UNIVERSITY OF WISCONSIN - MADISON

Computer Sciences Department

CS412, Fall 19

General Information

September 10, 2019

Course Name:

Introduction to Numerical Methods

Lectures:

Time:	MWF 2:30-3:45
Place:	1221 CS

Instructor:

Name:	Amos Ron
Office:	7381 CS
Phone:	262-6621
e-mail	amos@cs.wisc.edu
Office Hours:	W 17-18

TAs:

Name:	Jihye Choi	Rocil Machado
Office:	1302 CS	5364 CS
Office Hours:	T 2-3, F 12-1	M 11:30-12:30, R 9-10
Email:	jihye@cs.wisc.edu	rmachado@wisc.edu

Text Books

Many of you, who attend lectures regularly, listen carefully, and take good notes, may not need a text book at all. Most importantly, notes summarizing our actual lectures are available at our web site.

If you still believe that you will not survive our course without frequent consultation with a book, I recommend *Numerical Methods using Matlab*, Mathews & Fink, Prentice Hall. (The publisher sure would like you to buy the most recent edition, but an earlier edition will do as well.) Many other text books will do as well: use them in order to add more examples, and in order to reinforce the basics. If you need some further guidance, do not hesitate to contact the Instructor. E.g., come to his office hour, and bring with you your favorite text book.

In addition, you need an access to Matlab. You can either use the student's version of Matlab on your personal computer, or use one of the instructional machines (that has Matlab on it); see below for more details.

Introduction

This course covers the basic material in the numerical solution of various problems, including solving non-linear equations, polynomial interpolation, numerical differentiation and integration, solution of linear systems, least-squares methods, and numerical solution of ordinary differential equations.

Tentative Syllabus (pp. in () correspond to text book, but perhaps of an older edition.)

Introduction to `Matlab` (638–646)

Finite precision computations, loss of significance, speed of convergence (24–36)

Solving equations: bisection (51–61), fixed-point algorithms (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: basic rules: rectangular, midpoint, trapezoid, Simpson Composite rules Gaussian rules (the entire material is scattered in (chapter 7)).

Linear Algebra by `Matlab`: LU-factorization, QR-factorization, least squares, norms of errors. (chapter 3), Least square curve fitting (253–263).

Approximation by splines: spline interpolation (279–294) using `Matlab`. Cubic-Hermite interpolation.

Ordinary differential equations: Runge-Kutta method. Systems . Multistep methods . Adaptive techniques Higher order equations (chapter 9)

Machine

Student accounts will be accessible from any CS unix machine. Activate your account (go to the CSL web site: `https://csl.cs.wisc.edu/` and click the "Activate Account" link at the top of the page) ASAP, and familiarize yourself with the operating system, with an editor of your choice, and with `Matlab` (see below). Your account is already active (with the same `login` and `passwd`) if you are a CS major and/or you took a CS class last semester. The operating system is, essentially, *Unix* aka *Linux*.

Programming

All programs will be written in `Matlab`, which is a Linear Algebra-based interactive language, and which is quite different (and in our context, simpler) than standard PLs (such as `C++ or Java`). No prior knowledge on `Matlab` is required, or assumed. The text book provides valuable information on `Matlab`. In addition, there will be `Matlab` presentations in class, and tutorial assignments on `Matlab`. On top of that a `Matlab` primer will be posted at the class web page (do not print the primer on a CSL printer, since this will eat a big chunk of your page quota; instead, print it at home, or use it on-line). The `Matlab`'s `help` command is very effective, too. Also, while in your account, type
`matlab`
at the `>>` prompt type
`demo`
you will find it really enjoyable.

Class Account and class list

All information (assignments, samples of exams, etc) should be obtained from the class account on the web:
`www.cs.wisc.edu/~amos/cs412.html`
A link to our homepage is also found at `http://www.cs.wisc.edu/classes.html`
Most files are pdf.

Sending an e-mail message to
`compsci412-2-f19@lists.wisc.edu`
will send your message to the entire class, including the instructor and TAs. The messages are sent to your "preferred email address", which you may change/update via myUW. Check your mail frequently: the standing assumption is that every student checks his/her email at least once a day. The up-to-date communication that went through the `compsci412-2-f19` alias can be found at `https://www-auth.cs.wisc.edu/lists/classes/` .

Info about grades, and perhaps more, will be available to students at:
`https://uwmad.courses.wisconsin.edu/` I recommend that you go to that site, and check that you "see" our course there (after entering your id and passwd). While you get all the handouts and assignment electronically, you submit paper assignments. In addition, you will need to submit e-copy of all the programs you wrote for an assignment, so that we, at our discretion, may be able to run and test them. Info about the e-submission procedure will be sent by email.

Note: It might take a few days during the first week of class until the grade website is active. Do not be alarmed if you cannot see there our class on the first day of the semester.

Attendance of Lectures

Attendance of our lectures is *mandatory* for all students who are officially enrolled in it. Practically, it means the following:

- If you plan to be absent from a particular lecture, you should simply send a message to me, copy our TAs, and state in the message your name, student ID, and the date(s) of the lecture(s). No need to include anything else. However, you must send the message at least an hour before class begins. Please send the message from your university account: gmail/yahoo/hotmail and the like messages may go directly to my spam. You may be absent from class as many lectures as you wish, but we might assume then a pro-active position and look for ways to help you.
- Missing a lecture without an advance notice is not allowed. Exceptions can only be granted in documented emergencies.

Assignments

Will be assigned (more or less) on a fortnightly basis. Due time will appear on each assignment. Past due penalties apply as follows:

(1) Up to 6 class days (accumulated throughout the semester): no penalty.

(2) You loose 10% from the grade of the assignment for each day in access of the 6 days above. The calculation is done for each assignment separately.

(3) The due time is always on a MWF day. You need to turn in your assignment during the class meeting on that day in order to avoid late days.

In this context "a class day" is each day when classes are held in UW. *Late assignments must be put in the TA's mailbox* (5th floor CS building). You must write on the assignment the date and hour it is turned in. Keep in mind that unused grace days may be used to buy-out a portion of the last assignment.

Grading Policy

One midterm (40%), one final (40%), 6 homework assignments (15-30%, see below). The midterm is scheduled for October 23, 7:15-9:15 p.m. Report *by September 13* to the instructor any conflict you have with this date. You are guaranteed an "A" in class if your final average grade is above 100. All other grades are determined by a curving policy. **There are no make-ups for this class.**

Prerequisites

Math 223/234, CS302 (or equivalent), knowledge of matrix algebra.

Midterm

As said, the midterm is scheduled for October 23, 19:15-21:15. The lecture on that day will be replaced by a review session.

Academic Honesty

Strict academic integrity is expected of each and every student, and any apparent violation of such code will be automatically referred to the appropriate university authorities. Scholastic dishonesty, in addition, harms all hard-working students in class, due to the curving policy. In this regard note the following:

Discussions among students of material taught in class or relevant to class are strongly encouraged. This may include general discussions of material in assignments. However, a disclosure of any portion of your written assignment to another student in class is an outright violation of the scholastic honesty code.

Credit for assignments

The credit you get for assignments depends on your exams, too. The complicated rule below is designed to penalize students who do not do the assignments entirely on their own. We calculate the credit of the first three assignments based on your midterm grade, and the credit for the last three assignments based on your final exam grade. The formula is as follows: after we grade the relevant exam, we will calculate your relative standing in class in that exam (x) and in the corresponding three assignments (y) (on a 0-1 scale: 1 means you are the first student in class and 0 means you are the last student in class). Then: if $x > y - .30$, your assignments are worth 15% (i.e., you will be credited 15% for perfect assignments etc. Keep in mind that we are talking about three assignments.) Otherwise, your three assignments are worth the greater of 7.5% and $(1.30 + x - y) \times 15\%$.

The simple moral of the above is that if, for whatever reason, your assignments are way, way better than your exams (relative to other students in class), then we will take from you the joy of having such nice assignments. No questions asked!