18.086 Course Outline

This course has two major topics:

1. Initial Value Problems
    - Linear: Wave equation, heat equation, convection equation
    - Nonlinear: Conservation laws, Navier-Stokes equation
    - Finite Difference Methods: Accuracy and Stability
    - Lax Equivalence Theorem: CFL and von Neumann conditions
    - Fourier Analysis: Diffusion, Dissipation, Dispersion
    - Separation of Variables and Spectral Methods
2. Solution of Large Linear Systems
    - Finite Differences, Finite Elements, Optimization
    - Direct Methods: Reordering by Minimum Degree
    - Iterative Methods and Preconditioning

        Simple Iteration (Jacobi, Gauss-Seidel, Incomplete LU)
        Krylov Methods: Arnoldi Orthogonalization
        Conjugate Gradients and GMRES
        Multigrid Methods
    - Inverse Problems and Regularization

There are no exams in 18.086. Two computational projects take their place—one on each of the major topics in the course. The projects are chosen by each student and they include a brief report.

Texts: *Introduction to Applied Mathematics* / Gilbert Strang
(Wellesley-Cambridge Press, 1986)

Applied Mathematics and Scientific Computing / Gilbert Strang
(Wellesley-Cambridge Press, 2007)

MATLAB documentation:

`http://www.mathworks.com/access/helpdesk/help/helpdesk.html`
`http://www.mathworks.com/access/helpdesk/help/techdoc/math/math.html`