

Math 5176 Numerical methods for Partial Differential Equations

Fall 2020

Main Textbook: Finite Difference Methods for Ordinary and Partial Differential Equations by Randall J. LeVeque;

Minor Textbook: Finite Difference Schemes and Partial Differential Equations by John C. Strikwerda.

Topics to be covered:

1. For elliptic PDEs;

- Fundamental finite difference schemes (1D, 2D and different boundary conditions);
- Consistency and stability analysis for 1D problems;
- Iterative solvers and analysis;
- Possible high order schemes;

2. For parabolic PDEs;

- Fundamental schemes for first-order ODEs;
- Consistency and stability analysis of linear multistep methods;
- Fundamental schemes for Heat equations (Euler, backward Euler, Crank-Nicolson, etc);
- Alternating direction implicit method for high dimensional problems;
- Method of line discretization analysis;
- Von Neumann analysis;

3. For hyperbolic PDEs;

- Fundamental schemes for advection equations (Euler, Leap frog, Lax-Friedriches, Lax-Wendroff etc);
- Upwind method;
- Method of line discretization analysis;
- Von Neumann analysis;
- Initial boundary value problem;
- Advection-Diffusion problem;
- The Courant-Friedriches-Lewy (CFL) condition;