Math 441: Num. Linear algebra and optimization.

Topics covered may include:

1) **Introductory Issues**

    a) Absolute and Relative error and precision issues

    b) Nested multiplication - Horner's Method

    c) Taylor Series Review

    d) Truncated series error estimates

2) **Computer Arithmetic**

    a) Decimal and binary floating point representations

    b) IEEE single precisions

    c) Machine epsilon

    d) Floating point operations and loss of significance

3) **Roots of Nonlinear Equations**

    a) one dimension

        i Bisection method

        ii Newton's Method

        iii Secant Method

    b) higher dimension

        i Newton's Method

        ii Secant Method

4) **Solution of Linear systems**

    a) Matrix Review

        i matrix, vector notations

        ii inner products

        iii linear systems

        iv matrix inverses

        v solvability of systems

        vi condition, illconditioned, residual

    b) Gaussian Elimination

c) Special Systems

    i tridiagonal systems
    ii upper/lower triangular
    iii banded systems

5) **Linear systems: Alternate Solution techniques**

    a) LU factorization

    b) Cholesky factorizaztion

    c) Matrix norms, condition number

    d) Iterative techniques: Jacobi, Gauss-Seidel, SOR

    e) Conjugate Gradient Method

    f) Eigenvalue Theory

    g) Singular Value Decomposition

    h) Power Method

6) **Data Smoothing and Approximation**

    a) Least Squares - Linear

    b) Least Squares - Nonlinear

    c) Least Squares - Orthogonal Basis Functions

    d) SVD and the Pseudo Inverse

7) **Minimization of Functions**

    a) One dimension (optional)

        i Fibonacci Algorithm
        ii Golden Search Algorithm
        iii Quadratic Interpolation

    b) Multivariate Case

        i Steepest Decent
        ii Quasi-Newton