Math 256A Special Topics in Applied Mathematics: Topics in Finite Element Methods

9-9:50 MWF, Firestone 306

Instructor: Jeff Ovall

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Office Hours: 3-4:30 MW, or by appointment

Recommended Text: *Finite Elements: Theory, fast solvers, and applications in solid mechanics (3rd Ed)* by Dietrich Braess.

Aim of Course: This course is intended to provide a solid introduction to the finite element method for solving partial differential equations – with a heavier-than-usual treatment of *a posteriori* error estimation and adaptive refinement. In order to do this in one quarter, we will focus on second-order, linear, elliptic PDEs. As the simplest non-trivial case, we will consider piecewise linear finite elements in two dimensions in detail – both theory and practice are most well-developed in this case, and it provides a good starting point for further investigation. Topics to be covered (not necessarily in order) include:

- boundary value and eigenvalue problems
- existence and uniqueness of weak solutions, and enough function space theory for this discussion to make sense
- approximation of functions via finite element "interpolation", and *a priori* error estimation
- *a posteriori* norm and functional error estimation and adaptive refinement

Data structures and the assembly and solution of the corresponding linear systems will not be ignored entirely, but will not be given as much attention as they might deserve. If time permits, we may consider some of the following: non-coercive problems, mixed methods, more exotic finite elements, or topics of interest to you.

Grading: Your grade for this course will be based on eight, equally-weighted homework assignments – their will be no midterm or final exams.

Homework: Assignments will be given on the following Wednesdays: Jan. 16, 23, 30; Feb. 6, 13, 20, 27; Mar. 5; and they are to be turned in on the subsequent Wednesdays.