Math 471 Section 201

Summer 2010

Numerical Methods

Instructor	Bin Cheng (4826 EH by the elevator. Email: bincheng)
Lectures	TuWFr 8-10am at B844 East Hall
Office hours	TuWTh 10-11am or by appointment.
Textbook	A Friendly Introduction to Numerical Analysis, 1st ed. *by* B. Bradie
Website	http://www.umich.edu/~bincheng/Math471Su2010/
Prerequisites	Math 216, 256, 286, or 316 for Diff Equations; Math 217, 417, or 419 for Linear Algebra; Working knowledge of one coding software, preferably Matlab.

This is a survey course of the basic numerical methods used to solve/simulate practical scientific problems. These methods consist of programmable algorithms targeted at particular sets of theoretical problems (consult the Syllabus below). Based on such computation, the results are most likely to be approximate solutions as the unavailability of exact solutions is the very motivation of using numerical methods. This leads to the important concepts of *accuracy, stability,* and *efficiency* — essential criteria for practicality of numerical methods.

Of course there are software packages that can be used as a black box. But in this course we look under the hood and see how the methods work. A fair amount of coding is necessary for mastering the materials. Sample codes are written in Matlab and therefore it is the recommended software.

Course goals for the students:

- learn numerical methods used in engineering and science
- practice programming of numerical methods
- reinforce math learned in previous courses (calculus, linear algebra, diff equations)

Syllabus (tentative), totally 40 hrs.

1. Algorithms, convergence and floating-point arithmetic (§1.1-1.4) , 2 hrs
2. Nonlinear equations and root-finding (§2.1-2.5), 4 hrs

3. Numerical linear algebra (§3.1-3.8) , 10 hrs
4. Two-point boundary value problems (§8.1-8.2), 2 hrs
5. Poisson equation on a rectangle (§9.1-9.3), 2 hrs
6. Eigenvalues and eigenvectors (§4.1-4.3) , 4 hrs
7. Polynomial and spline interpolation (§5.1-5.6 except 5.4), 6 hrs
8. Numerical differentiation and integration (§6.1-6.6), 6 hrs
9. Initial value problems for ordinary diff equations (§7.1-7.4 and implicit methods), 4 hrs

Attendance (10%): Mandatory.
Homework (40%): Assignments can be downloaded from the website (see above), usually on or before Thursdays. Each one covers materials learned in that week. Students submit individual write-up while group discussion is encouraged. The presentation should be neat and legible.
Midterm (20%): Monday, July 19, 6pm-8pm. Room TBA.
Final (30%): Friday, August 20, 10:30am-12:30am. Room TBA.

- In both exams, an 8"-by-11" double-sided sheet of notes is allowed.
- About 1/3 of the Final Exam will come from the first half of the semester.
- Starting on Monday, August 16, the instuctor will be out of town for the rest of the semester.

Codes on the Internet?

There are bazillions of codes available on the Internet, e.g. those hinted in the textbook at `www.pcs.cnu.edu/~bbradie/textbookcode.html`. **Copy-pasting is strictly prohibited**. Besides the obvious reasons for not doing this, one may find understanding someone else' codes takes even more time than writing his/her own.

It is legitimate, on the other hand, to run these codes and compare the results with yours.