

REFERENCES

Each reference is followed by a note highlighting a contribution of that publication that is relevant to this book. These notes are by no means comprehensive: in most cases the references include other significant contributions too. Papers listed by authors such as Cauchy, Chebyshev, Gauss, Jacobi, and Weierstrass can also be found in their collected works.

Among mathematicians of the 19th century, it is hard not to be struck by the remarkable creativity of Jacobi (1804–1851), who in his short life made key early contributions to barycentric interpolation [1825], orthogonal polynomials and Gauss quadrature [1826], and Padé approximation and rational interpolation [1846], as well as innumerable topics outside the scope of this book.

As of May 2012, the Mathematics Genealogy Project lists 8605 academic descendants of Pafnuty Lvovich Chebyshev. For example, one chain runs Chebyshev–Lyapunov–Steklov–Smirnov–Sobolev–V. I. Lebedev, and another runs Chebyshev–Markov–Voronoy–Sierpinsky–Mazurkiewicz–Zygmund–Stein–C. Fefferman.

N. I. ACHIESER, On extremal properties of certain rational functions (Russian), *DAN* 18 (1930), 495–499. [Equioscillation characterization for best rational approximations.]

N. I. ACHIESER, *Theory of Approximation*, Dover, 1992. [Treatise by one of Chebyshev’s academic great-grandsons, first published in 1956.]

V. ADAMYAN, D. AROV AND M. KREIN, Analytic properties of Schmidt pairs for a Hankel operator and the generalized Schur–Takagi problem, *Math. USSR Sb.* 15 (1971), 31–73. [Major work with a general extension of results of Carathéodory, Fejér, Schur and Takagi to rational approximation on the unit circle.]

L. AHLFORS, *Complex Analysis*, 3rd ed., McGraw-Hill, 1978. [A terse and beautiful complex analysis text by one of the masters, first published in 1953.]

N. AHMED AND P. S. FISHER, Study of algorithmic properties of Chebyshev coefficients, *Int. J. Comp. Math.* 2 (1970), 307–317. [Possibly the first paper to point out that Chebyshev coefficients can be computed by Fast Fourier Transform.]

A. C. AITKEN, On Bernoulli’s numerical solution of algebraic equations, *Proc. Roy. Soc. Edinb.* 46 (1926), 289–305.

B. K. ALPERT AND V. ROKHLIN, A fast algorithm for the evaluation of Legendre expansions, *SIAM J. Sci. Stat. Comp.* 12 (1991), 158–179. [Algorithm for converting between Legendre and Chebyshev expansion coefficients.]

A. AMIRASLANI, *New Algorithms for Matrices, Polynomials, and Matrix Polynomials*, PhD diss., U. Western Ontario, 2006. [Algorithms related to rootfinding by values rather than Chebyshev coefficients.]

A. AMIRASLANI, R. M. CORLESS, L. GONZALEZ-VEGA AND A. SHAKOORI, Polynomial algebra by values, TR-04-01, Ontario Research Center for Computer Algebra, www.orcca.on.ca, 2004. [Outlines eigenvalue-based algorithms for finding roots of polynomials from their values at sample points rather than from coefficients in an expansion.]

A. C. ANTOUNAS, *Approximation of Large-Scale Dynamical Systems*, SIAM, 2005. [Textbook about model reduction, a subject making much use of rational approximation.]

A. I. APTEKAREV, Sharp constants for rational approximations of analytic functions, *Math. Sbornik* 193 (2002), 1–72. [Extends the result of Gonchar & Rakhmanov 1989]

on rational approximation of e^x on $(-\infty, 0]$ to give the precise asymptotic form $E_{nn} \sim 2H^{n+1/2}$ first conjectured by Magnus, where H is Halphen's constant.]

T. BAGBY AND N. LEVENBERG, Bernstein theorems, *New Zeal. J. Math.* 22 (1993), 1–20. [Presentation of four proofs of Bernstein's result that best polynomial approximants to a function $f \in C([-1, 1])$ converge geometrically if and only if f is analytic, with discussion of extension to higher dimension.]

G. A. BAKER, JR. AND P. GRAVES-MORRIS, *Padé Approximants*, 2nd ed., Cambridge U. Press, 1996. [The standard reference on many aspects of Padé approximations and their applications.]

N. S. BAKHVALOV, On the optimal speed of integrating analytic functions, *Comput. Math. Math. Phys.* 7 (1967), 63–75. [A theoretical paper that introduces the idea of going beyond polynomials to speed up Gauss quadrature by means of a change of variables/conformal map, as in Hale & Trefethen 2008.]

S. BARNETT (1975A), A companion matrix analogue for orthogonal polynomials, *Lin. Alg. Applies.* 12 (1975), 197–208. [Generalization of Good's colleague matrices to orthogonal polynomials other than Chebyshev. Barnett apparently did not know that Specht 1957 had covered the same ground.]

S. BARNETT (1975B), Some applications of the comrade matrix, *Internat. J. Control* 21 (1975), 849–855. [Further discussion of comrade matrices.]

Z. BATTLES, *Numerical Linear Algebra for Continuous Functions*, DPhil thesis, Oxford U. Computing Laboratory, 2005. [Presentation of Chebfun, including description of Chebfun's rootfinding algorithm based on recursion and eigenvalues of colleague matrices.]

Z. BATTLES AND L. N. TREFETHEN, An extension of Matlab to continuous functions and operators, *SIAM J. Sci. Comp.* 25 (2004), 1743–1770. [Chebfun was conceived on December 8, 2001, and this was the first publication about it.]

F. L. BAUER, The quotient-difference and epsilon algorithms, in R. E. Langer, ed., *On Numerical Approximation*, U. Wisconsin Press, 1959, pp. 361–370. [Introduction of the eta extrapolation algorithm for series.]

R. BELLMAN, B. G. KASHEF AND J. CASTI, Differential quadrature: a technique for the rapid solution of nonlinear partial differential equations, *J. Comp. Phys.* 10 (1972), 40–52. [Perhaps the first publication to give the formula for entries of a spectral differentiation matrix.]

S. N. BERNSTEIN, Sur l'approximation des fonctions continues par des polynômes, *Compt. Rend. Acad. Sci.* 152 (1911), 502–504. [Announcement of some results proved in Bernstein 1912b.]

S. N. BERNSTEIN (1912A), Sur les recherches récentes relatives à la meilleure approximation des fonctions continues par des polynômes, *Proc. 5th Intern. Math. Congress*, v. 1, 1912, 256–266. [Announcement of the results of Bernstein and Jackson on polynomial approximation, including a table summarizing theorems by Bernstein, Jackson and Lebesgue linking smoothness to rate of convergence.]

S. N. BERNSTEIN (1912B), *Sur l'ordre de la meilleure approximation des fonctions continues par des polynômes de degré donné*, Mém. Acad. Roy. Belg., 1912, pp. 1–104. [Major work (which won a prize from the Belgian Academy of Sciences) establishing a number of the Jackson and Bernstein theorems on rate of convergence of best approximations for differentiable or analytic f . Bernstein's fundamental estimates for functions analytic in an ellipse appear in Sections 9 and 61.]

- S. N. BERNSTEIN (1912C), Sur la valeur asymptotique de la meilleure approximation des fonctions analytiques, *Compt. Rend. Acad. Sci.* 155 (1912), 1062–1065. [One of the first appearances of Bernstein ellipses, used here to analyze convergence of best approximations for a function with a single real singularity on the ellipse.]
- S. N. BERNSTEIN (1912D), Démonstration du théorème de Weierstrass fondée sur le calcul des probabilités, *Proc. Math. Soc. Kharkov* 13 (1912), 1–2. [Bernstein’s proof of the Weierstrass approximation theorem based on Bernstein polynomials.]
- S. N. BERNSTEIN (1914A), Sur la meilleure approximation des fonctions analytiques possédant des singularités complexes, *Compt. Rend. Acad. Sci.* 158 (1914), 467–469. [Generalization of Bernstein 1912c to functions with a conjugate pair of singularities.]
- S. N. BERNSTEIN (1914B), Sur la meilleure approximation de $|x|$ par des polynômes de degrés donnés, *Acta Math.* 37 (1914), 1–57. [Investigates polynomial best approximation of $|x|$ on $[-1, 1]$ and mentions as a “curious coincidence” that $nE_n \approx 1/2\sqrt{\pi}$, a value that became known as the “Bernstein conjecture,” later shown false by Varga and Carpenter.]
- S. N. BERNSTEIN, Quelques remarques sur l’interpolation, *Math. Annal.* 79 (1919), 1–12. [Written in 1914 but delayed in publication by the war, this paper, like Faber 1914, pointed out that no array of nodes for interpolation could yield convergence for all continuous functions.]
- S. N. BERNSTEIN, Sur la limitation des valeurs d’un polynôme $P(x)$ de degré n sur tout un segment par ses valeurs en $(n+1)$ points du segment, *Izv. Akad. Nauk SSSR* 7 (1931), 1025–1050. [Discussion of the problem of optimal interpolation nodes, defined by minimization of the Lebesgue constant.]
- S. N. BERNSTEIN, On the inverse problem of the theory of the best approximation of continuous functions, *Sochineya* 2 (1938), 292–294. [Bernstein’s lethargy theorem.]
- J.-P. BERRUT, Rational functions for guaranteed and experimentally well-conditioned global interpolation, *Comput. Math. Appl.* 15 (1988), 1–16. [Observes that if the barycentric formula is applied on an arbitrary grid with weights $1, -1, 1, -1, \dots$ or $\frac{1}{2}, -1, 1, -1, \dots$, the resulting rational interpolants are pole-free and accurate.]
- J.-P. BERRUT, R. BALTENSPERGER AND H. D. MITTELMANN, Recent developments in barycentric rational interpolation, *Intern. Ser. Numer. Math.* 151 (2005), 27–51. [Combines conformal maps with the rational barycentric formula to get high-accuracy approximations of difficult functions.]
- J.-P. BERRUT, M. S. FLOATER AND G. KLEIN, Convergence rates of derivatives of a family of barycentric rational interpolants, *Appl. Numer. Math.* 61 (2011), 989–1000. [Establishes convergence rates for derivatives of Floater–Hormann barycentric rational interpolants.]
- J.-P. BERRUT AND L. N. TREFETHEN, Barycentric Lagrange interpolation, *SIAM Rev.* 46 (2004), 501–517. [Review of barycentric formulas for polynomial and trigonometric interpolation.]
- A. BIRKISSON AND T. DRISCOLL, Automatic Fréchet differentiation for the numerical solution of boundary-value problems. *ACM Trans. Math. Softw.*, to appear, 2012. [Description of Chebfun’s method for solving nonlinear differential equations based on Newton or damped-Newton iteration and Automatic Differentiation.]
- H.-P. BLATT, A. ISERLES AND E. B. SAFF, Remarks on the behaviour of zeros of best approximating polynomials and rational functions, in J. C. Mason and M. G. Cox, *Algorithms for Approximation*, Clarendon Press, 1987, pp. 437–445. [Shows that

the type (n, n) best rational approximations to $|x|$ on $[-1, 1]$ have all their zeros and poles on the imaginary axis and converge to x in the right half-plane and to $-x$ in the left half-plane.]

H.-P. BLATT AND E. B. SAFF, Behavior of zeros of polynomials of near best approximation, *J. Approx. Th.* 46 (1986), 323–344. [Shows that if $f \in C([-1, 1])$ is not analytic on $[-1, 1]$, then the roots of its best approximants $\{p_n^*\}$ cluster at every point of $[-1, 1]$ as $n \rightarrow \infty$.]

H. F. BLICHFELDT, Note on the functions of the form $f(x) \equiv \phi(x) + a_1x^{n-1} + a_2x^{n-2} + \cdots + a_n$ which in a given interval differ the least possible from zero, *Trans. Amer. Math. Soc.* 2 (1901), 100–102. [Blichfeldt proves a part of the equioscillation theorem: optimality implies equioscillation.]

M. BÔCHER, Introduction to the theory of Fourier’s series, *Ann. Math.* 7 (1906), 81–152. [The paper that named the Gibbs phenomenon.]

E. BOREL, *Leçons sur les fonctions de variables réelles et les développements en series de polynômes*, Gauthier-Villars, Paris, 1905. [The first textbook essentially about approximation theory, including a proof of the equioscillation theorem, which Borel attributes to Kirchberger.]

F. BORNEMANN, D. LAURIE, S. WAGON AND J. WALDVOGEL, *The SIAM 100-Digit Challenge: A Study in High-Accuracy Numerical Computing*, SIAM, 2004. [Detailed study of ten problems whose answers are each a single number, nine of which the authors manage to compute to 10,000 digits of accuracy through the use of ingenious algorithms and acceleration methods.]

J. P. BOYD, *Chebyshev and Fourier Spectral Methods*, 2nd ed., Dover, 2001. [A 668-page treatment of the subject with a great deal of practical information.]

J. P. BOYD, Computing zeros on a real interval through Chebyshev expansion and polynomial rootfinding, *SIAM J. Numer. Anal.* 40 (2002), 1666–1682. [Proposes recursive Chebyshev expansions for finding roots of real functions, the idea that is the basis of the `roots` command in Chebfun.]

D. BRAESS, On the conjecture of Meinardus on rational approximation to e^x . II, *J. Approx. Th.* 40 (1984), 375–379. [Establishes an asymptotic formula conjectured by Meinardus for the best approximation error of e^x on $[-1, 1]$.] CHECK

D. BRAESS, *Nonlinear Approximation Theory*, Springer, 1986. [Advanced text on rational approximation and other topics, with emphasis on methods of functional analysis.]

C. BREZINSKI, Extrapolation algorithms and Padé approximations: a historical survey, *Appl. Numer. Math.* 20 (1996), 299–318. [Historical survey.]

C. BREZINSKI AND M. REDIVO ZAGLIA, *Extrapolation Methods: Theory and Practice*, North-Holland, 1991. [Extensive survey.]

L. BRUTMAN, On the Lebesgue function for polynomial interpolation, *SIAM J. Numer. Anal.* 15 (1978), 694–704. [Sharpening of a result of Erdős 1960 concerning Lebesgue constants.]

L. BRUTMAN, Lebesgue functions for polynomial interpolation—a survey, *Ann. Numer. Math.* 4 (1997), 111–127. [Exceptionally useful survey, including detailed results on interpolation in Chebyshev points.]

P. BUTZER AND F. JONGMANS, P. L. Chebyshev (1821–1894): A guide to his life and work, *J. Approx. Th.* 96 (1999), 111–138. [Discussion of the leading Russian mathematician of the 19th century.]

- C. CANUTO, M. Y. HUSSAINI, A. QUARTERONI AND T. A. ZANG, *Spectral Methods: Fundamentals in Single Domains*, Springer, 2006. [A major monograph on both collocation and Galerkin spectral methods.]
- C. CARATHÉODORY AND L. FEJÉR, Über den Zusammenhang der Extremen von harmonischen Funktionen mit ihrer Koeffizienten und über den Picard-Landauschen Satz, *Rend. Circ. Mat. Palermo* 32 (1911), 218–239. [The paper that led, together with Schur 1918, to the connection of approximation problems with eigenvalues and singular values of Hankel matrices, later the basis of the Carathéodory–Fejér method for near-best approximation.]
- A. J. CARPENTER, A. RUTTAN AND R. S. VARGA, Extended numerical computations on the “1/9” conjecture in rational approximation theory, in P. Graves-Morris, E. B. Saff and R. S. Varga, eds., *Rational Approximation and Interpolation*, Lect. Notes Math. 1105, Springer, 1984. [Calculation to 40 significant digits of the best rational approximations to e^x on $(-\infty, 0]$ of types $(0, 0), (1, 1), \dots, (30, 30)$.]
- A. L. CAUCHY, Sur la formule de Lagrange relative à l’interpolation, *Cours d’Analyse de l’École Royale Polytechnique: Analyse algébrique*, Imprimerie Royale, Paris, 1821. [First treatment of the “Cauchy interpolation problem” of interpolation by rational functions.]
- A. L. CAUCHY, Sur un nouveau genre de calcul analogue au calcul infinitésimal, *Exerc. Mathématiques* 1 (1926), 11–24. [One of Cauchy’s foundational texts on residue calculus, including a derivation of what became known as the Hermite integral formula.]
- P. L. CHEBYSHEV, Théorie des mécanismes connus sous le nom de parallélogrammes, *Mém. Acad. Sci. Pétersb.*, Series 7 (1854), 539–568. [Introduction of the idea of best approximation by polynomials in the supremum norm.]
- P. L. CHEBYSHEV, Sur les questions de minima qui se rattachent à la représentation approximative des fonctions, *Mém. Acad. Sci. Pétersb.* Series 7 (1859), 199–291. [Chebyshev’s principal work on best approximation.]
- E. W. CHENEY, *Introduction to Approximation Theory*, Chelsea, 1999. [Classic approximation theory text first published in 1966.]
- J. F. CLAERBOUT, *Imaging the Earth’s Interior*, Blackwell, 1985. [Text about the mathematics of migration for earth imaging by the man who developed many of these techniques, based on rational approximations of pseudodifferential operators.]
- C. W. CLENSHAW AND A. R. CURTIS, A method for numerical integration on an automatic computer, *Numer. Math.* 2 (1960), 197–205. [Introduction of Clenshaw–Curtis quadrature.]
- C. W. CLENSHAW AND K. LORD, Rational approximations from Chebyshev series, in B. K. P. Scaife, ed., *Studies in Numerical Analysis*, Academic Press, 1974, pp. 95–113.
- W. J. CODY, The FUNPACK package of special function subroutines, *ACM Trans. Math. Softw.* 1 (1975), 13–25. [Codes for evaluating special functions based on rational approximations.]
- W. J. CODY, Algorithm 715: SPECFUN—A portable FORTRAN package of special function routines and test drivers, *ACM Trans. Math. Softw.* 19 (1993), 22–32. [Descendant of FUNPACK with greater portability.]
- W. J. CODY, W. FRASER AND J. F. HART, Rational Chebyshev approximation using linear equations, *Numer. Math.* 12 (1968), 242–251. [Algol 60 code for best rational approximation by a variant of the Remes algorithm.]
- W. J. CODY, G. MEINARDUS AND R. S. VARGA, Chebyshev rational approxima-

- tions to e^{-x} in $[0, +\infty)$ and applications to heat-conduction problems, *J. Approx. Th.* 2 (1969), 50–65. [Introduces the problem of approximation of e^{-x} on $[0, \infty)$, or equivalently e^x on $(-\infty, 0]$, and shows that rational best approximants converge geometrically.]
- R. M. CORLESS AND S. M. WATT, Bernstein bases are optimal, but, sometimes, Lagrange bases are better, 2004, Proc. SYNASC (Symbolic and Numeric Algorithms for Scientific Computing), Timisoara, 2004, pp. 141–152. [A contribution to polynomial rootfinding with a marvelous title.]
- G. DARBOUX, Mémoire sur l’approximation des fonctions de très-grands nombres, et sur une classe étendue de développements en série, *J. Math. Pures Appl.* 4 (1878), 5–56. CHECK
- S. DARLINGTON, Analytical approximations to approximations in the Chebyshev sense, *Bell System Tech. J.* 49 (1970), 1–32. [A precursor to the Carathéodory–Fejér method.]
- P. J. DAVIS, *Interpolation and Approximation*, Dover, 1975. [A leading text on the subject, first published in 1963.]
- P. J. DAVIS AND P. RABINOWITZ, *Methods of Numerical Integration*, 2nd ed., Academic Press, 1984. [The leading reference on numerical integration, with detailed information on many topics, first published in 1975.]
- D. M. DAY AND L. ROMERO, Roots of polynomials expressed in terms of orthogonal polynomials, *SIAM J. Numer. Anal.* 43 (2005), 1969–1987. [A rediscovery of the results of Specht, Good, Barnett and others on colleague and comrade matrices.]
- C. DE BOOR AND A. PINKUS, Proof of the conjectures of Bernstein and Erdős concerning the optimal nodes for polynomial interpolation, *J. Approx. Th.* 24 (1978), 289–303. [Together with Kilgore 1978, one of the papers solving the theoretical problem of optimal interpolation.]
- R. A. DEVORE AND G. G. LORENTZ, *Constructive Approximation*, Springer, 1993. [An monograph emphasizing advanced topics.]
- Z. DITZIAN AND V. TOTIK, *Moduli of Smoothness*, Springer-Verlag, New York, 1987. [Careful analysis of smoothness and its effect on polynomial approximation on an interval, including the dependence on location in the interval.]
- T. A. DRISCOLL, F. BORNEMANN AND L. N. TREFETHEN, The chebop system for automatic solution of differential equations, *BIT Numer. Math.* 48 (2008), 701–723. [Extension of Chebfun to solve differential and integral equations.]
- T. A. DRISCOLL AND N. HALE, Resampling methods for boundary conditions in spectral collocation, paper in preparation, 2012. [Introduction of spectral collocation methods based on rectangular matrices.]
- M. DUPUY, Le calcul numérique des fonctions par l’interpolation barycentrique, *Compt. Rend. Acad. Sci.* 226 (1948), 158–159. [This paper is apparently the first to use the expression “barycentric interpolation” and also the first to discuss barycentric interpolation for non-equidistant points, the situation considered by Taylor 1945.]
- A. DUTT, M. GU AND V. ROKHLIN, Fast algorithms for polynomial interpolation, integration, and differentiation, *SIAM J. Numer. Anal.* 33 (1996), 1689–1711. [Uses the Fast Multipole Method to derive fast algorithms for non-Chebyshev points.]
- H. EHLICH AND K. ZELLER, Auswertung der Normen von Interpolationsoperatoren, *Math. Ann.* 164 (1966), 105–112. [Bound on Lebesgue constant for interpolation in Chebyshev points.]

- D. ELLIOTT, A direct method for “almost” best uniform approximation, in *Error, Approximation, and Accuracy*, eds. F. de Hoog and C. Jarvis, U. Queensland Press, St. Lucia, Queensland, 1973, 129–143. [A precursor to the Carathéodory–Fejér method.]
- M. EMBREE AND D. SORESENSEN, *An Introduction to Model Reduction for Linear and Nonlinear Differential Equations*, to appear. [Textbook.]
- B. ENGQUIST AND A. MAJDA, Absorbing boundary conditions for the numerical simulation of waves, *Math. Comput.* 31 (1977), 629–651. [Highly influential paper on the use of Padé approximations to a pseudodifferential operator to develop numerical boundary conditions.]
- P. ERDŐS, Problems and results on the theory of interpolation. II, *Acta Math. Acad. Sci. Hungar.* 12 (1961), 235–244. [Shows that Lebesgue constants for optimal interpolation points are no better than for Chebyshev points asymptotically as $n \rightarrow \infty$.]
- T. O. ESPELID, Extended doubly adaptive quadrature routines, Tech. Rep. 266, Dept. Informatics, U. Bergen, Feb. 2004. [Presentation of `coteda` and `da2glob` quadrature codes.]
- L. EULER, *De Seriebus Divergentibus*, *Novi Commentarii academiae scientiarum Petropolitanae* 5, (1760) (205). [Early work on divergent series.]
- L. EULER, De eximio usu methodi interpolationum in serierum doctrina, *Opuscula Analytica* 1 (1783), 157–210. [A work on various applications of interpolation, including equations related to the Newton and Lagrange formulas for polynomial interpolation.]
- L. C. EVANS AND R. F. GARIEPY, *Measure Theory and Fine Properties of Functions*, CRC Press, 1991. [Includes a definition of the total variation in the measure theoretic context.]
- G. FABER, Über die interpolatorische Darstellung stetiger Funktionen, *Jahresber. Deutsch. Math. Verein.* 23 (1914), 190–210. [Shows that no fixed system of nodes for polynomial interpolation will lead to convergence for all continuous f .]
- L. FEJÉR, Sur les fonctions bornées et intégrables, *Compt. Rend. Acad. Sci.* 131 (1900), 984–987. [Fejér, age 20, provides a new method of summing divergent Fourier series, with a new proof of the Weierstrass approximation theorem as a corollary.] CHECK
- L. FEJÉR, Lebesguesche Konstanten und divergente Fourierreihen, *J. f. Math.* 138 (1910), 22–53. [Shows that Lebesgue constants for Fourier projection are asymptotic to $(4/\pi^2) \log n$ as $n \rightarrow \infty$.]
- L. FEJÉR, Ueber Interpolation, *Nachr. Gesell. Wiss. Göttingen Math. Phys. Kl.* (1916), 66–91. [Proves the Weierstrass approximation theorem by showing that Hermite–Fejér interpolants in Chebyshev points of the first kind converge for any $f \in C([-1, 1])$.]
- A. M. FINKELSHTEIN, Equilibrium problems of potential theory in the complex plane, in *Orthogonal Polynomials and Special Functions*, *Lect. Notes Math.* 1883, pp. 79–117, Springer, 2006. [Survey article.]
- M. S. FLOATER AND K. HORMANN, Barycentric rational interpolation with no poles and high rates of approximation, *Numer. Math.* 107 (2007), 315–331. [Extension of results of Berrut 1988 to a family of barycentric rational interpolants of arbitrary order.]
- G. B. FOLLAND, *Introduction to Partial Differential Equations*, 2nd ed., Princeton U. Press, 1995. [An elegant introduction to PDEs published first in 1976, including the Weierstrass approximation theorem proved via the heat equation and generalized to multiple dimensions.]

- B. FORNBERG, Generation of finite difference formulas on arbitrarily spaced grids, *Math. Comp.* 51 (1988), 699–706. [Stable algorithm for generating finite difference formulas on arbitrary grids.]
- B. FORNBERG, *A Practical Guide to Pseudospectral Methods*, Cambridge U. Press, 1996. [Practically-oriented textbook of spectral collocation methods for solving ordinary and partial differential equations, based on Chebyshev interpolants.]
- S. FORTUNE, Polynomial root finding using iterated eigenvalue computation, *Proc. 2001 Intl. Symp. Symb. Alg. Comput.*, ACM, 2001, pp. 121–128. [An eigenvalue-based rootfinding algorithm that works directly from data samples rather than expansion coefficients.]
- L. FOX AND I. B. PARKER, *Chebyshev Polynomials in Numerical Analysis*, Oxford U. Press, 1968. [A precursor to the work of the 1970s and later on Chebyshev spectral methods.]
- J. G. F. FRANCIS, The QR transformation: a unitary analogue to the LR transformation, parts I and II, *Computer J.* 4 (1961), 256–272 and 332–345. [Introduction of the QR algorithm for numerical computation of matrix eigenvalues.]
- G. FROBENIUS, Ueber Relationen zwischen den Näherungsbrüchen von Potenzreihen, *J. Reine Angew. Math.* 90 (1881), 1–17. [The first systematic treatment of Padé approximation.]
- M. FROISSART, Approximation de Padé: application à la physique des particules élémentaires, *RCP, Programme No. 25*, v. 9, CNRS, Strasbourg (1969), pp. 1–13. [A rare publication by the mathematician and physicist after whom Froissart doublets were named (by Bessis).]
- D. GAIER, *Lectures on Complex Approximation*, Birkhäuser, 1987. [A shorter book presenting some of the material considered at greater length in Smirnov & Lebedev 1968 and Walsh 1969.]
- C. F. GAUSS, Methodus nova integralium valores per approximationem inveniendi, *Comment. Soc. Reg. Scient. Gotting. Recent.*, 1814, pp. 39–76. [Introduction of Gauss quadrature—via continued fractions, not orthogonal polynomials.]
- W. GAUTSCHI, A survey of Gauss–Christoffel quadrature formulae, in P. L. Butzer and F. Fehér, eds., *E. B. Christoffel: The Influence of His Work in Mathematics and the Physical Sciences*, Birkhäuser, 1981, pp. 72–147. [Outstanding survey of many aspects of Gauss quadrature.]
- W. GAUTSCHI, *Orthogonal Polynomials: Computation and Approximation*, Oxford U. Press, 2004. [A monograph on orthogonal polynomials with emphasis on numerical aspects.]
- K. O. GEDDES, Near-minimax polynomial approximation in an elliptical region, *SIAM J. Numer. Anal.* 15 (1978), 1225–1233. [Chebyshev expansions via FFT for analytic functions on an interval.]
- W. M. GENTLEMAN (1972A), Implementing Clenshaw–Curtis quadrature, I: Methodology and experience, *Comm. ACM* 15 (1972), 337–342. [A surprisingly modern paper that includes the aliasing formula for Chebyshev polynomials.]
- W. M. GENTLEMAN (1972B), Implementing Clenshaw–Curtis quadrature, II: Computing the cosine transformation, *Comm. ACM* 15 (1972), 343–346. [First connection of Clenshaw–Curtis quadrature with FFT.]
- A. GLASER, X. LIU AND V. ROKHLIN, A fast algorithm for the calculation of the roots of special functions, *SIAM J. Sci. Comp.* 29 (2007), 1420–1438. [Introduction of an

- algorithm for computation of Gauss quadrature nodes and weights in $O(n)$ operations rather than $O(n^2)$ as in Golub & Welsch 1969.]
- K. GLOVER, All optimal Hankel-norm approximations of linear multivariable systems and their L^∞ -error bounds, *Internat. J. Control* 39 (1984), 1115–1193. [Highly influential article on rational approximations in control theory.]
- S. GOEDECKER, Remark on algorithms to find roots of polynomials, *SIAM J. Sci. Comput.* 15 (1994), 1059–1063. [Emphasizes the stability of companion matrix eigenvalues as an algorithm for polynomial rootfinding, given a polynomial expressed by its coefficients in the monomial basis.]
- G. H. GOLUB AND J. H. WELSCH, Calculation of Gauss quadrature rules, *Math. Comp.* 23 (1969), 221–230. [Presentation of the famous $O(n^2)$ algorithm for Gauss quadrature nodes and weights via a tridiagonal Jacobi matrix eigenvalue problem.]
- A. A. GONCHAR AND E. A. RAKHMANOV, Equilibrium distributions and degree of rational approximation of analytic functions, *Math. USSR Sbornik* 62 (1989), 305–348. [A landmark paper, first published in Russian in 1987, that applies methods of potential theory to prove that the optimal rate of convergence for type (n, n) rational minimax approximations of e^x on $(-\infty, 0]$ is $O((9.28903\dots)^{-n})$ as $n \rightarrow \infty$.]
- V. L. GONCHAROV, The theory of best approximation of functions, *J. Approx. Th.* 106 (2000), 2–57. [English translation of a 1945 historical survey in Russian emphasizing contributions of Chebyshev and his successors.]
- P. GONNET, S. GÜTTEL AND L. N. TREFETHEN, Robust Padé approximation via SVD, *SIAM Rev.*, to appear. [Introduction of the robust SVD-based algorithm for computing Padé approximants presented in Chapter 27.]
- P. GONNET, R. PACHÓN AND L. N. TREFETHEN, Robust rational interpolation and least-squares, *Elect. Trans. Numer. Anal.* 38 (2011), 146–167. [A robust algorithm based on the singular value decomposition for computing rational approximants without spurious poles.]
- I. J. GOOD, The colleague matrix, a Chebyshev analogue of the companion matrix, *Quart. J. Math.* 12 (1961), 61–68. [Together with Specht 1960, one of the two original independent discoveries that roots of polynomials in Chebyshev form can be computed as eigenvalues of colleague matrices, a term introduced here. Good recommends this approach to numerical rootfinding for functions other than polynomials too.]
- D. GOTTLIEB, M. Y. HUSSAINI AND S. A. ORSZAG, Introduction: theory and applications of spectral methods, in R. G. Voigt, D. Gottlieb and M. Y. Hussaini, *Spectral Methods for Partial Differential Equations*, SIAM, 1984. [Early survey article on spectral collocation methods, including the first publication of the formula for the entries of Chebyshev differentiation matrices.]
- W. B. GRAGG, The Padé table and its relation to certain algorithms of numerical analysis, *SIAM Rev.* 14 (1972), 1–62. [A careful and extensive mathematical reference on the structure and algebra of the Padé table as presented in Chapter 27, though with an emphasis on determinants.]
- A. GREENBAUM AND L. N. TREFETHEN, GMRES/CR and Arnoldi/Lanczos as matrix approximation problems, *SIAM J. Sci. Comput.* 15 (1994), 359–368. [Shows that the GMRES/CR and Arnoldi/Lanczos matrix iterations are equivalent to certain polynomial approximation problems and generalizes this observation to matrix approximation problems such as “ideal GMRES”.]
- T. H. GRONWALL, Über die Gibbssche Erscheinung und die trigonometrischen Sum-

- men $\sin x + \frac{1}{2} \sin 2x + \cdots + \frac{1}{n} \sin nx$, *Math. Ann.* 72 (1912), 228–243. [Investigates detailed behavior of Fourier approximations near Gibbs discontinuities.]
- M. H. GUTKNECHT, Algebraically solvable Chebyshev approximation problems, in C. K. Chui, L. L. Schumaker and J. D. Ward., eds., *Approximation Theory IV*, Academic Press, 1983. [Shows that many examples of ∞ -norm best approximations that can be written down explicitly correspond to Carathéodory–Fejér approximations.]
- M. H. GUTKNECHT, In what sense is the rational interpolation problem well posed?, *Constr. Approx.* 6 (1990), 437–450. [Generalization of Trefethen & Gutknecht 1985 from Padé to multipoint Padé approximation.]
- M. H. GUTKNECHT AND L. N. TREFETHEN, Real polynomial Chebyshev approximation by the Carathéodory–Fejér method, *SIAM J. Numer. Anal.* 19 (1982), 358–371. [Introduction of CF approximation on an interval.]
- S. GÜTTEL, *Rational Krylov Methods for Operator Functions*, PhD dissertation, TU Bergakademie Freiberg, 2010. [Survey and analysis of advanced methods of numerical linear algebra based on rational approximations.]
- N. HALE, N. J. HIGHAM AND L. N. TREFETHEN, Computing A^α , $\log(A)$, and related matrix functions by contour integrals, *SIAM J. Numer. Math.* 46 (2008), 2505–2523. [Derives efficient algorithms for computing matrix functions from trapezoid rule approximations to contour integrals accelerated by contour maps. These are equivalent to rational approximations.]
- N. HALE AND T. W. TEE, Conformal maps to multiply slit domains and applications, *SIAM J. Sci. Comput.* 31 (2009), 3195–3215. [Extension of Tee & Trefethen 2006 to new geometries and applications.]
- N. HALE AND A. TOWNSEND, Fast and accurate computation of Gauss–Jacobi quadrature nodes and weights, manuscript in preparation, 2012. [Proposes an $O(n)$ algorithm based on asymptotic formulas for computing Gauss quadrature nodes and weights for large n , much faster than the Glaser–Liu–Rokhlin algorithm in a Matlab implementation.]
- N. HALE AND L. N. TREFETHEN, New quadrature formulas from conformal maps, *SIAM J. Numer. Anal.* 46 (2008), 930–948. [Shows that conformal mapping can be used to derive quadrature formulas that converge faster than Gauss, as in Bakhvalov 1967.]
- N. HALE AND L. N. TREFETHEN, Chebfun and numerical quadrature, *Science in China*, to appear, 2012. [Review of quadrature algorithms in Chebfun, including fast Gauss and Gauss–Legendre quadrature by the Glaser–Liu–Rokhlin algorithm (but not yet the Hale–Townsend algorithm) with applications to computing with functions with singularities.]
- L. HALPERN AND L. N. TREFETHEN, Wide-angle one-way wave equations, *J. Acoust. Soc. Amer.* 84 (1988), 1397–1404. [Review of rational approximations to $\sqrt{1-s^2}$ on $[-1, 1]$ for application to one-way wave equations.]
- G. H. HALPHEN, *Traité des fonctions elliptiques et de leurs applications*, Gauthier-Villars, Paris, 1886. [A treatise on elliptic functions that contains a calculation to six digits of the number $\approx 1/9.28903$ that later became known as “Halphen’s constant” in connection with the rational approximation of e^x on $(-\infty, 0]$.]
- P. C. HANSEN, *Rank-Deficient and Discrete Ill-Posed Problems: Numerical Aspects of Linear Inversion*, SIAM, 1998. [A leading monograph on the treatment of rank-deficient or ill-posed matrix problems.]

- G. H. HARDY, *Divergent Series*, revised ed., Éditions Jacques Gabay, 1991. [Hardy's marvelous posthumous volume on the mathematics of divergent series, first published in 1949.]
- J. F. HART ET AL., *Computer Approximations*, Wiley, 1968. [A classic compendium on computer evaluation of special functions, containing 150 pages of explicit coefficients of rational approximations.]
- E. HAYASHI, L. N. TREFETHEN AND M. H. GUTKNECHT, The CF table, *Constr. Approx.* 6 (1990), 195–223. [The most systematic and detailed treatment of the problem of rational CF approximation of a function f on the unit disk, including cases where f is just in the Wiener class or continuous on the unit circle.]
- G. HEINIG AND K. ROST, *Algebraic Methods for Toeplitz-like Matrices and Operators*, Birkhäuser, 1984. [Analyzes rank properties of Toeplitz and Hankel matrices related to the robust Padé algorithms of Chapter 27.]
- G. HELMBERG AND P. WAGNER, Manipulating Gibbs' phenomenon for Fourier interpolation, *J. Approx. Th.* 89 (1997), 308–320. [Analyzes the overshoot in various versions of the Gibbs phenomenon for trigonometric interpolation.]
- P. HENRICI, *Applied and Computational Complex Analysis*, vols. 1–3, Wiley, 1974 and 1977 and 1986. [An extensive and highly readable account of applied complex analysis, full of details that are hard to find elsewhere.]
- C. HERMITE, Sur la formule d'interpolation de Lagrange, *J. Reine Angew. Math.* 84 (1878), 70–79. [Application of what became known as the Hermite integral formula for polynomial interpolation, which had earlier been given by Cauchy, to problems of interpolation with confluent data points.]
- J. S. HESTAVEN, S. GOTTLIEB AND D. GOTTLIEB, *Spectral Methods for Time-Dependent Problems*, Cambridge U. Press, 2007. [Well-known textbook on spectral methods.]
- E. HEWITT AND R. E. HEWITT, The Gibbs–Wilbraham phenomenon: an episode in Fourier analysis, *Arch. Hist. Exact Sci.* 21 (1979), 129–160. [Discussion of the complex and not always pretty history of attempts to analyze the Gibbs phenomenon.]
- N. J. HIGHAM, The numerical stability of barycentric Lagrange interpolation, *IMA J. Numer. Anal.* 24 (2004), 547–556. [Proves that barycentric interpolation in Chebyshev points is numerically stable, following earlier work of Rack & Reimer 1982.]
- N. J. HIGHAM, *Functions of Matrices: Theory and Computation*, SIAM, 2008. [The definitive treatment of the problem of computing functions of matrices as of 2008. Many of the algorithms have connections with polynomial or rational approximation.]
- N. J. HIGHAM, The scaling and squaring method for the matrix exponential revisited, *SIAM Rev.* 51 (2009), 747–764. [Careful analysis of Matlab's method of evaluating e^A leads to several improvements in the algorithm and the recommendation to use the Padé approximant of type (13, 13).]
- N. J. HIGHAM AND A. H. AL-MOHY, Computing matrix functions, *Acta Numer.* 19 (2010), 159–208. [Survey includes an appendix comparing Padé and Taylor approximants for computing the exponential of a matrix.]
- E. HILLE, *Analytic Function Theory*, 2 vols., 2nd ed., Chelsea, 1973. [Major work first published in 1959 and 1962.]
- M. HOCHBRUCK AND A. OSTERMANN, Exponential integrators, *Acta Numer.* 19 (2010), 209–286. [Survey of exponential integrators for the fast numerical solution of stiff ODEs and PDEs.]

- G. HORNECKER, Détermination des meilleures approximations rationnelles (au sens de Tchebychef) des fonctions réelles d'une variable sur un segment fini et des bornes d'erreur correspondantes, *Compt. Rend. Acad. Sci.* 249 (1956), 2265–2267. [Possibly the first proposal of a kind of Chebyshev–Padé approximation for intervals.]
- J. P. IMHOF, On the method for numerical integration of Clenshaw and Curtis, *Numer. Math.* 5 (1963), 138–141. [Shows that the Clenshaw–Curtis quadrature weights are positive.] CHECK
- A. ISERLES, A fast and simple algorithm for the computation of Legendre coefficients, *Numer. Math.* 117 (2011), 529–553. [A fast algorithm based on a numerical contour integral over an ellipse in the complex plane.]
- D. JACKSON, *Über die Genauigkeit der Annäherung stetiger Funktionen durch ganze rationale Funktionen gegebenen Grades und trigonometrische Summen gegebener Ordnung*, dissertation, Göttingen, 1911. [Jackson's PhD thesis under Landau in Göttingen, which together with Bernstein's work at the same time (1912B) established many of the fundamental results of approximation theory. Despite the German, Jackson was an American from Massachusetts, like me—Harvard Class of 1908.]
- D. JACKSON, On the accuracy of trigonometric interpolation, *Trans. Amer. Math. Soc.* 14 (1913), 453–461. [In the final paragraph of this paper, polynomial interpolation in Chebyshev points (2.2) is considered, possibly for the first time in the literature.] CHECK
- C. G. J. JACOBI, *Disquisitiones Analyticae de Fractionibus Simplicibus*, dissertation, Berlin, 1825. [In his discussion of partial fractions Jacobi effectively states the “first form” of the barycentric interpolation formula.]
- C. G. J. JACOBI, Über Gauss' neue Methode, die Werthe der Integrale näherungsweise zu finden, *J. Reine Angew. Math.* 1 (1826), 301–308. [This paper first invents the subject of orthogonal polynomials, then shows that Gauss quadrature can be derived in this framework.]
- C. G. J. JACOBI, Über die Darstellung einer Reihe gegebener Werthe durch eine gebrochene rationale Function, *J. Reine Angew. Math.* 30 (1846), 127–156. [Jacobi's major work on rational interpolation.]
- R. JENTZSCH, *Untersuchungen zur Theorie analytischer Funktionen*, dissertation, Berlin, 1914. [Jentzsch, who was also a noted poet and was killed at age 27 in World War I, proves here that every point on the circle of convergence of a power series is the limit of zeros of its partial sums.]
- D. C. JOYCE, Survey of extrapolation processes in numerical analysis, *SIAM Rev.* 13 (1971), 435–490. [Scholarly review of a wide range of material.]
- A.-K. KASSAM AND L. N. TREFETHEN, Fourth-order time-stepping for stiff PDEs, *SIAM J. Sci. Comput.* 26 (2005), 1214–1233. [Application of exponential integrator formulas to efficient numerical solution of stiff PDEs.]
- T. A. KILGORE, A characterization of the Lagrange interpolating projection with minimal Tchebycheff norm, *J. Approx. Th.* 24 (1978), 273–288. [Together with de Boor & Pinkus 1978, one of the papers solving the theoretical problem of optimal interpolation.]
- P. KIRCHBERGER, *Ueber Tchebycheffsche Annäherungsmethoden*, PhD thesis, Göttingen, 1902. [Kirchberger's PhD thesis under Hilbert contains apparently the first full statement and proof of the equioscillation theorem.]
- P. KIRCHBERGER, Über Tchebycheffsche Annäherungsmethoden, *Math. Ann.* 57 (1903), 509–540. [Extract from his PhD thesis the year before, focusing on multi-

variable extensions but without the equioscillation theorem.]

A. N. KOLMOGOROV, A remark on the polynomials of P. L. Chebyshev deviating the least from a given function, *Uspehi Mat. Nauk* 3 (1948), 216–221 [Russian]. [Criterion for best complex approximations.]

D. KOSLOFF AND H. TAL-EZER, A modified Chebyshev pseudospectral method with an $O(N^{-1})$ time step restriction, *J. Comp. Phys.* 104 (1993), 457–469. [Introduces a change of variables as a basis for non-polynomial spectral methods.]

A. B. J. KUIJLAARS, Convergence analysis of Krylov subspace iterations with methods from potential theory, *SIAM Rev.* 48 (2006), 3–40. [Analyzes the connection between potential theory and the roots of polynomial approximants implicitly constructed by Krylov iterations such as the conjugate gradient and Lanczos iterations.]

J. L. LAGRANGE, Leçons élémentaires sur les Mathématiques, Leçon V., *J. de l'École polytechnique*, Tome II, Cahier 8, pp. 274–278, Paris, 1795. [Contains what became known as the Lagrange interpolation formula, published earlier by Waring 1779 and Euler 1783.]

B. LAM, *Some Exact and Asymptotic Results for Best Uniform Approximation*, PhD thesis, U. of Tasmania, 1972. [A precursor to the Carathéodory–Fejér method.]

E. LANDAU, Abschätzung der Koeffizientensumme einer Potenzreihe, *Archiv Math. Phys.* 21 (1913), 42–50 and 250–255. [Investigates the norm of the degree n Taylor projection for functions analytic in the unit disk, now known as the Landau constant, showing it is asymptotic to $\pi^{-1} \log n$ as $n \rightarrow \infty$.]

H. LEBESGUE, Sur l'approximation des fonctions, *Bull. Sci. Math.* 22 (1898), 278–287. [In Lebesgue's first published paper, he proves the Weierstrass approximation theorem by approximating $|x|$ by polynomials and noting that any continuous function can be approximated by piecewise linear functions.]

A. L. LEVIN AND E. B. SAFF, Potential theoretic tools in polynomial and rational approximation, in J.-D. Fournier, et al., eds., *Harmonic Analysis and Rational Approximation*, Lec. Notes Control Inf. Sci. 326/2006 (2006), 71–94. [Survey article by two of the experts.]

R.-C. LI, Near optimality of Chebyshev interpolation for elementary function computations, *IEEE Trans. Computers* 53 (2004), 678–687. [Shows that although Lebesgue constants for Chebyshev points grow logarithmically as $n \rightarrow \infty$, for many classes of functions of interest the interpolants come within a factor of 2 of optimality.]

E. L. LINDMAN, 'Free-space' boundary conditions for the time-dependent wave equation, *J. Comput. Phys.* 18 (1975), 66–78. [Absorbing boundary conditions based on Padé approximation of a square root function, later developed further by Engquist & Majda 1977].

G. G. LORENTZ, *Approximation of Functions*, 2nd ed., Chelsea, 1986. [A readable treatment including good summaries of the Jackson theorems for polynomial and trigonometric approximation, first published in 1966.]

K. N. LUNGU, Best approximations by rational functions, *Math. Notes* 10 (1971), 431–433. [Shows that the best rational approximations to a real function on an interval may be complex and hence also nonunique, with examples as simple as type (1, 1) approximation of $|x|$ on $[-1, 1]$.]

H. J. MAEHLY AND CH. WITZGALL, Tschebyscheff-Approximationen in kleinen Intervallen. II. Stetigkeitssätze für gebrochen rationale Approximationen, *Numer. Math.* 2 (1960), 293–307. [Investigates well-posedness of the Cauchy interpolation problem]

and asymptotics of best approximations on small intervals.]

A. P. MAGNUS, CFGT determination of Varga's constant '1/9', unpublished manuscript, 1985. [First identification of the the exact value of Halphen's constant $C = 9.28903\dots$ for the optimal rate of convergence $O(C^{-n})$ of best type (n, n) approximations to e^x on $(-\infty, 0]$, later proved correct by Gonchar & Rakhmanov 1989.]

A. P. MAGNUS AND J. MEINGUET, The elliptic functions and integrals of the "1/9" problem, *Numer. Alg.* 24 (2000), 117–139. [Summary of work initiated by Magnus relating potential theory, elliptic functions, and the "1/9" problem.]

J. MARCINKIEWICZ, Quelques remarques sur l'interpolation, *Acta Sci. Math. (Szeged)* 8 (1936–37), 127–30. [In contrast to the result of Faber 1914, shows that for any fixed continuous function f there is an array of interpolation nodes that leads to convergence as $n \rightarrow \infty$.]

A. I. MARKUSHEVICH, *Theory of Functions of a Complex Variable*, 2nd ed., 3 vols., Chelsea, 1985. [A highly readable treatise on complex variables first published in 1965, including chapters on Laurent series, polynomial interpolation, harmonic functions, and rational approximation.]

J. C. MASON AND D. C. HANDSCOMB, *Chebyshev Polynomials*, Chapman and Hall/CRC, 2003. [An extensive treatment of four varieties of Chebyshev polynomials and their applications.]

G. MASTROIANNI AND M. G. RUSSO, Some new results on Lagrange interpolation for bounded variation functions, *J. Approx. Th.* 162 (2010), 1417–1428. [A collection of bounds in L^p norms for both $p < \infty$ and $p = \infty$.]

G. MASTROIANNI AND J. SZABADOS, Jackson order of approximation by Lagrange interpolation. II, *Acta Math. Acad. Sci. Hungar.* 69 (1995), 73–82. [Corollary 2 bounds the rate of convergence of Chebyshev interpolants for functions whose k th derivative has bounded variation.]

J. H. MCCABE AND G. M. PHILLIPS, On a certain class of Lebesgue constants, *BIT* 13 (1973), 434–442. [Shows that the Lebesgue constant for polynomial interpolation in $n + 1$ Chebyshev points of the second kind is bounded by that of n Chebyshev points of the first kind. The same result had been found earlier by Ehlich & Zeller 1966.]

J. H. MCCLELLAN AND T. W. PARKS, A personal history of the Parks–McClellan algorithm, *IEEE Sign. Proc. Mag.* 82 (2005), 82–86. [The story of the development of the celebrated filter design algorithm published in Parks & McClellan 1972.]

G. MEINARDUS, *Approximation of Functions: Theory and Numerical Methods*, Springer, 1967. [Classic approximation theory monograph.]

C. MÉRAY, Observations sur la légitimité de l'interpolation, *Annal. Scient. de l'École Normale Supérieure* 3 (1884), 165–176. [Discussion of the possibility of nonconvergence of polynomial interpolants 17 years before Runge, though without so striking an example or conclusion. Méray uses just the right technique, the Hermite integral formula, which he correctly attributes to Cauchy.]

C. MÉRAY, Nouveaux exemples d'interpolations illusoires, *Bull. Sci. Math.* 20 (1896), 266–270. [Continuation of Méray 1884 with more examples.]

S. N. MERGELYAN, On the representation of functions by series of polynomials on closed sets (Russian). *Dokl. Akad. Nauk SSSR (N. S.)* 78 (1951), 405–408. Translation: *Translations Amer. Math. Soc.* 3 (1962), 287–293. [Famous theorem asserting that a function continuous on a compact set in the complex plane whose complement is connected, and analytic in the interior, can be uniformly approximated by

polynomials.]

H. N. MHASKAR AND D. V. PAI, *Fundamentals of Approximation Theory*, CRC/Narosa, 2000. [Extensive treatment of many topics, especially in linear approximation.]

G. MITTAG-LEFFLER, Sur la représentation analytique des fonctions d'une variable réelle, *Rend. Circ. Mat. Palermo* (1900), 217–224. [Contains a long footnote by Phragmén explaining how the Weierstrass approximation theorem follows from the work of Runge.]

C. MOLER AND C. VAN LOAN, Nineteen dubious ways to compute the exponential of a matrix, twenty-five years later, *SIAM Rev.* 45 (2003), 3–49. [Expanded reprinting of 1978 paper summarizing methods for computing $\exp(A)$, the best method being related to Padé approximation.]

R. DE MONTESSUS DE BALLORE, Sur les fractions continues algébriques, *Bull. Soc. Math. France* 30 (1902), 28–36. [Shows that type (m, n) Padé approximants to meromorphic functions converge pointwise as $m \rightarrow \infty$ in a disk about $z = 0$ with exactly n poles.]

M. MORI AND M. SUGIHARA, The double-exponential transformation in numerical analysis, *J. Comput. Appl. Math.* 127 (2001), 287–296. [Survey of a the quadrature algorithm introduced by Takahasi & Mori 1974]

J.-M. MULLER, *Elementary Functions: Algorithms and Implementation*, 2nd ed., Birkhäuser, 2006. [A text on implementation of elementary functions on computers, including a chapter on the Remez algorithm.]

Y. NAKATSUKASA, Z. BAI AND F. GYGI, Optimizing Halley's iteration for computing the matrix polar decomposition, *SIAM J. Matrix Anal. Appl.* 31 (2010), 2700–2720. [Introduction of an algorithm based on a rational function of high degree generated by iteration of a simple equiripple approximation.] CHECK

I. P. NATANSON, *Constructive Theory of Functions*, 3 vols., Frederick Ungar, 1964 and 1965. [This major work by a scholar in Leningrad gives equal emphasis to algebraic and trigonometric approximation.]

D. J. NEWMAN, Rational approximation to $|x|$, *Mich. Math. J.* 11 (1964), 11–14. [Shows that whereas polynomial approximants to $|x|$ on $[-1, 1]$ converge at the rate $O(n^{-1})$, for rational approximants the rate is $O(\exp(-C\sqrt{n}))$.]

D. J. NEWMAN, Rational approximation to e^{-x} , *J. Approx. Th.* 10 (1974), 301–303. [Shows by a lower bound 1280^{-n} that type (n, n) rational approximants to e^x on $(-\infty, 0]$ can converge no faster than geometrically as $n \rightarrow \infty$ in the supremum norm.]

J. NUTTALL, The convergence of Padé approximants of meromorphic functions, *J. Math. Anal. Appl.* 31 (1970), 147–153. [Shows that type (n, n) Padé approximants to meromorphic functions converge in measure as $n \rightarrow \infty$, though not pointwise.]

H. O'HARA AND F. J. SMITH, Error estimation in the Clenshaw–Curtis quadrature formula, *Comput. J.* 11 (1968), 213–219. [Early paper arguing that Clenshaw–Curtis and Gauss quadrature have comparable accuracy in practice.]

A. V. OPPENHEIM, R. W. SCHAFER AND J. R. BUCK, *Discrete-time Signal Processing*, Prentice Hall, 1999. [A standard textbook on the subject, which is tightly connected with polynomial and rational approximation.]

S. A. ORSZAG (1971A), Galerkin approximations to flows within slabs, spheres, and cylinders, *Phys. Rev. Lett.* 26 (1971), 1100–1103. [Orszag's first publication on Chebyshev spectral methods.]

- S. A. ORSZAG (1971B), Accurate solution of the Orr–Sommerfeld stability equation, *J. Fluid Mech.* 50 (1971), 689–703. [The most influential of Orszag’s early papers on Chebyshev spectral methods.]
- R. PACHÓN, *Algorithms for Polynomial and Rational Approximation in the Complex Domain*, DPhil thesis, U. of Oxford, 2010. [Includes chapters on rational best approximants, interpolants, and Chebyshev–Padé approximants and their application to exploration of functions in the complex plane.]
- R. PACHÓN, P. GONNET AND J. VAN DEUN, Fast and stable rational interpolation in roots of unity and Chebyshev points, *SIAM J. Numer. Anal.*, to appear. [Linear algebra formulation of the rational interpolation problem in a manner closely suited to computation.]
- R. PACHÓN, R. B. PLATTE AND L. N. TREFETHEN, Piecewise-smooth chebfuns, *IMA J. Numer. Anal.* 30 (2010), 898–916. [Generalization of Chebfun from single to multiple polynomial pieces, including edge detection algorithm to determine breakpoints.]
- R. PACHÓN AND L. N. TREFETHEN, Barycentric-Remez algorithms for best polynomial approximation in the chebfun system, *BIT Numer. Math.* 49 (2009), 721–741. [Chebfun implementation of Remez algorithm for computing polynomial best approximations.]
- H. PADÉ, Sur la représentation approchée d’une fonction par des fractions rationnelles, *Annales Sci. de l’École Norm. Sup.* 9 (1892) (supplément), 3–93. [The first of many publications by Padé on the subject that became known as Padé approximation, with discussion of defect and block structure including a number of explicit examples.]
- T. W. PARKS AND J. H. MCCLELLAN, Chebyshev approximation for nonrecursive digital filters with linear phase, *IEEE Trans. Circuit Theory* CT-19 (1972), 189–194. [Proposes what became known as the Parks–McClellan algorithm for digital filter design, based on a barycentric formulation of the Remez algorithm for best approximation by trigonometric polynomials.]
- B. N. PARLETT AND C. REINSCH, Handbook series linear algebra: balancing a matrix for calculation of eigenvalues and eigenvectors, *Numer. Math.* 13 (1969), 293–304. [Introduction of the technique of balancing a matrix by a diagonal similarity transformation that is crucial to the success of the QR algorithm.]
- K. PEARSON, *On the Construction of Tables and on Interpolation I. Uni-variate Tables*, Cambridge U. Press, 1920. [Contains as an appendix a fascinating annotated bibliography of 50 early contributions to interpolation. Pearson’s annotations are not always as polite as my own, with comments like “Not very adequate” and “A useful, but somewhat disappointing book.”]
- O. PERRON, *Die Lehre von den Kettenbrüchen*, 2nd ed., Teubner, 1929. [This classic monograph on continued fractions, first published in 1913, was perhaps the first to identify the problem of spurious poles or Froissart doublets in Padé approximation. At the end of §78 a function is constructed whose type $(m, 1)$ Padé approximants have poles appearing infinitely often on a dense set of points in the complex plane.]
- P. P. PETRUSHEV AND V. A. POPOV, *Rational Approximation of Real Functions*, Cambridge U. Press, 1987. [Detailed presentation of a great range of results known up to 1987.]
- R. PIESSENS, Algorithm 473: Computation of Legendre series coefficients [C6], *Comm. ACM* 17 (1974), 25–25. [$O(n^2)$ algorithm for converting from Chebyshev to Legendre expansions.]

- A. PINKUS, Weierstrass and approximation theory, *J. Approx. Th.* 107 (2000), 1–66. [Detailed discussion of Weierstrass’s nowhere-differentiable function and of the Weierstrass approximation theorem and its many proofs and generalizations.]
- R. B. PLATTE, L. N. TREFETHEN AND A. B. J. KUIJLAARS, Impossibility of fast stable approximation of analytic functions from equispaced samples, *SIAM Rev.* 53 (2011), 308–318. [Shows that any exponentially convergent scheme for approximating analytic functions from equispaced samples in an interval must be exponentially ill-conditioned as $n \rightarrow \infty$; thus no approximation scheme can eliminate the Gibbs and Runge phenomena completely.]
- G. PÓLYA, Über die Konvergenz von Quadraturverfahren, *Math. Z.* 37 (1933), 264–286. [Proves that a family of interpolating quadrature rules converges for all continuous integrands if and only if the sums of the absolute values of the weights are uniformly bounded; proves further that Newton–Cotes quadrature approximations do not always converge as $n \rightarrow \infty$, even if the integrand is analytic.]
- CH. POMMERENKE, Padé approximants and convergence in capacity, *J. Math. Anal. Appl.*, 41 (1973), 775–780. [Sharpens Nuttall’s result on convergence of Padé approximants in measure to convergence in capacity.]
- J. V. PONCELET, Sur la valeur approchée linéaire et rationnelle des radicaux de la forme $\sqrt{a^2 + b^2}$, $\sqrt{a^2 - b^2}$ etc., *J. Reine Angew. Math.* 13 (1835), 277–291. [Perhaps the very first discussion of minimax approximation.]
- D. POTTS, G. STEIDL AND M. TASCHE, Fast algorithms for discrete polynomial transforms, *Math. Comp.* 67 (1998), 1577–1590. [Algorithms for converting between Chebyshev and Legendre expansions.]
- M. J. D. POWELL, *Approximation Theory and Methods*, Cambridge U. Press, 1981. [Approximation theory text with a computational emphasis, particularly strong on the Remez algorithm and on splines.]
- H. A. PRIESTLEY, *Introduction to Complex Analysis*, 2nd ed., Oxford U. Press, 2003. [Well known introductory complex analysis textbook first published in 1985.]
- I. E. PRITSKER AND R. S. VARGA, The Szegő curve, zero distribution and weighted approximation, *Trans. Amer. Math. Soc.* 349 (1997), 4085–4105. [Analysis of the Szegő curve using methods of potential theory.]
- P. RABINOWITZ, Rough and ready error estimates in Gaussian integration of analytic functions, *Comm. ACM* 12 (1969), 268–270. [Derives tight bounds on accuracy of Gaussian quadrature by simple arguments.]
- H.-J. RACK AND M. REIMER, The numerical stability of evaluation schemes for polynomials based on the Lagrange interpolation form, *BIT* 22 (1982), 101–107. [Proof of stability for barycentric polynomial interpolation in well-distributed point sets, later developed further by Higham 2004.]
- T. RANSFORD, *Potential Theory in the Complex Plane*, Cambridge U. Press, 1995. [Perhaps the only book devoted to this subject.]
- T. RANSFORD, Computation of logarithmic capacity, *Comput. Meth. Funct. Th.* 10 (2010), 555–578. [An algorithm for computing capacity of a set in the complex plane, with examples.]
- E. REMES, Sur un procédé convergent d’approximations successives pour déterminer les polynômes d’approximation, *Compt. Rend. Acad. Sci.* 198 (1934), 2063–2065. [One of the original papers presenting the Remez algorithm.] CHECK
- E. REMES, Sur le calcul effectif des polynômes d’approximation de Tchebichef, *Compt.*

- Rend. Acad. Sci.* 199 (1934), 337–340. [The other original paper presenting the Remez algorithm.] CHECK
- E. Y. REMES, On approximations in the complex domain, *Dokl. Akad. Nauk SSSR* 77 (1951), 965–968 [Russian]. CHECK
- E. YA. REMEZ, General computational methods of Tchebycheff approximation, Atomic Energy Commission Translation 4491, Kiev, 1957, pp. 1–85. CHECK
- J. R. RICE, *The Approximation of Functions*, Addison-Wesley, 1964 and 1969. [Two volumes, the first linear and the second nonlinear.]
- L. F. RICHARDSON, The deferred approach to the limit. I—single lattice. *Phil. Trans. Roy. Soc. A* (1927), 299–349. [Systematic discussion of Richardson extrapolation, emphasizing discretizations with $O(h^2)$ error behavior.]
- M. RICHARDSON AND L. N. TREFETHEN, A sinc function analogue of Chebfun, *SIAM J. Sci. Comput.* 33 (2011), 2519–2535. [Presents a “Sincfun” software analogue of Chebfun for dealing with functions with endpoint singularities via variable transformation and sinc function interpolants.]
- F. RIESZ, Über lineare Funktionalgleichungen, *Acta Math.* 41 (1918), 71–98. [First statement of the general existence result for best approximation from finite-dimensional linear spaces.]
- M. RIESZ, Über einen Satz des Herrn Serge Bernstein, *Acta. Math.* 40 (1916), 43–47. [Gives a new proof of a Bernstein inequality based on the barycentric formula for Chebyshev points, in the process deriving the barycentric coefficients $(-1)^j$ half a century before Salzer 1972.] CHECK
- T. J. RIVLIN, *An Introduction to the Approximation of Functions*, Dover, 1981. [Appealing short textbook originally published in 1969.]
- T. J. RIVLIN, *Chebyshev Polynomials: From Approximation Theory to Algebra and Number Theory*, 2nd ed., Wiley, 1990. [Classic book on Chebyshev polynomials and applications, with first edition in 1974.]
- J. D. ROBERTS, Linear model reduction and solution of the algebraic Riccati equation by use of the sign function, *Internat. J. Control* 32 (1980), 677–687. [This article connecting rational functions with the sign function was written in 1971 as Technical Report CUED/B-Control/TR13 of the Cambridge University Engineering Dept.]
- W. RUDIN, *Principles of Mathematical Analysis*, 3rd ed., McGraw-Hill, 1976. [Influential textbook first published in 1953.]
- P. O. RUNCK, Über Konvergenzfragen bei Polynominterpolation mit äquidistanten Knoten. II, *J. Reine Angew. Math.* 210 (1962), 175–204. [Analyzes the Gibbs overshoot for two varieties of polynomial interpolation of a step function.]
- C. RUNGE (1885A), Zur Theorie der eindeutigen analytischen Functionen, *Acta Math.* 6 (1885), 229–244. [Publication of Runge’s theorem: a function analytic on a compact set in the complex plane whose complement is connected can be uniformly approximated by polynomials. This was later generalized by Mergelyan.]
- C. RUNGE (1885B), Über die Darstellung willkürlicher Functionen, *Acta Math.* 7 (1885), 387–392. [Shows that a continuous function on a finite interval can be uniformly approximated by rational functions. It was later noted by Phragmén and Mittag-Leffler that this and the previous paper by Runge together imply the Weierstrass approximation theorem.]
- C. RUNGE, Über empirische Funktionen und die Interpolation zwischen äquidistanten Ordinaten, *Z. Math. Phys.* 46 (1901), 224–243. [Méray had pointed out that poly-

nomial interpolants might fail to converge, but it was this paper that focussed on equispaced sample points, showed that divergence can take place even in the interval of interpolation, and identified the “Runge region” where analyticity is required for convergence.]

A. RUTTAN, The length of the alternation set as a factor in determining when a best real rational approximation is also a best complex rational approximation, *J. Approx. Th.* 31 (1981), 230–243. [Shows that complex best approximations are always better than real ones in the strict lower-right triangle of a square block of the Walsh table.]

A. RUTTAN AND R. S. VARGA, A unified theory for real vs. complex rational Chebyshev approximation on an interval, *Trans. Amer. Math. Soc.* 312 (1989), 681–697. [Shows that type $(m, m + 2)$ complex rational approximants to real functions can be up to 3 times as accurate as real ones.]

E. B. SAFF, An extension of Montessus de Ballore’s theorem on the convergence of interpolating rational functions, *J. Approx. Th.* 6 (1972), 63–67. [Generalizes the de Montessus de Ballore theorem from Padé to multipoint Padé approximation.]

E. B. SAFF AND A. D. SNIDER, *Fundamentals of Complex Analysis with Applications to Engineering, Science, and Mathematics*, 3rd ed., Prentice Hall, 2003. [Widely used introductory complex analysis textbook.]

E. B. SAFF AND V. TOTIK, *Logarithmic Potentials with External Fields*, Springer, 1997. [Presentation of connections between potential theory and rational approximation.]

E. B. SAFF AND R. S. VARGA (1978A), Nonuniqueness of best complex rational approximations to real functions on real intervals, *J. Approx. Th.* 23 (1978), 78–85. [Rediscovery of results of Lungu 1971.]

E. B. SAFF AND R. S. VARGA (1978b), On the zeros and poles of Padé approximants to e^z . III, *Numer. Math.* 30 (1978), 241–266. [Analysis of the curves in the complex plane along which poles and zeros of these approximants cluster.]

T. W. SAG AND G. SZEKERES, Numerical evaluation of high-dimensional integrals, *Math. Comp.* 18 (1964), 245–253. [Introduction of changes of variables that can speed up Gauss and other quadrature formulas, even in one dimension.]

SALAZAR CELIS, *CHECK*

H. E. SALZER, A simple method for summing certain slowly convergent series, *J. Math. Phys.* 33 (1955), 356–359. [“Salzer’s method” for acceleration of convergence, based on interpreting a sequence of values as samples of a function $f(x)$ at $x_n = n^{-1}$.]

H. E. SALZER, Lagrangian interpolation at the Chebyshev points $x_{n,\nu} = \cos(\nu\pi/n)$, $\nu = 0(1)n$; some unnoted advantages, *Computer J.* 15 (1972), 156–159. [Barycentric formula for polynomial interpolation in Chebyshev points.]

H. E. SALZER, Rational interpolation using incomplete barycentric forms, *Z. Angew. Math. Mech.* 61 (1981), 161–164. [One of the first publications to propose the use of rational interpolants defined by barycentric formulas.]

T. SCHMELZER AND L. N. TREFETHEN, Evaluating matrix functions for exponential integrators via Carathéodory–Fejér approximation and contour integrals, *Elect. Trans. Numer. Anal.* 29 (2007), 1–18. [Fast methods based on rational approximations for evaluating the φ functions used by exponential integrators for solving stiff ODEs and PDEs.]

J. R. SCHMIDT, On the numerical solution of linear simultaneous equations by an iterative method, *Philos. Mag.* 32 (1941), 369–383. [Proposal of what became known

- as the epsilon or eta algorithm some years before Shanks 1955, Wynn 1956, and Bauer 1959.]
- C. SCHNEIDER AND W. WERNER, Some new aspects of rational interpolation, *Math. Comp.* 47 (1986), 285–299. [Extension of barycentric formulas to rational interpolation.]
- A. SCHÖNHAGE, Fehlerfortpflanzung bei Interpolation, *Numer. Math.* 3 (1961), 62–71. [Independent rediscovery of results close to those of Turetskii 1940 concerning Lebesgue constants for equispaced points.]
- A. SCHÖNHAGE, Zur rationalen Approximierbarkeit von e^{-x} über $[0, \infty)$, *J. Approx. Th.* 7 (1973), 395–398. [Proves that in maximum-norm approximation of e^x on $(-\infty, 0]$ by inverse-polynomials $1/p_n(x)$, the optimal rate is $O(3^{-n})$.]
- I. SCHUR, Über Potenzreihen, die im Innern des Einheitskreises beschränkt sind, *J. Reine Angew. Math.* 148 (1918), 122–145. [Solution of the problem of Carathéodory and Fejér via the eigenvalue analysis of a Hankel matrix of Taylor coefficients.]
- D. SHANKS, Non-linear transformations of divergent and slowly convergent sequences, *J. Math. Phys.* 34 (1955), 1–42. [Introduction of Shanks’ method for convergence acceleration by Padé approximation, closely related to the epsilon algorithm of Wynn 1956.]
- J. SHEN, T. TANG AND L.-L. WANG, *Spectral Methods: Algorithms, Analysis and Applications*, Springer, 2011. [Systematic presentation of spectral methods including convergence theory.]
- B. SHIFMAN AND S. ZELDITCH, Equilibrium distribution of zeros of random polynomials, *Int. Math. Res. Not.* 2003, no. 1. [Shows that polynomials given by expansions in orthogonal polynomials with random coefficients have roots clustering near the support of the orthogonality measure.] CHECK
- A. SIDI, *Practical Extrapolation Methods*, Cambridge U. Press, 2003. [Extensive treatment of methods for acceleration of convergence.]
- G. A. SITTON, C. S. BURRUS, J. W. FOX AND S. TREITEL, Factoring very-high-degree polynomials, *IEEE Signal Proc. Mag.*, Nov. 2003, 27–42. [Discussion of rootfinding for polynomials of degree up to one million by the Lindsey–Fox algorithm.]
- V. I. SMIRNOV AND N. A. LEBEDEV, *Functions of a Complex Variable: Constructive Theory*, MIT Press, 1968. [Major survey of problems of polynomial and rational approximation in the complex plane.]
- F. SMITHIES, *Cauchy and the Creation of Complex Function Theory*, Cambridge U. Press, 1997. [Detailed account of Cauchy’s almost single-handed creation of this field during 1814–1831.]
- M. A. SNYDER, *Chebyshev Methods in Numerical Approximation*, Prentice Hall, 1966. [An appealing short book emphasizing rational as well as polynomial approximations.]
- W. SPECHT, Die Lage der Nullstellen eines Polynoms. III, *Math. Nachr.* 16 (1957), 369–389. [Development of comrade matrices, whose eigenvalues are roots of polynomials expressed in bases of orthogonal polynomials.]
- W. SPECHT, Die Lage der Nullstellen eines Polynoms. IV, *Math. Nachr.* 21 (1960), 201–222. [The final page considers colleague matrices, the special case of comrade matrices for Chebyshev polynomials. These ideas were developed independently by Good 1961.]
- H. STAHL, The convergence of Padé approximants to functions with branch points, *J. Approx. Th.* 91 (1997), 139–204. [Generalizes the Nuttall–Pommerenke theorem on

convergence of type (n, n) Padé approximants to the case of functions f with branch points.]

H. STAHL, Spurious poles in Padé approximation, *J. Comp. Appl. Math.* 99 (1998), 511–527. [Defines and analyzes what it means for a pole of a Padé approximant to be spurious.]

H. STAHL, Best uniform rational approximation of $|x|$ on $[-1, 1]$, *Russian Acad. Sci. Sb. Math.* 76 (1993), 461–487. [Proof of the conjecture of Varga, Rutman and Carpenter that best rational approximations to $|x|$ on $[-1, 1]$ converge at the rate $\sim 8 \exp(-\pi\sqrt{n})$.]

H. R. STAHL, Best uniform rational approximation of x^α on $[0, 1]$, *Acta Math.* 190 (2003), 241–306. [Generalization of the results of the paper above to approximation of x^α on $[0, 1]$, completing earlier investigations of Ganelius and Vyacheslavov.]

H. STAHL AND T. SCHMELZER, An extension of the ‘1/9’-problem, *J. Comput. Appl. Math.* 233 (2009), 821–834. [Announcement of numerous extensions of the “9.28903” result of Gonchar & Rakhmanov 1989 for type (n, n) best approximation of e^x on $(-\infty, 0]$, showing that the same rate of approximation applies on compact sets in the complex plane and on Hankel contours, and that “9.28903” is also achieved on $(-\infty, 0]$ in type $(n, n+k)$ approximation of e^x or of related functions such as φ functions for exponential integrators.]

K.-G. STEFFENS, *The History of Approximation Theory: From Euler to Bernstein*, Birkhäuser, 2006. [Discussion of many people and results, especially of the St. Petersburg school, by a student of Natanson.]

E. M. STEIN AND R. SHAKARCHI, *Real Analysis: Measure Theory, Integration, and Hilbert Spaces*, Princeton U. Press, 2005. [A leading textbook.]

F. STENGER, Explicit nearly optimal linear rational approximation with preassigned poles, *Math. Comput.* 47 (1986), 225–252. [Construction of rational approximants by a method related to sinc expansions.]

F. STENGER, *Numerical Methods Based on Sinc and Analytic Functions*, Springer, 1993. [Comprehensive treatise by the leader in sinc function algorithms.]

F. STENGER, *Sinc Numerical Methods*, CRC Press, 2010. [A handbook of sinc methods and their implementation in the author’s software package Sinc-Pack.]

T. J. STIELTJES (1884A), Note sur quelques formules pour l’évaluation de certaines intégrales, *Bull. Astr. Paris* 1 (1884), 568–569. CHECK

T. J. STIELTJES (1884B), Quelques recherches sur la théorie des quadratures dites mécaniques, *Ann. Sci. École Norm. Sup.* 1 (1884), 409–426. [Proves that Gauss quadrature converges for any Riemann integrable integrand.] CHECK

T. J. STIELTJES, Sur les polynômes de Jacobi, *Compt. Rend. Acad. Sci.* 199 (1885), 620–622. [Shows that the roots of $(x^2 - 1)P_{n-1}^{(1,1)}(x)$ are Fekete points (minimal-energy points) in $[-1, 1]$.]

J. SZABADOS, Rational approximation to analytic functions on an inner part of the domain of analyticity, in A. Talbot, ed., *Approximation Theory*, Academic Press, 1970, pp. 165–177. [Shows that for some functions analytic in a Bernstein ρ -ellipse, type (n, n) rational best approximations are essentially no better than degree n polynomial best approximations.]

G. SZEGŐ, Über eine Eigenschaft der Exponentialreihe, *Sitzungsber. Berl. Math. Ges.* 23 (1924), 50–64. [Shows that as $n \rightarrow \infty$, the zeros of the normalized partial sums $s_n(nz)$ of the Taylor series of e^z approach the Szegő curve in the complex z -plane]

defined by $|ze^{1-z}| = 1$ and $|z| \leq 1$.]

G. SZEGŐ, *Orthogonal Polynomials*, Amer. Math. Soc., 1985. [A classic monograph by the master, including chapters on polynomial interpolation and quadrature, first published in 1939.]

E. TADMOR, The exponential accuracy of Fourier and Chebyshev differencing methods, *SIAM J. Numer. Anal.* 23 (1986), 1–10. [Presents theorems on exponential accuracy of Chebyshev interpolants of analytic functions and their derivatives.]

T. TAKAGI, On an algebraic problem related to an analytic theorem of Carathéodory and Fejér and on an allied theorem of Landau, *Japan J. Math.* 1 (1924), 83–91 and *ibid.*, 2 (1925), 13–17. [Beginnings of the generalization of Carathéodory & Fejér 1911 and Schur 1918 to rational approximation.]

H. TAKAHASI AND M. MORI, Estimation of errors in the numerical quadrature of analytic functions, *Applicable Anal.* 1 (1971), 201–229. [Relates the accuracy of a quadrature formula to the accuracy of an associated rational function as an approximation to $\log((z+1)/(z-1))$ on a contour enclosing $[-1, 1]$.]

H. TAKAHASI AND M. MORI, Double exponential formulas for numerical integration, *Publ. RIMS, Kyoto U.* 9 (1974), 721–741. [Introduction of the double exponential or tanh-sinh quadrature rule, in which Gauss quadrature is transformed by a change of variables to another formula that can handle endpoint singularities.]

A. TALBOT, The uniform approximation of polynomials by polynomials of lower degree, *J. Approx. Th.* 17 (1976), 254–279. [A precursor to the Carathéodory–Fejér method.]

F. D. TAPPERT, The parabolic approximation method, in J. B. Keller and J. S. Papadakis, eds., *Wave Propagation and Underwater Acoustics*, Springer, 1977, pp. 224–287. [Describes techniques for one-way acoustic wave simulation in the ocean, based on polynomial and rational approximations of a pseudodifferential operator.]

R. TAYLOR AND V. TOTIK, Lebesgue constants for Leja points, *IMA J. Numer. Anal.* 30 (2010), 462–486. [Proves that for general sets in the complex plane, the Lebesgue constants associated with Leja points grow subexponentially.]

W. J. TAYLOR, Method of Lagrangian curvilinear interpolation, *J. Res. Nat. Bur. Stand.* 35 (1945), 151–155. [The first use of the barycentric interpolation formula, for equidistant points only and without the term “barycentric”, which was introduced by Dupuy 1948.]

T. W. TEE AND L. N. TREFETHEN, A rational spectral collocation method with adaptively transformed Chebyshev grid points, *SIAM J. Sci. Comp.* 28 (2006), 1798–1811. [Numerical solution of differential equations with highly nonuniform solutions using Chebyshev–Padé approximation, conformal maps, and spectral methods based on rational barycentric interpolants, as advocated by Berrut and coauthors.]

H. TIETZE, Eine Bemerkung zur Interpolation, *Z. Angew. Math. Phys.* 64 (1917), 74–90. [Investigates the Lebesgue function for equidistant points, showing the local maxima decrease monotonically from the outside of the interval toward the middle.]

A. F. TIMAN, A strengthening of Jackson’s theorem on the best approximation of continuous functions by polynomials on a finite interval of the real axis, *Doklady Akad. Nauk SSSR* 78 (1951), 17–20. [A theorem on polynomial approximation that recognizes the greater approximation power near the ends of the interval.]

A. F. TIMAN, *Theory of Approximation of Functions of a Real Variable*, Dover, 1994. [First published in Russian in 1960.]

- K.-C. TOH AND L. N. TREFETHEN, Pseudozeros of polynomials and pseudospectra of companion matrices, *Numer. Math.* 68 (1994), 403–425. [Analysis of stability of companion matrix eigenvalues as an algorithm for polynomial rootfinding, given a polynomial expressed by its coefficients in the monomial basis.]
- L. TONELLI, I polinomi d'approssimazione di Tschebychev, *Annali di Mat.* 15 (1908), 47–119. [Extension of results on real best approximation to the complex case.]
- L. N. TREFETHEN, Chebyshev approximation on the unit disk, in H. Werner et al., eds., *Constructive Aspects of Complex Analysis*, D. Riedel, 1983. [An introduction to several varieties of CF approximation.]
- L. N. TREFETHEN, Square blocks and equioscillation in the Padé, Walsh, and CF tables, in P. R. Graves-Morris, et al., eds., *Rational Approximation and Interpolation*, Lect. Notes in Math., v. 1105, Springer, 1984. [Shows that square block structure in all three tables of rational approximations arises from equioscillation-type characterizations involving the defect.]
- L. N. TREFETHEN, *Spectral Methods in MATLAB*, SIAM, 2000. [Matlab-based textbook on spectral methods for ODEs and PDEs.]
- L. N. TREFETHEN, Is Gauss quadrature better than Clenshaw–Curtis?, *SIAM Rev.* 50 (2008), 67–87. [Shows by considering approximation properties in the complex plane that for most functions, the Clenshaw–Curtis and Gauss formulas have comparable accuracy.]
- L. N. TREFETHEN, Householder triangularization of a quasimatrix, *IMA J. Numer. Anal.* 30 (2010), 887–897. [Extends the Householder triangularization algorithm to quasimatrices, i.e., “matrices” whose columns are functions rather than vectors.]
- L. N. TREFETHEN AND D. BAU, III, *Numerical Linear Algebra*, SIAM, 1997. [A standard text, with a section “When vectors become continuous functions” at p. 52 that foreshadows Chebfun computation with quasimatrices.]
- L. N. TREFETHEN AND M. H. GUTKNECHT (1983A), Real vs. complex rational Chebyshev approximation on an interval, *Trans. Amer. Math. Soc.* 280 (1983), 555–561. [Shows that type (m, n) complex rational approximations to a real function on an interval may be arbitrarily much better than real ones, for $n \geq m + 3$.]
- L. N. TREFETHEN AND M. H. GUTKNECHT (1983B), The Carathéodory–Fejér method for real rational approximation, *SIAM J. Numer. Anal.* 20 (1983), 420–436. [Introduction of real rational CF approximation, and first numerical computation of the constant 9.28903... for minimax rational approximation of e^x on $(-\infty, 0]$.]
- L. N. TREFETHEN AND M. H. GUTKNECHT, On convergence and degeneracy in rational Padé and Chebyshev approximation, *SIAM J. Math. Anal.* 16 (1985), 198–210. [Proves theorems to the effect that the Padé approximation operator is continuous, and Padé approximants are limits of best approximants on regions shrinking to a point, provided that the defect is 0.]
- L. N. TREFETHEN AND M. H. GUTKNECHT, Padé, stable Padé, and Chebyshev–Padé approximation, in J. C. Mason and M. G. Cox, *Algorithms for Approximation*, Clarendon Press, 1987, pp. 227–264. [Reduces the problem of Chebyshev–Padé approximation to the problem of stable Padé approximation, that is, Padé approximation with a constraint on location of poles.]
- L. N. TREFETHEN AND L. HALPERN, Well-posedness of one-way wave equations and absorbing boundary conditions, *Math. Comput.* 47 (1986), 421–435. [Shows that approximations from two diagonals of the Padé table must be used in these applications;

polynomial and other approximations are ill-posed.]

L. N. TREFETHEN AND J. A. C. WEIDEMAN, Two results concerning polynomial interpolation in equally spaced points, *J. Approx. Th.* 65 (1991), 247–260. [Discussion of the size of Lebesgue constants and “6 points per wavelength” for polynomial interpolation in equispaced points.]

L. N. TREFETHEN, J. A. C. WEIDEMAN AND T. SCHMELZER, Talbot quadratures and rational approximations, *BIT Numer. Math.* 46 (2006), 653–670. [Shows how integrals approximated by the trapezoid rule correspond to rational approximations in the complex plane, with particular attention to the approximation of e^x on $(-\infty, 0]$.]

A. H. TURETSKII, The bounding of polynomials prescribed at equally distributed points, *Proc. Pedag. Inst. Vitebsk* 3 (1940), 117–127 (Russian). [Derivation of the $\sim 2^n/en \log n$ asymptotic size of Lebesgue constants for equispaced polynomial interpolation. This paper went largely unnoticed for fifty years and the main result was rediscovered by Schönhage 1961.]

CH.-J. DE LA VALLÉE POUSSIN, Note sur l’approximation par un polynôme d’une fonction dont la dérivée est à variation bornée, *Bull. Acad. Belg.* 1908, 403–410. CHECK

CH. DE LA VALLÉE POUSSIN, Sur les polynômes d’approximation et la représentation approchée d’un angle, *Acad. Roy. de Belg., Bulletins de la Classe des Sci.* 12 (1910).

CHECK

CH. J. DE LA VALLÉE POUSSIN, *Leçons sur l’approximation des fonctions d’une variable réelle*, Gauthier-Villars, Paris, 1919. CHECK

J. VAN DEUN AND L. N. TREFETHEN, A robust implementation of the Carathéodory–Fejér method, *BIT Numer. Math.* 51 (2011), 1039–1050. [Twenty-five years after the original theoretical papers, a paper describing the practical details behind the Chebfun `cf` command.]

R. S. VARGA AND A. J. CARPENTER, On the Bernstein conjecture in approximation theory, *Constr. Approx.* 1 (1985), 333–348. [Shows that degree n best polynomial approximants to $|x|$ have asymptotic accuracy $0.280\dots n^{-1}$ rather than $0.282\dots n^{-1}$.]

R. S. VARGA, A. RUTTAN AND A. J. CARPENTER, Numerical results on best uniform rational approximation of $|x|$ on $[-1, 1]$, *Math. USSR Sbornik* 74 (1993), 271–290. [High-precision numerical calculations lead to the conjecture that best rational approximations to $|x|$ on $[-1, 1]$ converge asymptotically at the rate $\sim 8\exp(-\pi\sqrt{n})$, proved by Stahl 1993.]

N. S. VYACHESLAVOV, On the uniform approximation of $|x|$ by rational functions, *Sov. Math. Dokl.* 16 (1975), 100–104. [Sharpens the result of Newman 1964 by showing that rational approximations to $|x|$ on $[-1, 1]$ converge at the rate $O(\exp(-\pi\sqrt{n}))$.]

J. WALDVOGEL, Fast construction of the Fejér and Clenshaw–Curtis quadrature rules, *BIT Numer. Math.* 46 (2006), 195–202. [Presentation of $O(n \log n)$ algorithms for finding nodes and weights.]

H. WALLIN, On the convergence theory of Padé approximants, in *Linear Operators and Approximation*, Internat. Ser. Numer. Math. 20 (1972), pp. 461–469. [Shows that there exists an entire function f whose (n, n) Padé approximants are unbounded for all $z \neq 0$.]

J. L. WALSH, The existence of rational functions of best approximation, *Trans. Amer. Math. Soc.* 33 (1931), 668–689. [Shows that there exists a best rational approximation of type (m, n) to a given continuous function f , not just on an interval such as $[-1, 1]$ but also on more general sets in the complex plane.]

- J. L. WALSH, On approximation to an analytic function by rational functions of best approximation, *Math. Z.* 38 (1934), 163–176. [Perhaps the first discussion of what is now called the Walsh table, the table of best rational approximations to a given function f for various types (m, n) .]
- J. L. WALSH, The analogue for maximally convergent polynomials of Jentzsch’s theorem, *Duke Math. J.* 26 (1959), 605–616. [Shows that every point on the boundary of a region of convergence of a sequence of polynomial approximations is the limit of zeros of its partial sums.]
- J. L. WALSH, *Interpolation and Approximation by Rational Functions in the Complex Domain*, 5th ed., American Mathematical Society, 1969. [An encyclopedic but hard-to-read treatise on all kinds of material related to polynomial and rational approximation in the complex plane, originally published in 1935.]
- H. WANG AND S. XIANG, On the convergence rates of Legendre approximation, *Math. Comp.* 81 (2012), 861–877. [Theorem 3.1 connects barycentric interpolation weights $\{\lambda_k\}$ and Gauss–Legendre quadrature weights $\{w_k\}$.]
- R. C. WARD, Numerical computation of the matrix exponential with accuracy estimate, *SIAM J. Numer. Anal.* 14 (1977), 600–610. [Presentation of a scaling-and-squaring algorithm for computing the exponential of a matrix by Padé approximation, a form of which is used by Matlab’s `expm` command.]
- E. WARING, Problems concerning interpolations, *Phil. Trans. R. Soc.* 69 (1779), 59–67. [Presents the Lagrange interpolation formula 16 years before Lagrange.]
- G. A. WATSON, *Approximation Theory and Numerical Methods*, Wiley, 1980. [Textbook with special attention to L_1 and L_p norms.]
- M. WEBB, Computing complex singularities of differential equations with Chebfun, *SIAM Undergrad. Research Online*, submitted, 2012. [Exploration of rational approximation for locating complex singularities of numerical solutions to ODE problems including Lorenz and Lotka–Volterra equations.]
- M. WEBB, L. N. TREFETHEN AND P. GONNET, Stability of barycentric interpolation formulas, *SIAM J. Sci. Comp.*, submitted, 2011. [Confirming the theory of Higham 2004, shows that the “type 2” barycentric interpolation formula can be dangerously unstable if used for extrapolation outside the data interval.]
- J. A. C. WEIDEMAN, Computing the dynamics of complex singularities of nonlinear PDEs, *SIAM J. Appl. Dyn. Syst.* 2 (2003), 171–186. [Applies Padé approximation to computed solutions of nonlinear time-dependent PDEs to estimate locations of moving poles and other singularities.]
- J. A. C. WEIDEMAN AND S. C. REDDY, A MATLAB differentiation matrix suite, *ACM Trans. Math. Softw.* 26 (2000), 465–519. [A widely-used collection of Matlab programs for generating Chebyshev, Legendre, Laguerre, Hermite, Fourier, and sinc spectral differentiation matrices of arbitrary order.]
- J. A. C. WEIDEMAN AND L. N. TREFETHEN, The kink phenomenon in Fejér and Clenshaw–Curtis quadrature, *Numer. Math.* 107 (2007), 707–727. [Analysis of the effect that as n increases, Clenshaw–Curtis quadrature initially converges at the same rate as Gauss rather than half as fast as commonly supposed.]
- J. A. C. WEIDEMAN AND L. N. TREFETHEN, Parabolic and hyperbolic contours for computing the Bromwich integral, *Math. Comput.* 76 (2007), 1341–1356. [Derivation of geometrically-convergent “Talbot contour” type rational approximations for problems related to e^x on $(-\infty, 0]$.]

- K. WEIERSTRASS, Über continuierliche Functionen eines reellen Arguments, die für keinen Werth des letzteren einen bestimmten Differentialquotienten besitzen, *Königliche Akademie der Wissenschaften*, 1872. [Weierstrass's publication of an example (which he had lectured on a decade earlier) of a continuous, nowhere-differentiable function.]
- K. WEIERSTRASS, Über die analytische Darstellbarkeit sogenannter willkürlicher Functionen einer reellen Veränderlichen, *Sitzungsberichte der Akademie zu Berlin*, 633–639 and 789–805, 1885. [Presentation of the Weierstrass approximation theorem.]
- B. D. WELFERT, Generation of pseudospectral differentiation matrices. I, *SIAM J. Numer. Anal.* 34 (1997), 1640–1657. [Derivation of stable recursive formulas for computation of derivatives of interpolants.]
- E. J. WENIGER, Nonlinear sequence transformations for the acceleration of convergence and the summation of divergent series, *Computer Phys. Rep.* 10 (1989), 189–371 (also available as arXiv:math/0306302v1, 2003). [Extensive survey.]
- H. WERNER, On the rational Tschebyscheff operator, *Math. Z.* 86 (1964), 317–326. [Shows that the operator mapping a real function $f \in C[-1, 1]$ to its best real rational approximation of type (m, n) is continuous if and only if f is itself rational of type (m, n) or its best approximation has defect 0 (“nondegenerate”).]
- H. WILBRAHAM, On a certain periodic function, *Cambridge and Dublin Math. J.* 3 (1848), 198–201. [Analyzes the Gibbs phenomenon fifty years before Gibbs.]
- J. H. WILKINSON, The perfidious polynomial, in G. H. Golub, ed., *Studies in Numerical Analysis*, Math. Assoc. Amer., 1984. [Wilkinson's major work on polynomials was in the 1960s, but this entertaining review, which won the Chauvenet Prize of the Mathematical Association of America in 1987, remains noteworthy not least because of its memorable title.]
- J. WIMP, *Sequence Transformations and their Applications*, Academic Press, 1981. [Monograph on many methods for acceleration of convergence.]
- C. WINSTON, On mechanical quadratures formulae involving the classical orthogonal polynomials, *Ann. Math.* 35 (1934), 658–677. [States a general connection between Gauss–Jacobi quadrature weights and the Lagrange polynomials.] CHECK
- P. WYNN, On a device for computing the $e_m(S_n)$ transformation, *Math. Comp.* 10 (1956), 91–96. [Wynn's first of many papers about the epsilon algorithm for acceleration of convergence of sequences.]
- S. XIANG AND F. BORNEMANN, On the convergence rates of Gauss and Clenshaw–Curtis quadrature for functions of limited regularity, archive 1203.2445v1, 2012. CHECK
- K. ZHOU, J. C. DOYLE AND K. GLOVER, *Robust and Optimal Control*, Prentice Hall, 1996. [A leading textbook on optimal control, with special attention to approximation issues.]
- W. P. ZIEMER, *Weakly Differentiable Functions*, Springer, 1989. [Includes a definition of total variation in the measure theoretic context.]