Advanced Finite Element Programming (MMF710), 7.5 hp

Course period:
November 2016 – March 2016

Last day for application:
November 1 2016

Course leader / Address for applications:
Anders Logg / logg@chalmers.se

Course description (Advertisement for Ph.D. students):

The course teaches fundamental concepts of programming the finite element method for solving PDEs, including common data structures, fundamental algorithms, and the application to a range of PDEs such as the Poisson equation, the heat equation, linear and nonlinear elasticity, the incompressible Navier–Stokes equations, and systems of nonlinear advection–diffusion–reaction equations. We will use the FEniCS software framework (http://fenicsproject.org) in both Python and C++, as well as study the implementation of finite element data structures and algorithms directly in C++.

Responsible department and other participation departments/organisations:
Department of Mathematical Sciences

Teacher:
Anders Logg

Examiner:
Anders Logg

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1. Confirmation
The syllabus was confirmed by the Head of the Department on 2016-XX-XX.

Disciplinary domain: Science
Department in charge: Department of Mathematical Sciences
Main field of study: Mathematics

2. Position in the educational system
Elective course; third-cycle education

3. Entry requirements
Multivariable calculus, PDE, programming

4. Course content

Topics covered:

- Data structures for finite element computation (matrices, vectors, meshes, function spaces, functions).
- Algorithms for finite element computation (assemble, solve, mesh refinement).
- Implementation of state-of-the-art solvers in modern software frameworks (FEniCS).
- Programming in Python, C++ and possibly also C#.

5. Outcomes
At the end of the course, the students will have acquired experience with how to program finite element PDE solvers in both Python and C++.

6. Required reading

- Hans Petter Langtangen and Anders Logg: *Solving PDEs in Minutes - The FEniCS Tutorial Vol 1.*
- Stanley B. Lippman: *C++ Primer* (5th Edition), *or*
- Bjarne Stroustrup: *Programming: Principles and Practice Using C++* (2nd Edition).

7. Assessment
There will be four assignments with mandatory assignment reports and presentations.

8. Grading scale
The grading scale comprises Fail (U), Pass (G).

9. Course Evaluation
The course evaluation is carried out together with the Ph.D. students at the end of the course.

10. Language of instruction
The language of instruction is English.