Math 225 – Numerical Analysis

Spring 2014 Syllabus

Class Meetings:	PPHAC 101 MWF 2:35-3:45pm
Text:	*Numerical Analysis* (2nd edition), by Timothy Sauer
On-line resource:	Math 225 Spring 2014 (Google Community)
Instructor:	Kevin Hartshorn
Office Hours:	PPHAC 215: Wed 8:30-10:30am, Virtual (via Google Hangouts): Wed 8:30-10:10pm
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1 General Comments and Introduction

> *Catalog description:* Numerical techniques for solving applied mathematical problems. Topics include interpolation and approximation of functions, solution of non-linear equations, solution of systems of linear equations, and numerical integration, with error analysis and stability.

While the particular topics will change based on the progress of the class, the key idea is to learn some of the fundamental ideas of solving mathematical problems with computers. Many of these problems lead to three central challenges: efficiency (how quickly does the algorithm find the answer?), accuracy (how close to the "true" answer is our approximation?), and stability (how likely is it that the algorithm will fail or change dramatically if we alter the problem?).

While almost any computer language can be employed to tackle the problems of this course, we will focus on using *Maple*[1] and class discussions will tend to focus on how to use *Maple* for solving these problems. Basic familiarity with programming concepts will be assumed this course —mostly using loops and conditional statements, as well as a basic awareness of data types. However, the focus is using the computer algorithms and scripts to gain a better understanding and appreciation of how to tackle real mathematical problems from a computational viewpoint.

2 Goals and Objectives

- *Be able to select and apply basic numerical methods for solving problems.*
  This will include both implementing given algorithms (or adapting those algorithms) to solve problems and working more abstractly (read: using pencil and paper) to demonstrate how and why these algorithms work.
- *Be able to perform simple programming in* Maple*, including writing procedures, importing/exporting data to a file, and working with various data types.*
  Most algorithms will be provided, though you will often be called to manipulate algorithms to work with a given problem.
- *Be able to communicate new information both verbally and orally, including presentation of material to the class.*
  Almost all homework will be presented in class — you will be expected to show and explain your work to the rest of the class. In addition, the midterms will be oral exams checking your understanding of the material to date.

[1] While our text uses MATLAB as the core language, *Maple* analogs to the MATLAB code will be provided.

3 Technology for this course

The class will use the Google community **Math 225 Spring 2014** to hold discussion, share materials, and hold virtual office hours. Be sure that you have signed up for this community. In addition, you will be expected to share a folder with me on the Google Drive — this will be where homework (including *Maple* worksheets) can be submitted.

All algorithms will be implemented in *Maple*, which is available on most on-campus computers. During class, I will provide frequent demonstrations of *Maple* programming.

Those familiar with Python may opt to experiment with the software *Sage*[2], which is a Python-based freeware alternative to *Maple*. I will accept solutions sets using either platform. Note that *Sage* is not installed on campus computers, but may be freely downloaded to install on your own machine.

4 Course Format

From week to week, we will spend roughly half of the class time working on new material and the other half presenting solutions to homework problems. There will be two midterms (both oral exams) and a written final exam[3].

The components of the course will be weighted as shown in the table below.

15%	Engagement with the course and the material
30%	Homework problem presentations (in class)
15%	First midterm
15%	Second midterm
25%	Final Project
100%	**Total**

Generally speaking, your final course grade translates to a letter grade loosely based on the standard 4-point system: generally 85% marks the difference between an "A" and a "B", 70% marks the difference between a "B" and a "C", 60% marks the difference between a "C" and a "D", and any score below 50% is considered failing. Note that these numbers are meant only as a guideline and are subject to change over the course of the semester. See the Student Handbook[4] for a qualitative description for the various grades.

4.1 Engagement with the course

To help contribute to everyone's learning in the course, you are expected to contribute to discussion of the class material both in class and on-line. Contribution includes:

- **In-class participation:** Whether new material is being presented, or fellow students are presenting solutions to homework problems, you are expected to actively participate by asking relevant questions, offering genuine feedback, or otherwise contributing to the conversation. In particular, be sure that everyone in the class takes ownership of the accuracy of the homework problems presented in class.
- **Preparation for class:** For each new topic, you are expected to read the relevant section *before* we meet in class. Use the Google community to post questions or concerns you have about the reading. If you don't have questions but can help clarify questions from you classmates, that also counts for classroom preparation. Active participation in the on-line community will help make sure we are all more prepared for a fruitful discussion when we get together in the classroom.

[2] `http://www.sagemath.org/`

[3] What should this exam be? I'm thinking about a portfolio-style activity in which the students would revise work from throughout the semester, as well as completing some sort of larger project.

[4] http://www.moravian.edu/studentLife/handbook/academic/academic.html

I will periodically provide feedback on the level of your classroom engagement. As a rule, a "C" grade for participation means that you attended all the classes and contributed minimally to the discussion. A "B" grade indicates active engagement in both the class and on-line discussions. An "A" grade suggests an outstanding contribution to the learning environment (this could be achieved by asking excellent questions that further our discussion).

4.2 Homework problems

I will assign homework regularly. Each week, at least one day will be set aside as a "presentation day." On this day, you will be expected to present solutions to some of the homework problems. These days will be guided by the following principles:

- We will work toward having a balance of problems assigned to each person. Everyone should contribute roughly equally toward the presentations.
- Each problem will be graded on a 3-point scale[5]. Your homework score for the day will be the average of the score for all the problems you present that period.
- Your presentation is meant to reflect your work at home — after you present your work (based on your homework notes), you can then discuss with the class where you got stuck or what parts caused difficulty.
- Any homework solutions requiring a *Maple* presentation should be placed in your shared folder before the beginning of class. I recommend giving your file a helpful title such as `homework01.mw`.

In completing your homework, feel free to use:

- Your text, class notes, or any material from the course web page.
- Any capabilities of *Maple* (except when specifically told otherwise).
- The *Maple* support page (`http://www.maplesoft.com/support/help/`).
- Consultation with the professor.
- Consultation with your classmates. Note that discussion on the class Google community counts toward classroom engagement and is a valid approach to working on the problems.

4.3 Exams

There will be two exams. They are both planned to be oral examinations: you will schedule a time to meet with me so that we can discuss the material to date. The first midterm will take place around the week of February 10–14, and the second will take place around the week of March 17–21.

4.4 Final project

For the final project, you will each be called to solve a significant numerical analysis problem. In solving this problem, you will need to write a paper explaining the problem and your solution. An initial solution to the problem will be due on **Wednesday, April 16 by 4:00pm**. If there are problems with the mathematics, we can address them as we look toward the final write-up. The final version of your solution will be due on **Monday, April 28 at 8:30am**.

On **Monday, April 28**, you will each be asked to present your problem and solution to the class. Our final exam period starts at 8:30am.

[5]As a rule of thumb, 3 means the problem is essentially correct, 2 means you got the right idea but have some important error (or didn't finish), 1 means you were on wrong track or did not make significant progress. A score of 0 is reserved for when you did not prepare the problem or are absent.

Your grade for the final project will be based on the two drafts of the written solution, as well as your class presentation. Details on the expectations for the project, as well as selection of topics will occur in the week before spring break.

5 Attendance and other Issues

5.1 Attendance

While I expect you to attend every session, unavoidable situations will arise during the semester. This course does not have an official attendance policy. However, keep in mind the following:

- If you are absent on a presentation day, you will be given a 0 for that day's homework score (regardless the reason for the absence).
- If you know that you will miss a class that requires your presence (e.g.: one of the days for class presentations), let me know as soon as possible so that other arrangements can be made.
- Any 0 score can be made up by creating one of the mini-lectures for the new material. You will work with me in both selecting the topic to present, as well as getting help putting the mini-lecture together. My assessment of your mini-lecture will replace the 0-score.
- While any *Maple* worksheets will be posted online, it is your responsibility to get class notes from either myself or from your classmate if you miss class.

5.2 Final reminders and disclaimers

- Everyone is expected to adhere to Moravian College's Academic Honesty policy, as described in the Student Handbook[6].
- *Visit my office!* I would love to hear feedback about which aspects of the course are or are not going well. You have a great deal of power to determine the path this class takes – take advantage of it.

  You can also reach me

  – by e-mail (`hartshorn@math.moravian.edu`)
  – by IM/Chat (`hartshornk@moravian.edu`).
- This syllabus is subject to change through the semester. The most recent version of the syllabus can be found on the shared Google drive folder.
- Final determination of your course grade is subject to my discretion as professor of the course.

[6] `http://www.moravian.edu/studentLife/handbook/academic/academic2.html`