

Midterm Review

The exam is Monday, May 7, 2007 in class. No notes, books or calculators allowed. Bring your mind. I will provide you a list of relevant MATLAB function calls if you need them. In the exam you will be asked to both calculate by hand and **ALSO** write MATLAB code. When you write code for the exam, write it as if I will write a .m file and run your code.

- Linear Systems (page 14-26 in notes)
 - vectors, matrices, matrix-vector and matrix-matrix multiplication. Requirements on dimensions for multiplication to make sense.
 - LU factorization (no pivoting) of a matrix A (without pivoting). Be able to carry out by hand for a simple system.
 - With the LU factorization, solve a system using backward and forward substitution.
 - Jacobi Iteration method for solving a linear system $Ax = b$. (when is it guaranteed to converge?)
 - Gauss-Seidel Iteration for solving a linear system $Ax = b$.
 - Eigenvalues and eigenvectors.
- Curve Fitting (pages 26-38 in notes)
 - Least squares polynomial fit (use of polyfit and polyval functions).
 - Data linearization with exponential function.
 - Nonlinear least squares fit (use of fminsearch function).
 - Idea of minimizing the E_2 error.
 - Interpolation and splines (use of spline and interp1 commands).
- Solving nonlinear equations and nonlinear systems of equations (from in-class notes)
 - Bisection method
 - Fixed point iteration (FPI)
 - * Rewriting $f(x) = 0$ as a fixed point problem $x = g(x)$.
 - * When does it converge? How fast?
 - Newton's method for one equation
 - * Formula and application to specific $f(x)$.
 - * Graphical interpretation and derivation of formula from Taylor series.
 - * When does it converge? How fast?
 - * Understand the relation between FPI and Newton (see handout)
 - Newton's method for system of equations
 - * Given $\vec{F}(\vec{x}) = 0$, find Jacobian.
 - * Set up appropriate linear system to be solved for update $\Delta\vec{x}$.
 - * Formula and application to specific system.

Example Problem

1.

$$f(x) = x^{1/3} + 2 - x$$

- (a) To solve the equation $f(x) = 0$, use the initial guess $x_0 = 1$ and take **one** iteration (BY HAND) using Newton's method to find x_1 .
- (b) Write MATLAB code that would find the solution to $f(x) = 0$ using Newton's method with initial guess $x_0 = 1$ and tolerance level (on the function) of 10^{-6} .