APMA 0160: Introduction to Scientific Computing
Brown University, Summer 2017
MWF 12:15 pm - 2:55 pm, Sayles Hall, Room 305

Instructor: Leroy Jia
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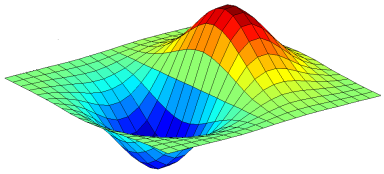
Office: 170 Hope St, Room 216
Hours: TR 12:30 pm - 2:00 pm or by appointment
Canvas: https://canvas.brown.edu/courses/1073309



Course Content: Scientific computing is a multidisciplinary field that employs computers to approximately solve problems in STEM that are too complex to be tackled by hand. This course serves two main purposes: to introduce fundamental numerical techniques commonly used in applied mathematics and to familiarize students with the basics of programming in MATLAB, which has many useful computational routines conveniently built in. Important topics we will discuss include: roots of nonlinear equations, numerical differentiation and integration, linear systems of equations, optimization, data fitting, ordinary and partial differential equations, and machine learning. Applications will be emphasized.

Course Objectives: Upon successful completion of the course, students will be able to

- program fluently in MATLAB (at the Associate level) and follow code in other popular languages
- identify sources of error associated with numerical discretization and minimize their impact
- analyze algorithms for computational efficiency, accuracy, and scalability
- design and numerically solve mathematical models relevant to their fields of interest

Prerequisites: Credit for two semesters of calculus, equivalent to MATH 0090 and MATH 0100. Exposure to programming, differential equations, and linear algebra will be helpful but is not required.

Textbooks: No required texts. Recommended references include:

- *Scientific Computing with MATLAB and Octave*, A. Quarteroni, F. Saleri, and P. Gervasio (4th edition). ISBN 978-3-642-45366-3. Available online. Past sections of this course have used this book.
- *Engineering Computation with MATLAB*, D. Smith (2nd edition). ISBN 978-0-13-608063-3. This book is a general introduction to the MATLAB language written for students with no programming experience but does not discuss numerical methods in much detail.
- *An Introduction to Numerical Analysis*, K. Atkinson (2nd edition). ISBN 978-0-471-62489-6. This book is a more rigorous and detailed introduction to the theory of scientific computing.

Grading: The traditional ranges of $90+\% = \text{A}$, $80-89\% = \text{B}$, $70-79\% = \text{C}$, or $70+\% = \text{S}$ for pass/fail, will be used to assign letter grades. Grades will be calculated according to the following scheme:

- Homework (60%): There will be 1 or 2 homework assignments per week (roughly 10 total) involving both computational and analytical problems.
- Midterm exam (15%): There will be a one hour in-class midterm on Friday, July 14. No outside resources permitted.
- Final exam (25%): The in-class final exam will take place 1:00-4:00 pm on Friday, August 11. No outside resources permitted. The final exam is cumulative but is weighed toward the second half of the course.

Time Expectations: Here is a rough breakdown of how much time students might expect to spend on this course in total:

- Lectures (6 hours/week $\times$ 6 weeks = 36 hours): Attendance at all lectures is mandatory. Summer Session courses contain the same amount of material as an ordinary semester but are condensed into a six week period instead of the usual thirteen. As such, the pace of the course will feel substantially faster with lectures lasting longer and covering more material. Students who enroll in a Summer Session course should only do so with a full understanding of the magnitude of the expected workload.

- Recitations (2 hours/week $\times$ 6 weeks = 12 hours): In order to give students an opportunity to take a more active role in their education, half of every other lecture will be used as a recitation period, where students divide up into groups of three and collaborate on a problem that directly applies what they have learned recently. The instructor will take on a more facilitatory role for these sessions.

- Self-study/review (6 hours/week $\times$ 6 weeks = 36 hours): Students are highly recommended to spend time outside of class reading the suggested references, exploring any points of the lectures that were unclear, or reviewing feedback on their homework assignments and exams. Students are also encouraged to email the instructor or visit office hours to discuss anything related to the course.

- Homework (12 hours/week $\times$ 6 weeks = 72 hours): As homework assignments constitute the bulk of the overall grade, they will demand a substantial time commitment, and submitted work will be held to a high standard. Full credit will only be given to homework assignments that are written up neatly with all steps clearly shown. MATLAB files should execute properly (code that does not run will receive no credit) and be easy to follow, using comments to clarify any potentially unclear sections of code. Students are encouraged to work together to complete homework as long as they write up their own solutions individually. *Copying and other forms of cheating will not be tolerated.*

- Exams (average of 12 hours/exam $\times$ 2 exams = 24 hours): In addition to the time actually spent completing the exams in class, students will need to allocate sufficient time to prepare and review.

- Feedback (1 hour): Occasionally, students will be solicited for anonymous constructive criticism regarding the course, which will help the instructor provide a more inclusive learning environment.

The total time as outlined above is 181 hours.

MATLAB: Brown University students can visit software.brown.edu to download MATLAB for free. Submitted code must be written either in MATLAB or GNU Octave. However, lectures and exams will specifically use MATLAB, so those who wish to use Octave should plan accordingly.

Canvas: Canvas will be used to make course announcements, upload assignments, and report grades. It is the responsibility of the student to ensure that they can receive announcements in a timely manner and that all grades are reported correctly.

Absence/Makeup Policy: Students anticipating an absence on an exam day should inform the instructor as soon as possible (preferably at least two weeks in advance). *No makeup exams will be given for unexcused absences. Late homework assignments will not be accepted.* Official documentation must be provided in the case of unexpected events.

Student Support: Brown University is committed to the full inclusion of all students. Anyone requiring accommodations or modification of any course procedures should inform the instructor. For more information, please contact Student and Employee Accessibility Services at 401-863-9588 or SEAS@brown.edu.

Students are expected to comply with the University's Academic and Student Conduct Codes.