GEO 384F: Computational Methods for Geophysics  
Spring 2013

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Lectures: Monday/Wednesday, 10am-12 noon, JGB 2.202

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Description: This course treats numerical methods for the solution of partial differential equations arising in continuum geophysics. Our focus is on the finite element method (FEM), for its generality, adaptivity, and accuracy. We will develop the core ingredients of the FEM—weak formulation, Galerkin approximation, piecewise polynomial basis functions, numerical quadrature, isoparametric elements, assembly—with reference to a model potential problem. While the FEM method is applicable to a broad spectrum of geophysical models including those arising in meteorology, climate, seismology, geodynamics, subsurface flow, etc., we will consider a subset of problems depending on the interests of the students. Past settings have included heat conduction and viscous flow in mantle convection and ice sheet dynamics, seismic wave propagation, and porous media flow and transport. We will use a high-level finite element toolkit (FEniCS) to build simulators in each of these areas.

Prerequisites: Graduate standing or consent of instructor. The background required is just the vector calculus, linear algebra, and differential equations included in a standard undergraduate engineering or science degree curriculum. However, the required mathematical and computational background will be covered when needed, and thus the course will be relatively self-contained. Auditors are welcome.

Required work: Grades will be based on six assignments/mini-projects.

Text: E.B. Becker, G.F. Carey, and J.T. Oden, Finite Elements: An Introduction (Volume 1 of Texas Finite Element Series), Prentice Hall, 1981. Note: This book is out of print, but you can purchase it for $50 (cash or check) from Sue Rodriguez (suerod@ices.utexas.edu; ACE 4.236).