Information on Math 8500

Instructor: Ming-Jun Lai
Office: Boyd Graduate Studies Room 408
Class time: 10:10–11:00am MWF
Classroom: 326 Boyd Graduate Studies Building
Office Hours: 11:15–12:15pm MWF or by appointment
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Textbook: D. Kincaid and W. Cheney: **Numerical Analysis**, ITP

In this class, we will learn many numerical algorithms to solve various problems which are essential to applied sciences. We will also learn the theory behind of the algorithms and understand how the algorithms work.

The basic requirement of this class is to know the following algorithms well: Newton's Method for systems of Nonlinear equations, Laguerre's Method, LU Factorization, Cholesky Factorization, Gaussian Elimination with Pivotings, Jacobi's and Seidel Iteration, SOR, SSOR, Steepest Descent Method, Conjugate Gradient Method, Householder Transform and Givens rotation, QR method for Eigenvalues, Power Method, SVD for Least Square, Lagrange Interpolation Formula, Newton's Interpolation Formula, Cubic splines, Evaluation of B-splines, B-spline Approximation Formula, and the best approximation in the L_2 and L_∞ norms.

The advanced requirement is to know how and why these algorithms work and to be able to show the convergence of these methods.

There are four tests for hand-calculation and four computer projects which are listed below. Problem session is designed to discuss the problems in computer projects and/or problems in the textbook.

Tentative Schedule

Date	Topics	Sections	Project
M8/16	Introduction	§2.2	Read Chapters 1& 2
W8/18	Bisection method	§3.1	
F8/20	Newton's Method	§3.2	
M8/23	Newton's Method (II)		
W8/25	Secant method	§3.3	
F8/27	Fixed Point Iteration	§3.4	Project I
M8/30	Roots of Polynomials	§3.5	
W9/1	Roots of Polynomials (II)	§3.5	
F9/3	Roots of Polynomials (III)	§3.5	
M9/6	Homotopy Method and Continuation	§3.6	
W9/8	Problem Session		
F9/10	Test I	§3.5	Project I due
M9/13	Matrix Properties	§4.1	
W9/15	LU Factorization	§4.2	

F9/17	Pivoting Strategies	§4.3	
M9/20	Gaussian Eliminations	§4.3	
W9/22	Norm of Vectors and Matrices	§4.4	
F9/24	Error Analysis	§4.4	
M9/27	Iterative Methods	§4.5	
W9/29	Jacobi and Seidel Iterations	§4.6	
F10/1	Chebyshev Acceleration	§4.6	Project II
M10/4	Steepest Descent Method	§4.7	
W10/6	Conjugate Gradient Method (I)	§4.7	
F10/8	Conjugate Gradient Method (II)	§4.7	Project II due
M10/11	Problem Session		
W10/13	TEST II		
F10/15	Matrix Eigenvalue Problems	§5.2	
M10/18	Power and Inverse Power Methods	§5.3	
W10/20	Orthogonal Factorizations	§5.3	
F10/22	QR Method for Eigenvalues	§5.5	Project III
M10/25	Convergence for QR Method	§5.5	
W10/27	SVD and Pseudo-Inverse	§5.4	Project III due
F10/29	Fall Break		
M11/1	Least Squares Problems	§5.3	
W11/3	Problem Session		
F11/5	TEST III		
M11/8	Polynomial Interpolation	§6.1	
M11/10	Convergence for Interpolation	§6.1	
M11/12	Divided Differences	§6.2	
M11/15	Hermite Interpolation	§6.3	
W11/17	Cubic Spline Interpolation	§6.4	
F11/19	Spline Interpolation	§6.4	
F11/22–26	Thanksgiving Holiday		
M11/29	B-spline Theory	§6.5	
W12/1	More on B-splines	§6.6	Project IV
F12/3	Best Approximation (L_2)	§6.8	
M12/6	Best Approximation (L_∞)	§6.9	
T12/7	Best Approximation (L_∞)	§6.9	
W12/8	Problem Session		
F12/10	**Final Examination**		Project IV due

Grade Policy:

All projects and tests are 100 points each. The total is 800 points. One gets an A if he/she gets points $>= 90\%, B$ if $>= 75\%, C$ if $>= 60\%, D$ if $>= 40\%, F$ if $< 40\%$.