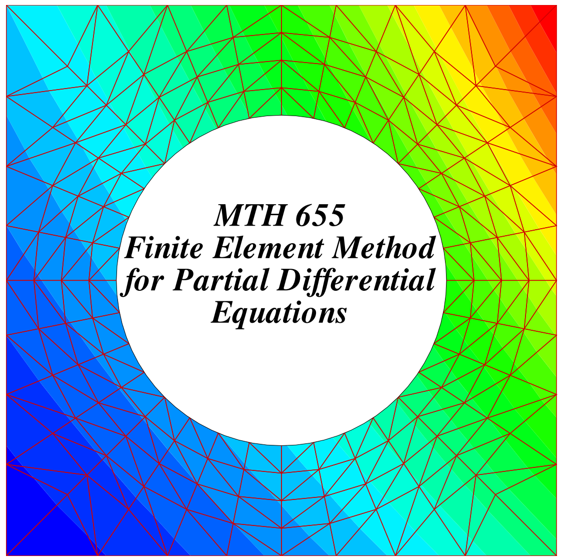
MTH 655/Numerical Analysis, Winter 2008
Finite Element Methods for Partial Differential Equations



http://www.math.oregonstate.edu/∼mpesz/655_W08

Instructor: Małgorzata Peszyńska, Department of Mathematics,
mpesz@math.oregonstate.edu

Class: MWF 9:00-9:50, Gilkey 115, CRN: 25702 (MTH 655)/ 25703 (MTH 659)

Background: The Finite Element Method (FEM) is a numerical method for solving partial differential equations. It provides foundation for most contemporary methods of analysis and discretization applied to engineering design, computational fluid dynamics and mass and energy flow and transport.

The strengths of FEM are multi-fold. First, its mathematical basis, with roots in variational calculus in Hilbert spaces, allow for elegant analysis of delicate problems which may not have classical solutions. Second, on the applications side, FE offer great flexibility for approximation of solutions to problems on irregular domains, and/or with highly varying coefficients, and/or singularities. Next, implementation aspects and in particular linear systems solvers for FE are very well understood and developed. Finally, the FE remain an active field of research with a vibrant mathematical and applications community.

Content: In the course we will develop basic mathematical foundations and algorithmic aspects of FEM. Topics will include error estimates, the related convergence and stability analysis, and implementation issues, all mainly for Galerkin conforming FE. The model problems will be of linear elliptic type but we will also discuss transient and nonlinear problems. As time allows, we develop basics of FE *adaptivity*, and introduce nonconforming FE methods. The necessary background in functional analysis, numerical integration, interpolation and approximation theory, as well as related computational issues, will be developed.

Students: The course is intended for graduate students of mathematics and various science and engineering disciplines. The basics of real variables and differential equations are required. Familiarity with numerical methods, partial differential equations, and familiarity with computer programming are a plus but are not required. The assignments will be a mixture of theoretical and computational exercises. Please contact the instructor with questions.

MTH 654-656 Sequence: This course is the second in a year-long sequence, and the courses in this sequence can be taken independently. In the Spring 2008 the course **MTH 656:** *"Numerical*