Math 521: Finite Element Methods
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Course Description:
Over the last few decades, finite element methods have emerged as the numerical solution methods of choice for large classes of partial differential equations arising in fluid dynamics, solid mechanics, and electromagnetics. This course is an introduction to the mathematical theory of finite element methods. We will introduce finite element discretizations for equations of various types and discuss how these discrete problems can be solved efficiently. We will address mathematical questions related to the concepts of consistency, stability, convergence, and error estimation. We will further look at applications in fluid mechanics. Implementation will be done using MATLAB or optionally with the freeware package DEAL-II.

The outline of the course is as follows:

- Finite element methods for boundary-value problems
- Nonlinear and time-dependent problems
- A-priori and a-posteriori error estimation
- Numerical Linear Algebra topics
- Mixed finite element methods for incompressible fluid flow problems

Text:
There will be no prescribed text, but there will be lecture notes available for most parts of the course material. Some optional references will be listed.

Prerequisites:
Some undergraduate level training in at least one of: partial differential equations, analysis, or numerical analysis.

Assessment:
There will be several challenging homework assignments involving both analysis and computation. In addition, students can choose whether to do a course project or have an oral final exam. Assignments are worth 60% of the final grade, the project or oral exam 40%.