Approximation Theory and Approximation Practice (Applied Mathematics)

By Lloyd N. Trefethen

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In a book that will appeal to beginners and experts alike, Oxford University s Nick Trefethen presents approximation theory using a fresh approach for this established field.

Approximation Theory and Approximation Practice is a textbook on classical polynomial and rational approximation theory for the twenty-first century. It uses MATLAB to teach the field s most important ideas and results and differs fundamentally from other works on approximation theory in a number of ways: its emphasis is on topics close to numerical algorithms; concepts are illustrated with Chebfun; and each chapter is a PUBLISHable Matlab M-file, available online.

In addition, the book centers on theorems and methods for analytic functions, which appear so often in applications, rather than on functions at the edge of discontinuity with their seductive theoretical challenges. Original sources are cited rather than textbooks, and each item in the bibliography is accompanied by an editorial comment.

Each chapter has a collection of exercises, which span a wide range from mathematical theory to Chebfun-based numerical experimentation.

Audience: This textbook is appropriate for advanced undergraduate or graduate students who have an understanding of numerical analysis and complex analysis. It is also appropriate for seasoned mathematicians who use MATLAB.

Contents:1. Introduction; 2. Chebyshev Points and Interpolants; 3. Chebyshev Polynomials and Series; 4. Interpolants, Projections, and Aliasing; 5. Barycentric Interpolation Formula; 6. Weierstrass Approximation Theorem; 7. Convergence for Differentiable Functions; 8. Convergence for Analytic Functions; 9. Gibbs Phenomenon; 10. Best Approximation; 11. Hermite Integral Formula; 12.

Potential Theory and Approximation; 13. Equispaced Points, Runge Phenomenon; 14. Discussion of High-Order Interpolation; 15. Lebesgue Constants; 16. Best and Near-Best; 17. Orthogonal Polynomials; 18. Polynomial Roots and Colleague Matrices; 19. Clenshaw--Curtis and Gauss Quadrature; 20. Carathéodory--Fejér Approximation; 21. Spectral Methods; 22. Linear Approximation: Beyond Polynomials; 23. Nonlinear Approximation: Why Rational Functions?; 24. Rational Best Approximation; 25. Two Famous Problems; 26. Rational Interpolation and Linearized Least-Squares; 27. Padé Approximation; 28. Analytic Continuation and Convergence Acceleration; Appendix: Six Myths of Polynomial Interpolation and Quadrature.

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Approximation Theory and Approximation Practice (Applied Mathematics) By Lloyd N. Trefethen Bibliography

- Rank: #621267 in Books
- Published on: 2012-12-03
- Original language: English
- Number of items: 1
- Dimensions: 9.72" h x .59" w x 6.85" l, .0 pounds
- Binding: Paperback
- 318 pages

Editorial Review

About the Author
Nick Trefethen is Professor of Numerical Analysis at the University of Oxford, a Fellow of the Royal Society, and a member of the U.S. National Academy of Engineering. He is also a SIAM Fellow and served as SIAM President from 2011-2012.

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