Math 4610 Fundamentals of Computational Mathematics Fall 2019

Instructor: Joe Koebbe
Office: ANSC 209

Office Hours: MWF 8:00am-9:20am
MWF 10:30am-11:20am
MWF 1:00pm-2:00pm

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If you cannot make office hours, you can also set up an appointment. This can be done before or after class meetings or by email. Note that each student is required to meet with the instructor in the instructor's office at least once during the first two weeks of the semester. Students are always welcome to show up without an appointment during office hours.

USU Math 4610 Fundamentals of Computational Mathematics Course Description:

This course presents fundamental topics and algorithms that are common to many areas of computational mathematics. Topics include: truncation and round-off error, basic numerical linear algebra (including Gaussian elimination and calculation of eigenvalues), root-finding methods, interpolation methods, and numerical differentiation/integration. Prerequisite: Math 1220 with a C- or better in Math 2250 or 2270 with a C- or better in a high-level programming language (C/C++, Python, Fortran)

Computer Programming Requirements:

If you have not completed a computer programming class, for example USU courses CS 1400 Introduction to Computer Science - CS 1 and/or CS 1410 Introduction to Computer Science - CS 2, you will **NOT** be able to complete this course. This course is not intended to be a platform for learning a computer programming language. This course is intended to provide students with an opportunity to apply an already mastered computer programming skill set to algorithm development and implementation. Students **MUST** be able to write computer programs on the first day of class - **NO EXCEPTIONS**.

Textbook Information:

There is no required textbook for Math 4610. Instead the course materials are made freely available to students enrolled in Math 4610. The materials are posted at the following online location:

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https://jvkoebbe.github.io/math4610/
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The materials are available to any person who is interested in learning about computational mathematics. There are a number of textbooks and other materials that might be useful in working through the materials Github available at the link given above. Note that the materials at the link above are governed by a Creative Commons License. This license allows free use of the materials for noncommercial purposes. This includes any derivative works from the materials at the given site.

Additional References:

There will be a number of topics that might arise during the semester. At the instructor's discretion any materials needed for these topics will be provided either in class, through handouts, or through posts to the instructor's main web page.

`http://www.math.usu.edu/~koebbe`

Note that this syllabus is posted at both the instructor's site and also on the Github site with link given above. Also, note that the syllabus will change from year to year based on how the course evolves and the instructor teaching the course in a current semester.

Additional Computer Skills:

During the semester, students will be required to use a few more computational tools to complete work. These include, but are not limited to the following list:

- **Command Line Terminals** Students will be required to use Linux/Unix terminals to complete many tasks. Basic usage will be covered in class and a Linux/Unix emulator (Cygwin) has been installed for public use in the Engineering Lab on campus. Students that have a Linux box or are able to install Cygwin on a personal laptop will be a bit better off.
- **git:** Students will need to master the use of " git" as a part of the class. Note that git is automatically installed with Cygwin. So, git is available on the Engineering Computer lab.
- **Github Account:** Students must be able to create a Github account to interface work in the class with a publicly available repository. This will be covered in class.
- **Graphical Output:** Students must be able to produce graphs and and other visual aids for homework tasks. This will be covered in class.

Instructor Course Comments:

This course is intended for advanced undergraduate students and graduate students who have already taken Math 2270 Linear Algebra **and** Math 2280 Ordinary Differential Equations **or** Math 2250 Linear Algebra and Ordinary Differential Equations. The content will contain methods for the approximate solution of simple mathematical problems through algorithms implemented into a high level computer programming language. The basic mathematics skill set needed for this course provides the backbone for computational mathematics and more advanced courses in numerical analysis and computational mathematics. However, you should not be enrolled in the course if you have not learned to write computer programs in a high level programming language (e.g, C, C++, Python, Fortran, or Java). If you have not taken a course in computer science, you will need to drop the course and complete a course like CS 1410 at USU.

- The course meets three days per week. We will be covering a lot of material in each and every class meeting.
- Although role will not be taken, students are required to attend this course in the sense that lectures will not be repeated. Students are expected to attend all classes and participate in discussions during class time. Time will be taken in each lecture to answer questions about material previously presented.
- It is highly recommended that students take notes during class to keep up with the material presented and to keep up with the lectures.
- Be on time! Most students in this course will take professional jobs that require an employee to be on time. This course is no different.

If you have any questions about the course material, course policies, or any other matters, please contact the instructor for the course via email, before or after class, or during office hours.

Why Not Matlab or Mathematica:

Students often ask questions about Matlab and/or Wolfram Alpha as options for writing programs. There are two important reasons for not allowing Matlab as a programming language. These are the following:

1. First, in many of the intrinsic routines, most of the details are buried in the code written by people employed at the Math Works, the people who produce Matlab. This means that students will not see the nuts and bolts of how numerical algorithms work.

2. **Cost!!!** While at USU, the cost for licensing Matlab or Maple is more than reasonable. However, corporate licensing is very expensive. It is highly unlikely that any company will want to license another product along with their own code. Students need to know how to write their own code, including the hidden details in intrinsic routines. This course assumes students want to learn these details.

Note that Matlab or Maple are great tools for prototyping ideas in applied and computational mathematics. Your instructor works in Matlab occasionally and used to use Mathematica extensively. However, your instructor never needed to purchase a license for these products. These tools were purchased within the structure of a grant proposal or by USU IT.

Grading:

Your grade in the course will be determined by the following:

1. Each student is required to meet with the instructor in the instructor's office during the first two weeks of the semester and prior to each of the exams described below during posted office hours or by making an appointment. This will count as one homework assignment.

2. Homework will account for a 35% of a student's grade. Homework must be turned in on time. **Under normal conditions late homework will not be accepted.** If you must be gone, any homework must be turned in on or before the due date. The only exception to this rule is for a family emergency. Also, homework must legible. Much of your work will be done using " git" and made available for grading using Github. This will mean that most of your homework will be typed. There will be times when a scanned, handwritten solution will be appropriate. Make sure these solutions are legible and the scan of the work is readable.

3. Students will be required to create a software manual to document the algorithms developed during the semester. This will account for %15 of the overall grade in the course. The software manual will be comprised of short descriptions of the algorithms developed and implemented in this class. For each piece of code that is developed in the class there must be an entry in your software manual. We will discuss this in some detail during the first week of the semester.

4. Two midterms will be given. Each will cover about one half of the content of the course. Each of these midterms will account for 15% or 30% of the grade earned in the course.

5. A comprehensive exam will be given during finals week. The final will account for %20 percent of the overall grade in the course.

If students have questions about assignments, the software manual, midterms, and/or final please contact your instructor. One of the assignments will be to meet with me at least once before each exam to discuss progress in the course. This means that 3 times during the semester you will need to show up during office hours or make an appointment to see your instructor.

University Policies:

There are a number of Utah State University (USU) policies that apply to students, faculty, and administrators at USU. Students should realize that any policies stated in this syllabus are included for convenience. The official policies applied to this course can be found online at the following address.

`http://catalog.usu.edu/content.php?catoid=12&navoid=3587`

Any policies in this document are superseded by the online policies at the link given above. Note that the above link was tested June 21, 2019. This may change in the future. However, official USU documents like this are available to all students, faculty, and staff. Questions about USU policies should be taken up with the appropriate office on campus, such as the Dean's office in the College of Science.

`http://www.usu.edu/`

Instructor/Department/University Policy Documents:

There are a number of policies related to courses, student participation in courses, and responsibilities of students, facilitators, and instructors for all courses at USU. Links to the appropriate policy documents can be found on the instructor's webpage for this course.

The Honor Pledge:

— To enhance the learning environment at Utah State University and to develop student academic integrity, each student agrees to the following Honor Pledge: "I pledge, on my honor, to conduct myself with the foremost level of academic integrity."

Violations of the Academic Integrity Standard (academic violations) include, but are not limited to:

1. **Cheating:** (1) using or attempting to use or providing others with any unauthorized assistance in taking quizzes, tests, examinations, or in any other academic exercise or activity, including working in a group when the instructor has designated that the quiz, test, examination, or any other academic exercise or activity be done "individually"; (2) depending on the aid of sources beyond those authorized by the instructor in writing papers, preparing reports, solving problems, or carrying out other assignments; (3) substituting for another student, or permitting another student to substitute for oneself, in taking an examination or preparing academic work; (4) acquiring tests or other academic material belonging to a faculty member, staff member, or another student without express permission; (5) continuing to write after time has been called on a quiz, test, examination, or any other academic exercise or activity; (6) submitting substantially the same work for credit in more than one class, except with prior approval of the instructor; or (7) engaging in any form of research fraud.
2. **Falsification:** altering or fabricating any information or citation in an academic exercise or activity.
3. **Plagiarism:** representing, by paraphrase or direct quotation, the published or unpublished work of another person as one's own in any academic exercise or activity without full and clear acknowledgment. It also includes using materials prepared by another person or by an agency engaged in the sale of term papers or other academic materials.
