection Method)

Introduction

The bisection method is simple, robust, and straight-forward: take an interval [a, b] such that f(a) and f(b) have opposite signs, find the midpoint of [a, b], and then decide whether the root lies on [a, (a + b)/2] or [(a + b)/2, b]. Repeat until the interval is sufficiently small.

Background

Useful background for this topic includes:

- 3. Iteration
- 8. Bracketing

References

- Bradie, Section 2.1, The Bisection Method, p.58.
- Mathews, Section 2.2, Bisection Method of Bolzano, p.53.
- Weisstein, http://mathworld.wolfram.com/Bisection.html.

Theory

Intermediate Value Theorem (IVT)

Given a continuous real-valued function f(x) defined on an interval [a, b], then if y is a point between the values of f(a) and f(b), then there exists a point r such that y = f(r).

As an example, consider the function f(x) = sin(x) defined on [1, 6]. The function is continuous on this interval, and the point 0.5 lies between the values of sin(1) = 0.841 and sin(6) = -0.279. Thus, there is at least one point r (there may be more) on the interval [1, 6] such that sin(r) = 0.5. In this case, r = 2.61799. This is shown in Figure 1.

Figure 1. The IVT applied to sin(x) on [1, 6] with y = 0.5.

Using the IVT to Bound a Root

Numerical Analysis Bsc Bisection Method Notes

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Numerical Analysis Bsc Bisection Method Notes:

Numerical Analysis and Computer Programming Pradip Narain and Tajender Singh Saluja,2008 Pradip Narain popularly known as PN sir has been teaching undergraduate and post graduate students of Mathematics for over thirty years After topping the Delhi University in MA Mathematics from St Stephen s College he taught in the department of Mathematics Economics and Commerce at St Stephen s College Hindu College and Jesus and Mary College and in the department of Business Economics at University of Delhi South Campus He is currently the Director of Alpha Plus Study Circle Tajender Singh Saluja teaches NACP and Mechanics at PNs Alpha Plus Study Circle He is well known for his lucid effective style of teaching As a student he had received a silver medal in the National Mathematics Olympiad Salient Features Covers both Numerical Analysis NA and Computer Programming CP in a single volume Written strictly according to the syllabus and guidelines of BA BSc Mathematics Hons of Delhi University Also useful for other Indian Universities and Competitive Examinations Concepts methods 137 questions 76 examples and 58 assignments given in a simple step by step graded form Formulation of 59 programs made easy Perfect for self study no teacher required All guidelines problems fully solved All questions of University examinations since 1994 included and solved in the text at relevant places Contains Frequency Table indicating the importance of each topic **Numerical Analysis of Spectral Methods** David Gottlieb,Steven A. Orszag,1977-01-01 A unified discussion of the formulation and analysis of special methods of mixed initial boundary value problems The focus is on the development of a new mathematical theory that explains why and how well spectral methods work Included are interesting extensions of the classical numerical analysis *An Introduction to the Numerical Analysis of Spectral Methods* Bertrand Mercier,2014-08-23 This is a very lucid introduction to spectral methods emphasizing the mathematical aspects of the theory rather than the many applications in numerical analysis and the engineering sciences The first part is a fairly complete introduction to Fourier series while the second emphasizes polynomial expansion methods like Chebyshev s The author gives rigorous proofs of fundamental results related to one dimensional advection and diffusions equations The book addresses students as well as practitioners of numerical analysis **Afternotes Goes to Graduate School** G. W. Stewart,1998 Afternotes on Numerical Analysis is the result of the author writing down his notes immediately after giving each lecture **Topics in Numerical Analysis** P. R Turner,2014-01-15 **Teapack Users' Manual** Robert L. Johnston,1982-01-01 Spectral Methods Jie Shen,Tao Tang,Li-Lian Wang,2011-08-25 Along with finite differences and finite elements spectral methods are one of the three main methodologies for solving partial differential equations on computers This book provides a detailed presentation of basic spectral algorithms as well as a systematical presentation of basic convergence theory and error analysis for spectral methods Readers of this book will be exposed to a unified framework for designing and analyzing spectral algorithms for a variety of problems including in particular high order differential equations and problems in unbounded domains The book contains a large number of figures which are designed

to illustrate various concepts stressed in the book A set of basic matlab codes has been made available online to help the readers to develop their own spectral codes for their specific applications   **Continuous Method in Numerical Analysis Applied to Examples from a New Class of Boundry Value Problems** H. Melvin Lieberstein,University of Wisconsin--Madison. Mathematics Research Center,Mathematics Research Center (United States. Army),1960

Innovative Methods in Numerical Analysis Association internationale pour les mathématiques et calculateurs en simulation,1994   Topic in Numerical Methods John H. Halton,1982   **Numerical Analysis and Scientific Computing for Partial Differential Equations and Their Challenging Applications** Rolf Stenberg,Jacques Periaux,Pekka Neittaanmäki,Juha Haataja,Peter Råback,2008   **Numerical Analysis of Spectral Methods: Theory and Applicatons** D. Gottlieb,S. Orszag,1986

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