MthSc 9830 Section 001: Spring 2014
The Finite Element Method in Scientific Computing

Instructor: Timo Heister (heister@clemson.edu, (864) 656-0411)
Homepage: http://www.math.clemson.edu/~heister/
Office: Martin O-14
Office Hours: (see homepage for updates)

Learning outcomes
Upon successful completion of this course, a student will be able to
1) understand practical aspects of finite element software
2) use the library deal.II for own computations
3) Build, document, and present a sophisticated software project
4) solve nonlinear, time-dependent, and coupled PDEs
5) use advanced tools in software development (IDEs, debuggers, ...)

Attendance
- Class meets MWF 12:20pm - 1:10pm in Martin E005
- Attendance is expected, more than two unexcused absences may result in a student being dropped from the course
- Late Policy: If the Instructor is more than 15 minutes late, the class will be considered canceled.

Textbook
No required book. See the course website for optional reading material.

Course Description and Outline
This course teaches practical aspects of the finite element method. We will be using the Open Source library deal.II, which is written in C++. This is a project based course, so large parts of the semester are spent on individual student projects.

The class will be hold in a "flipped" format: lectures are recorded and the students will watch the videos as homework. The time in class is used to summarize the lectures, answer open questions, exercises, and time to work on individual projects.

Each student will have a project assigned to work on during the semester. The topic will be agreed upon in the first couple of weeks based on a short presentation at the beginning of the semester.

Each student will keep an electronic journal. This is used to keep track of the progress, serves as a place to take notes about the video lectures, and to ask questions:

- Create a file on google drive shared with timo.heister@gmail.com
- Add a table of contents with titles and dates for each entry
- Record the video lectures you watched, note the 3 most important points, and any questions you have.
- Keep track of work on your project: what you did, what worked, didn't work, any questions, results (also add pictures!)
- two essays assigned as homework during the semester

I will read these journals during the semester and answer questions (right in the document).

Topical Outline:
1. basics of FEM, structure of FEM codes, algorithmic aspects
2. installation and usage of deal.II
3. modern tools for software development (IDEs, debuggers, …)
4. some C++ topics (templates, …) used in large software projects
5. iterative solvers and preconditioners
6. coupled PDEs, block systems
7. nonlinear problems
8. time discretization
9. parallel computations
10. software engineering practices

Course Objective
1. To give the student experience with practical aspects of the finite element method.
2. Build, document, and present a sophisticated project that uses finite elements using deal.II

Course Assessment
Assessment for the class will be based upon:
- Project 70% (based on differences to existing programs, functionality, documentation)
- Final Presentation 10%
- Journal 20% (completeness; reflection in essay assignments)

Late work will not be accepted.

Grading
Scale:
A = 90% - 100%, B = 80% - 89%, C = 70% - 79%, D = 60% - 69%, F = Below 59%.
Late work will not be accepted. Arrange for extensions ahead of time.

Academic Dishonesty
"As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a 'high seminary of learning'.

Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form. In instances where academic standards may have been compromised, Clemson University has a responsibility to respond appropriately to charges of violations of academic integrity."

Disability Access Statement
"It is university policy to provide, on a flexible and individualized basis, reasonable accommodations to students who have disabilities. Students are encouraged to contact Student Disability Services to discuss their individual needs for accommodation."