Numerical Analysis Review Guide for Test One -- Wednesday September 24th

Error Analysis

(e-text references: Sections 1.2, 1.3, 1.6

- Definition of true error, absolute true error and absolute relative error
- Definition of approximate error, absolute approximate error, and absolute relative approximate error.
- Compute any of the above for a specific problem.
- Compute the number of significant digits in an approximation from the relative error in such a problem

Handout on Significant Digits:

- Be able to perform computations reporting correct number of significant digits like those on the handout.

Solving Non-Linear Equations

Finding Roots for nonlinear equation (e-text references: Section 3.3, Second Lab)

- **Bisection Method:** Be able to explain how it works -- when it can be applied.
- Given a simple function f(x), and an interval containing a root, a) compute 2 or 3 iterations of the bisection method. b) give upper bound on the error for the n'th approximation.
- **False Position Method:** Explain how the false position method works -- how it differs from the bisection method. Explain precisely how the point division point c is chosen from endpoints a and b. Be able to demonstrate on a graph of a given function f(x).
- Determine appropriate initial subinterval(s) for given function to succfully for determine the roots.

Newton-Raphson and Secant Methods (e-text references: Sections 3.4 and 3.4, Third Lab)

- **Newton Method:** What are we trying to find with this method (root).
    - Newton-Raphson Method -- know the iteration formula. Explain geometrically how the next point in the iteration is determined (on a graph of a function).
    - Be able to compute next point in iteration, given a starting point for a particular function
    - Terms: Order of a root. Given a (simple) function f(x) and a root of f, determine the order of the root, using the definition.
    - Simple root, double root.
    - Definition of Order of Convergence
    - Linear vs. Quadratic Convergence
    - Give a table of calculations such as that which you did in the 3rd lab, compute the error terms Ek and then determine the whether the order of convergence is linear or quadratic.
    - Know convergence rate for simple roots (quadratic) and multiple roots (linear) and what this means.

- **Secant Method** What are we trying to find with this method (roots)
    - Know the iteration formula. Explain geometrically how the next point in the iteration is determined (on a graph of a function).
    - What advantage does this method have over Newton method.
    - Be able to compute next point in iteration, given starting point.

Solution of Linear Systems of Equations

General Concepts

- What a linear system of equations is.
- Given a linear system write in form AX = B, and augmented matrix form [A B]
- Know three elementary operations and corresponding row operations for augmented matrix

Method of Gaussian Elimination (e-text Section 4.6)

- What is an upper triangular system
- Solve an upper triangular system using back substitution.
- What is a pivot?
- What are the exact steps required for Gaussian Elimination with 1) no partial pivoting (only trivial pivoting), 2) with partial pivoting. Apply to a given problem. I will give you a linear system of 3 equations in three unknowns -- you will have to show one or more steps (or perhaps all) to perform pivoting.
- What is the purpose of partial pivoting

LU Decomposition (e-text Section 4.7)

- Given the LU Decomposition for a matrix A solve the system AX = B with forward and back substitution (Like Exercises 1 and 2)
- Given the LU decomposition PA = LU, solve the system AX = B.

Gauss Seidel Method (e-text Sectdion 4.8)

- Compute one or two iterations demonstrating this method for a particular small system of equations.
- Determine whether a given matrix of coefficients for a system is diagonally dominant. How does this relate to the convergence of Gauss Seidel on such a system.