

Open topics in applied mathematics: fast methods in scientific computing APPM 4720/5720, Spring 2011

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Meeting times: MWF 11.00 - 11.50, KOBL 255.

Text: The course is defined by the material covered in class, and there is no “official” text book. Printed lecture notes will be posted online, and supplementary reading material will occasionally be suggested.

Office hours: Monday 3pm – 5pm and Wednesday 10am – 11am.

Exams, grading, homework: There will be no formal exams. The grade will be based on class room participation, weekly (small) homeworks, and two projects.

Web-resources: There is a class website with up-to-date information about the syllabus, homework assignments, class handouts, and so on. You can find it at:
http://amath.colorado.edu/faculty/martinss/Teaching/APPM5720_2011s/

Course objectives: The central theme of the class is to describe “fast” methods for solving elliptic PDEs such as the Laplace and Poisson equations, Helmholtz’ equation, Maxwell’s equation, the equations of linear elasticity, and the Stokes equations. The class will also discuss several computational methods with broader use, e.g., quadrature, FFT, fast methods for N -body problems, etc. Practical programming techniques will be important — a principal goal is to encourage computing (how to minimize the pain and maximize the fun!). Mathematics, modeling, and numerical methods will all be emphasized.

Very tentative time line:

<i>Week:</i>	<i>Material covered:</i>
1,2:	Introduction and basic concepts (quadrature, FFT, matlab programming).
3,4	Solution strategies for the Laplace and Poisson equations (analytic and numerical).
5,6,7:	Methods for N -body problems (tree-codes, the Fast Multipole Method, etc.).
8,9:	Integral equation methods — theory and numerics.
10:	Iterative solvers.
11,12:	Extension to other equations (Helmholtz, Stokes, elasticity, etc.).
13,14:	Randomized methods in numerical linear algebra. (If there is demand.)
15:	Computing in the real world — what simplifications did we make in class?

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