

Analysis of Numerical Methods, I
MATH 6610 – Section 01 – Fall 2019
Course Information and Syllabus
Updated November 5, 2019

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Office hours: MW 10am-11:30am
Office hours location: WEB 4666

Class time and location: MWF, 11:50am-12:40pm, JTB 120 (James Talmage Building)

Course webpage: <http://www.sci.utah.edu/~akil/math6610>

Note: Scores for graded assignments will be posted on Canvas.

Course Information: This is a 3-credit course.

Learning objectives: Upon successful completion of this course, a student should be able to:

- Understand, utilize, and manipulate standard metrics on vectors and matrices
- Analyze and compute standard matrix decompositions: QR , LU , SVD, Cholesky
- Formulate notions of conditioning and stability for linear and nonlinear problems
- Solve linear systems via direct and iterative methods
- Understand theory and algorithms for polynomial approximations
- Utilize polynomial approximations for differentiation and integration/quadrature
- Be comfortable using \LaTeX document typesetting, version control with git, and either the MATLAB or Python programming environment

Course description: Mathematical analysis of numerical methods in linear algebra, interpolation, integration, differentiation, approximation (including least squares, Fourier analysis, and wavelets), initial- and boundary-value problems of ordinary and partial differential equations.

Text: L. N. Trefethen and D. Bau III, *Numerical Linear Algebra*, SIAM (1997), ISBN-10 0-89871-361-7.

Class lectures will *not* correspond directly to particular sections of any particular text. However, the text above is considered a mandatory reference text: homework assignments will feature problems from these texts.

Homework: Four or Five homework sets will be assigned, collected, and graded throughout the semester. These assignments will be posted on the course website and announced in-class. Students will have approximately 2 weeks work time for each assignment. Late assignments of any form will *not* be accepted without **prior** approval from the instructor. Homework assignments will consist of analysis along with programming exercises.

You are **required** to submit your assignment electronically via the version control system Git. Submissions requiring mathematical analysis **must** be composed and submitted in the \LaTeX typesetting system. Submission requiring programming must include source code used to generate any results or figures. Students will be permitted to program in either MATLAB or Python.

You are welcome to work on homework assignments in groups, but each student is required to submit his/her own individually-composed, written, and submitted assignment.

During the first two weeks of the semester, detailed instructions for homework submission will be provided.

Exams: This course will have 1 in-class midterm exam, and 1 final exam. The midterm exam will be held in class on Friday, October 4.

The final exam is a cumulative exam in the same format as the midterm exam. The final exam will be held on Friday, December 13 from 10:30am-12:30pm in the normal class meeting room, JTB 120.

Unless otherwise specified, **neither calculators nor notes of any kind are allowed on any of the exams.**

Grading: Your course grade will be computed as follows.

- Homework 40%
- Midterm exam 25%
- Final exam 35%

Final letter grades will be assigned based on the following scheme:

- 92% - 100% — A
- 90% - 91% — A–
- 88% - 89% — B+
- 82% - 87% — B
- 80% - 81% — B–
- 78% - 79% — C+
- 72% - 77% — C
- 70% - 71% — C–
- 68% - 69% — D+
- 62% - 67% — D
- 60% - 61% — D–
- 0% - 59% — E

Important dates:

Aug 30	Last day to add, drop (delete), elect CR/NC, or audit classes
Oct 4	Midterm
Oct 18	Last day to withdraw from classes
Nov 27	Last day to reverse CR/NC option
Dec 6	Reading Day
Dec 13 10:30am	Final exam

Class communication: An email list is set up with which I shall send out information not communicated during class. This email list will also be used to communicate class information

in the case of unusual circumstances affecting the the logistics of the class. If you are not officially registered for the class but wish to be on the roster, please discuss it with me.

If you are registered for the course, but do not receive the course email announcements to your University of Utah email address, please notify me immediately. It is not possible for me to arrange delivery of these emails to a non-UUtah account.

The section website will also be used to communicate more technical matter of the class (e.g. homework sets, lecture summaries, etc.).

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to change that may be necessitated by a revised semester calendar or other circumstances. The above two methods, in addition to the coursewide website, are reliable means of getting information about changes to the course.

Student responsibilities and integrity: All students are expected to maintain professional behavior in the classroom setting, according to the Student Code, spelled out in the Student Handbook. Students have specific rights in the classroom as detailed in Article III of the Code. The Code also specifies proscribed conduct (Article XI) that involves cheating on tests, plagiarism, and/or collusion, as well as fraud, theft, etc. Students should read the Code carefully and know they are responsible for the content. According to Faculty Rules and Regulations, it is the faculty responsibility to enforce responsible classroom behaviors, and I will do so, beginning with verbal warnings and progressing to dismissal from and class and a failing grade. Students have the right to appeal such action to the Student Behavior Committee.

<http://regulations.utah.edu/academics/6-400.php>

The Americans with Disabilities Act: The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 801-581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability Services.

Addressing Sexual Misconduct: Title IX makes it clear that violence and harassment based on sex and gender (which Includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran's status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677 (COPS).

Inclusivity: It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. It is my intent to present materials and activities that are respectful of diversity: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups. In addition, if any of our class meetings conflict with your religious events, please let me know so that we can make arrangements for you.

Undocumented Student Support: Immigration is a complex phenomenon with broad impact—those who are directly affected by it, as well as those who are indirectly affected by their relationships with family members, friends, and loved ones. If your immigration status presents obstacles to engaging in specific activities or fulfilling specific course criteria, confidential arrangements may be requested from the Dream Center. Arrangements with the Dream Center will not jeopardize your student status, your financial aid, or any other part of your residence. The Dream Center offers a wide range of resources to support undocumented students (with and without DACA) as well as students from mixed-status families. To learn more, please contact the Dream Center at 801-213-3697 or visit dream.utah.edu.

Veterans: If you are a student veteran, the University of Utah has a Veterans Support Center located in Room 161 in the Olpin Union Building. Hours: M-F 8-5pm. Please visit their website for more information about what support they offer, a list of ongoing events and links to outside resources: <http://veteranscenter.utah.edu/>.

Student wellness: Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a student's ability to succeed and thrive at the University of Utah. For helpful resources contact the Center for Student Wellness at www.wellness.utah.edu or 801-581-7776.

Semester calendar

(Subject to change!)

DAY	DATE	TOPIC
Monday	August 19, 2019	Hello
Wednesday	August 21, 2019	Linear algebraic preliminaries
Friday	August 23, 2019	Singular value decompositions
Monday	August 26, 2019	Submission tools: Git, L ^A T _E X, Matlab/Python
Wednesday	August 28, 2019	SVD applications
Friday	August 30, 2019	SVD applications
Monday	September 2, 2019	<u>NO CLASS</u> : Labor Day
Wednesday	September 4, 2019	<u>NO CLASS</u>
Friday	September 6, 2019	<u>NO CLASS</u>
Monday	September 9, 2019	Orthogonalization and the QR decomposition
Wednesday	September 11, 2019	Algorithms: Gram-Schmidt
Friday	September 13, 2019	Algorithms: Householder
Monday	September 16, 2019	Linear least-squares problems
Wednesday	September 18, 2019	More on least-squares problems
Friday	September 20, 2019	Condition numbers
Monday	September 23, 2019	(IEEE) floating-point arithmetic
Wednesday	September 25, 2019	Linear stability
Friday	September 27, 2019	Linear stability, II
Monday	September 30, 2019	Applications of stability
Wednesday	October 2, 2019	Review
Friday	October 4, 2019	<u>MIDTERM EXAM</u>
Monday	October 7, 2019	<u>NO CLASS</u> : Fall break
Wednesday	October 9, 2019	<u>NO CLASS</u> : Fall break
Friday	October 11, 2019	<u>NO CLASS</u> : Fall break
Monday	October 14, 2019	Linear systems: Gaussian elimination
Wednesday	October 16, 2019	Pivoting and stability
Friday	October 18, 2019	Cholesky factorizations
Monday	October 21, 2019	Cholesky factorizations
Wednesday	October 23, 2019	Eigenvalues and eigenvectors
Friday	October 25, 2019	Eigenvalues and eigenvectors
Monday	October 28, 2019	<u>NO CLASS</u>
Wednesday	October 30, 2019	<u>NO CLASS</u>
Friday	November 1, 2019	Algorithms: Power and inverse iteration
Monday	November 4, 2019	Algorithms: Rayleigh iteration
Wednesday	November 6, 2019	Algorithms: The QR algorithm
Friday	November 8, 2019	Iterative methods
Monday	November 11, 2019	Polynomial approximation and interpolation
Wednesday	November 13, 2019	Polynomial approximation and interpolation
Friday	November 15, 2019	Numerical integration
Monday	November 18, 2019	Numerical integration
Wednesday	November 20, 2019	Numerical differentiation
Friday	November 22, 2019	Lagrange interpolation, divided differences
Monday	November 25, 2019	Orthogonal polynomials
Wednesday	November 27, 2019	<u>NO CLASS</u>
Friday	November 29, 2019	<u>NO CLASS</u> : Thanksgiving
Monday	December 2, 2019	Gauss quadrature
Wednesday	December 4, 2019	Review
Friday	December 6, 2019	<u>NO CLASS</u> : Reading day
Friday	December 13, 2019	<u>FINAL EXAM</u> : 10:30am, JTB 120