APM 522 *Numerical Methods for Partial Differential Equations*
Class # 71096, Prof. Gardner, **Fall 2020**
MW 10:45–12:00 WXLR A304

`https://math.la.asu.edu/~gardner/522.html`

Text: *Finite Difference Methods for Ordinary and Partial Differential Equations* by Randy LeVeque

This course will survey modern numerical methods for computing solutions to parabolic, elliptic, and hyperbolic partial differential equations. We will mainly focus on finite difference and finite volume methods. Solution methods for nonlinear PDEs will be emphasized. Major applications will include:

- heat (diffusion) equation

  forward and backward Euler, TR, and TRBDF2 methods

- semiconductor process simulation (nonlinear diffusion)

  TRBDF2 method

- Poisson's equation (electrostatics)

  direct solvers

  Jacobi, Gauss-Seidel, SOR, and PCG iterative methods

- drift-diffusion model and ionic flow in biological cells

- wave equations

  upwind, Lax-Friedrichs, and Lax-Wendroff methods

- Burgers' equation

- gas dynamics and supersonic astrophysical jets

  Lax-Wendroff and WENO methods

- semiconductor device simulation (electro-gas dynamics)

- Navier-Stokes equations (incompressible fluid dynamics)

  Chorin projection method

Course Requirements/Prerequisites: Knowledge of a modern programming language and some experience with PDEs will be helpful. There will be two tests (25% each of the grade) and 7 problem sets (40% of the grade) consisting of problems, computations, and graphics.