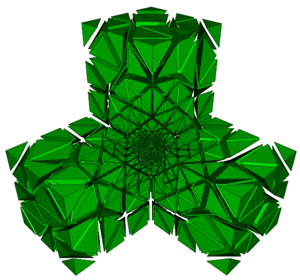
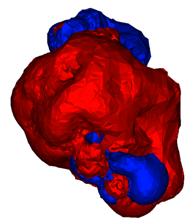
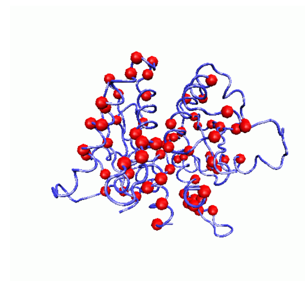
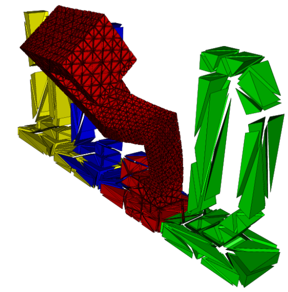
MATH 4066—NUMERICAL ANALYSIS II, SPRING 2006

INSTRUCTOR: BURAK AKSOYLU

Changes to course syllabus are possible and will be announced in class. Students are responsible for announcements made in class and on my website.

CONTACT: `burak@cct.lsu.edu`; http://www.cct.lsu.edu/~burak; Lockett 142; 578-5308.

PREREQUISITES: MATH 2057, 2065, 2070, 2090, 4027, 4065; basic programming skills in MATLAB, Fortran, C, C++, Java.

I do not enforce a strict background check :-)). Theorem-proof classes are not required. I expect students from quite liberal backgrounds: CS, ECE, CHEM, PHYS, FINANCE, BIO, ENG, etc. I very much like interdisciplinary work and willing to adjust the class to meet your needs and interests. In particular, within the first 3 weeks, you will choose a final project to work on from your field or interest. You can discuss or consult me about project ideas. I can accommodate any project which is relevant to the subject matter.

LECTURES: TU and TH 3:10PM – 4:30PM, Lockett 239.

OFFICE HOURS: TU and TH 4:30PM – 5:30PM, Lockett 142.

TEXTBOOKS:
Numerical Analysis, by Richard L. Burden and J. Douglas Faires, Thomson Brooks/Cole, 2005.
(optional) *Scientific Computing—An Introductory Survey*, by Michael T. Heath, McGraw-Hill, 2002.

GRADE: Midterm I = 20%, Midterm II = 20%, Homework and Programming Assignments = 30%, Final Project = 30%. For the final project, you have to turn in a report and do a slide presentation of your work for 15 min in front of the class using your numerical results. I expect students (especially, graduate students) to include a literature review for the problems they are working on. Moreover, graduate students are expected to work on more realistic projects, for example 3D applications rather than 1D.

WHY TAKE THIS CLASS: Scientific computing is ubiquitous in almost all fields of science and engineering. This course serves as a foundation class for scientific computing and is designed to train you if you are pursuing a career in computational sciences and engineering. This course must be appealing for students who are interested in numerical solutions to partial differential equations (my research field). Especially, students who want to go in computational math, physics, biology, chemistry, and engineering.

We are going to especially cover finite difference method and finite element method (FEM). I am part of two computational frameworks: Cactus (www.cactuscode.org) and the Finite Element ToolKit (FEtk) (www.fetk.org) in the context of numerical solutions to partial differential equations. In Cactus or FEtk, I can provide logistical and strategical support for you to do realistic projects which you will benefit in your professional life.

I also have a FEM package in Matlab in which we can do cool numerics using multigrid methods, hierarchical basis, various state-of-the-art iterative solvers.

HOMEWORK: Homework will be given regularly and to encourage you to do the homework, a certain fraction of the homework will directly be on the exams. Some homework assignments will contain computer projects. You may do these computer exercises using your choice of languages. My personal recommendation is to use MATLAB.

COURSE OUTLINE and SYLLABUS: (following the book "Numerical Analysis")

7 Iterative Techniques in Matrix Algebra
7.1 Norms of Vectors and Matrices;
7.2 Eigenvalues and Eigenvectors;
7.3 Iterative Techniques for Solving Linear Systems
7.4 Error Bounds and Iterative Refinement
7.5 The Conjugate Gradient Method

9 Approximating Eigenvalues
9.1 Linear Algebra and Eigenvalues;
9.2 The Power Method;
9.3 House Holder's Method;
9.4 The QR Algorithm.

11 Boundary-Value Problems for Ordinary Differential Equations
11.3 Finite Difference Methods for Linear Problems;
11.5 The Rayleigh-Ritz Method.

12 Numerical Solutions to Partial Differential Equations
12.1 Elliptic Partial Differential Equations;
12.2 Parabolic Partial Differential Equations;
12.3 Hyperbolic Partial Differential Equations;
12.4 The Finite Element Method