

# CS 412, Introduction to Numerical Methods, UW - Madison, Spring 2014

Instructor:

- Jesse Holzer, holzer@cs.wisc.edu, office 3395CS, office hours Tuesday 12:30-1:30, Wednesday 11:30-12:30.

Teaching Assistants:

- Menghui Wang, menghui@cs.wisc.edu, office 1307CS, office hours Monday 3:00-5:00
- Majid Aksari, majid@cs.wisc.edu, office 1307CS, office hours Thursday 12:30-2:30

Lecture: TR 11:00-12:15, 1325CS.

Course website: <http://www.cs.wisc.edu/~cs412-1>

Text: There is no required textbook for this class. The lectures will be drawn from the notes of Professor Amos Ron. These notes can be found on Professor Ron's webpage ([cs.wisc.edu/~amos](http://cs.wisc.edu/~amos)) and will also be placed on the course page. If you wish to consult a textbook, I recommend *Numerical Methods using Matlab* by Matthews & Fink.

Prerequisites: Math 222 and 234, CS 302, knowledge of matrix algebra.

Grading: final exam 40%, midterm exam 30%, homework 30%. There will be six homework assignments, each counting for 5% of your final numerical grade. An additional assignment, homework 0 introducing Matlab, counts for an extra 1%. Homework assignments are due in lecture. Late homework is not accepted.

Academic honesty: I strongly encourage you to discuss the material of this class with others. However, your homework must be your own work. Verbal discussion of homework with others in the class is fine, but you must

write up your solutions yourself, alone, and you must not show your solutions to other students in the class. Plagiarism, representing somebody else's work as your own, is a violation of University policy. All instances of plagiarism will be brought to the Dean.

Matlab: All homework will involve writing programs in Matlab, which is a language oriented towards numerical computation. No prior knowledge of Matlab is required or assumed. I will give demonstrations of Matlab in lecture, and the code for these demos will be put on the course page. The course page has a link to an introduction to Matlab. The Matlab website has extensive documentation. Assignment 0 is a short exercise designed to get you started with Matlab.

Computing facilities: Students registered for the class have a CS instructional account. If your account is not already active, you can activate it with the 'newuser' procedure. Instructions for this are in the CS labs, e.g. room 1350. Your CS account provides disk space and a printing quota. To complete the homework assignments, you will need to write programs in a text editor, e.g. gedit, emacs, vi, and you will need to run these programs in Matlab, and you will need to print your code and Matlab output. You can do all this from a command line. Also, Matlab itself has a text editor. Links to information on these facilities are on the course page.

Course topics (with approximate location in the optional textbook):

- Introduction to Matlab (638-646).
- Finite precision computations, loss of significant digits, speed of convergence (24-36).
- Solving equations: bisection (51-61), fixed-point methods (41-50), Newton's method and the secant method (70-90).
- Polynomial interpolation: Lagrange and Newton methods, divided differences (199-220).
- Numerical differentiation: basic rules and order estimates. Richardson extrapolation (320-334).
- Numerical integration: rectangular, midpoint, trapezoid, Simpson, and Gaussian rules (ch 7).

- Linear algebra with Matlab: LU and QR factorizations, least squares, norms of errors (ch 3), least square curve fitting (253-263).
- Approximation by splines: interpolation (279-294), Cubic-Hermite interpolation.
- Ordinary differential equations: Runge-Kutta, systems and higher order ODEs, multistep and adaptive techniques (ch 9).