198:510 Numerical Analysis, FALL 2018

Instructor: W. Steiger Hill 417 445-7293 steiger@cs.rutgers.edu
TA: Kun Wang CBIM

- **Office Hours:** Wed. 12:15-1:30 or by arrangement.
- **Course Homepage:**http://www.cs.rutgers.edu/∼steiger/cs510-18.html [Sakai coming]
- **Course Objectives, Prerequisites, Expected work:** Introduction to general issues arising in scientific computing and to specific algorithms for some important computational tasks that are at the heart of this subject. You will need to have familiarity with multivariate Calculus, Linear Algebra, and should have the ability to program in a high level language, e.g., C, C++,Fortran, Matlab, Python; grades will be based on several written homeworks and possibly a few small programs ($\leq 2/5$), and (likely) two exams ($\geq 3/5$).
- **Topics:**
  1. Floating point numbers and roundoff error
  2. Nonlinear Equations
     (a) bisection method, regla falsi, fixed point iteration, secant method, Newton's method
     (b) convergence rates
     (c) system of nonlinear equations - Newton's method
  3. Linear Systems
     (a) Gaussian elimination/ LU decomposition/ matrix inversion
     (b) complexity
     (c) error analysis, norms, condition number
     (d) iterative methods - Jacobi, Gauss-Seidel, SOR
     (e) Singular Value decomposiion
  4. Polynomial Approximation and Interpolation
     (a) The interpolating polynomial and its error
     (b) Tchebycheff interpolation, minimax approximation
     (c) splines
     (d) least squares approximation, orthogonal polynomials
  5. Numerical Differentiation and Integration
  6. Numerical Solution of Differential Equations
- **Some References:** Will be on reserve in the math/sci library
  1. "Elementary Numerical Analysis: An Algorithmic Approach", third edition, S. Conte and C. de Boor, Mc Graw-Hill, 1981.
  2. "Scientific Computing, An Introductory Survey", 2nd edition, M. T. Heath, McGraw-Hill, 2002
  3. "Numerical Analysis", G. Dahlquist, A. Bjorck, N. Anderson, Prentice-Hall, 1974 (2003, 2008).
  4. "Scientific Computing, An Introduction With Parallel Computing", G. Golub and J. M. Ortega, Academic Press, 1993.