Instructor: Sabine Lang  
Pronouns: she/her/hers  
Preferred address: Sabine  
Office: JWB 212  
E-mail: lang@math.utah.edu

Class Hours: MTWF, 9:40AM-10:30AM, JFB B-1

Office Hours: TBD or by appointment


Webpage: All information concerning this class will be posted on the Canvas webpage of the class. Any important information will be given in class and on the Canvas webpage. **You are responsible for checking the webpage on a regular basis** (you can have the communication from Canvas forwarded to your email address).

Prerequisites: At least a C grade in Math2210 OR Math1260 OR Math1321 OR Math1320 OR (Math1220 AND Full Major status in Computer Science OR Computer Engineering).

Course description: We start by thinking of vectors and matrices as arrays of numbers, then we progress to thinking of vectors as elements of a vector space and matrices as linear transformations. In our study of vectors and matrices, we learn to solve systems of linear equations, familiarize ourselves with matrix algebra, and explore the theory of vector spaces. Key topics covered in this course include Euclidean space, linear systems, Gaussian elimination, determinants, inverses, vector spaces, linear transformations, quadratic forms, least squares, eigenvalues and eigenvectors, diagonalization, orthogonal projections, and matrix factorizations, including QR, LU, and SVD.
**Expected Learning Outcomes:** Upon successful completion of this course, a student should be able to:

1. Understand the mathematical notation and geometric interpretation involved in the study of linear systems, and make connections between the two.
   
   (a) Students will understand the connection between $Ax$ and a linear combination of vectors.
   
   (b) Students will conceptualize matrices as linear transformations, and classify the linear transformations as onto and/or one-to-one.
   
   (c) Students should understand the properties of vector spaces, in particular $\mathbb{R}^n$ as a vector space. The students will extend this notion as they learn vector spaces isomorphic to $\mathbb{R}^n$ have the same algebraic properties as $\mathbb{R}^n$.

2. Perform matrix computations and understand them as examples of abstract mathematical concepts.
   
   (a) Students will perform row reductions and put matrices into echelon forms. Students will connect this to several theorems regarding span, linear independence, determinant, invertibility, and rank.
   
   (b) Students will calculate matrix-vector and matrix-matrix products and think about these processes in the context of linear transformations.
   
   (c) Students will find determinants, eigenvectors, and eigenvalues and link these concepts to existence and uniqueness of solutions. Students use eigenvalues and eigenvectors to find a basis in which the properties of the linear transformation become transparent.
   
   (d) Students will compute dimension and bases of vector spaces and develop these ideas in context of linear transformations and change of coordinate systems.

3. Recognize applications and interpretations of linear algebra concepts.
   
   (a) Students will develop approximations using orthogonal projection and GramSchmidt orthogonalization.
   
   (b) Students will link various linear algebra concepts to applications in computing. Examples to be discussed include the singular value decomposition in image processing and eigenvectors in the Google page rank algorithm.

**Class Culture:** We will model our class based on the axioms proposed by Federico Ardila:

Axiom 1 Mathematical talent is distributed equally among different groups, irrespective of geographic, demographic, and economic boundaries.

Axiom 2 Everyone can have joyful, meaningful, and empowering mathematical experiences.

Axiom 3 Mathematics is a powerful, malleable tool that can be shaped and used differently by various communities to serve their needs.

Axiom 4 Every student deserves to be treated with dignity and respect.

**Homework:** I will collect homework on Wednesdays each week at the beginning of class. Homework assignments need to be stapled, all work shown, neat and organized with all pages in order, in order to be graded. All homework assignments and due dates will be posted on canvas. Homeworks will be completed outside of class. The homeworks will be graded partially for completeness and partially for correctness. I will accept six late homework sections, up to one week late, throughout the semester for full credit. It is not necessary nor recommended that you tell me why your homework is late. This policy is meant to be flexible enough to cover all reasons. If you need to turn a homework more than a week late for a documented reason, please contact me! You may discuss the problems with others, but it is important to write up your own solutions.

**Friday Food for Thought (FFT):** These activities will be done in class every Friday and turned in at the end of class (or Monday if you really want more time to complete it). They will be graded only for completeness and full credit will be given if you were present, engaged and completed the problems. The goal of the FFT is to get students actively engaged during the Friday class and learning the concepts deeply. I’ll drop two weeks of FFT from this part of your grade (in other words, you can miss two Fridays without penalty). To get full credit on these assignments, you need to complete the entire FFT.
Projects: There will be two projects assigned throughout the semester. The project assignments will be posted on canvas at least three weeks before the due date. These projects may require some use of programming (Matlab or Python or any object-oriented language will be fine to use). Group may or may not be required, depending on the project assignment. Late projects will not be accepted, so please plan accordingly.

Tentative due dates: week 5 (project 1) and week 14 (project 2).

Exams: There will be two midterm exams. I will announce the sections covered for the exams in a Canvas announcement and in class about a week before the exam. The exams will have a group portion and a solo portion, hence it takes place over two days. The groups will be semi-randomly assigned by me, and put in the People tab in Canvas at least a week before each exam.

The final exam for this class is comprehensive. I will not reschedule the final exam for students to have personal time or travel home, etc., so please plan your travel arrangements around this exam. Absence from an exam will be excused only if you can provide verifiable and convincing evidence that you have a significant illness or serious family crisis that will prevent you from attending. Except under extremely unusual circumstances, you must inform me in advance of the missed test. It is your responsibility to promptly make arrangements with me to make up the test, I reserve the right to not give you a make-up exam if I think your excuse is not valid or if you contact me more than one week after the missed test. I reserve the right to make alternate exams more difficult than the scheduled exam.

1. Wednesday, February 5th, 9:40AM-10:30AM : Midterm 1, group portion
2. Friday, February 7th, 9:40AM-10:30AM : Midterm 1, solo portion
3. Wednesday, March 18th , 9:40AM-10:30AM : Midterm 2, group portion
4. Friday, March 20st , 9:40AM-10:30AM : Midterm 2, solo portion
5. Friday, April 24th, 8:00-10:00AM : Final

Grading Policy: The grades will be calculated as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Homework</td>
<td>15%</td>
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<tr>
<td>Friday Food for Thought (FFT)</td>
<td>5%</td>
</tr>
<tr>
<td>Projects</td>
<td>20%</td>
</tr>
<tr>
<td>Midterm exams</td>
<td>30% (15% each)</td>
</tr>
<tr>
<td>Final</td>
<td>30%</td>
</tr>
</tbody>
</table>

Online Grades: I will put your grades online on Canvas. You can get there easily from the main University of Utah website www.utah.edu. To log in, you use the same student id and password that you use for Campus Information System. I do my best to update the grades on a regular basis and keep everything accurate. However, I would advise you to check your grades often to make sure there were no data entry mistakes. I’m always happy to correct any mistakes I’ve made. You just need to let me know about them.

Gradescope: We’ll be using a software, Gradescope, to grade exams in this class. You will be able to access your exams in Gradescope and request regrades there, directly in Gradescope. You will not receive any written exam work back on paper, as it will be uploaded to Gradescope instead.

Grades: Final letter grades will be determined by overall percentage as follows:

- A: 93% – 100%  
- A-: 90% – 92%  
- B+: 87% – 89%  
- B: 83% – 86%  
- B-: 80% – 82%  
- C+: 77% – 79%  
- C: 73% – 76%  
- C-: 70% – 72%  
- D+: 67% – 69%  
- D: 63% – 66%  
- D-: 60% – 62%  
- E: 0% – 59%

ADA Statement: 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 and Access, 162 Olpin Union Building, 581-5020 (V/TDD). CDA will work with you and the instructor to make arrangements for accommodations. All information in this course can be made available in alternative format with prior notification to the Center for Disability and Access.
Veterans Center: If you are a student veteran, the U 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/. Please also let me know if you need any additional support in this class for any reason.

Student Responsibilities: All students are expected to maintain professional behavior in the classroom setting, according to the Student Code, spelled out in the Student Handbook. You 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, collusion, fraud, theft, etc. Students should read the Code carefully and know you are responsible for the content. According to Faculty Rules and Regulations, it is the faculty responsibility to enforce responsible classroom behaviors, beginning with verbal warnings and progressing to dismissal from 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

Student Names and Personal Pronouns: Class rosters are provided to the instructor with the students legal name as well as Preferred first name (if previously entered by you in the Student Profile section of your CIS account). While CIS refers to this as merely a preference, I will honor you by referring to you with the name and pronoun that feels best for you in class, on papers, exams, group projects, etc. Please advise me of any name or pronoun changes (and update CIS) so I can help create a learning environment in which you, your name, and your pronoun will be respected. If you need assistance getting your preferred name on your U-ID card, please visit the LGBT Resource Center Room 409 in the Olpin Union Building, or email bpeacock@sa.utah.edu to schedule a time to drop by. The LGBT Resource Center hours are M-F 8am-5pm, and 8am-6pm on Tuesdays.

Safety Statement: The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585- COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit safeu.utah.edu.

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, veterans 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).

Wellness Statement: 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 https://wellness.utah.edu/ or 801-581-7776.

Dean of Students Office: The Dean of Students Office is dedicated to being a resource for students through support, advocacy, involvement, and accountability. It serves as a support for students facing challenges to their success as students, and assist with the interpretation of university policy and regulations. Please consider reaching out to the Office of the Dean of Students for any questions, issues and concerns. https://deanofstudents.utah.edu/ or 801-581-7066

Tutoring: T. Benny Rushing Mathematics Student Center (adjacent to JWB and LCB), Room 155:
M - Th 8AM - 8PM
F 8AM - 6PM
(closed Saturdays, Sundays and holidays)
They are also offering group tutoring sessions. http://www.math.utah.edu/ugrad/tutoring.html
Private tutoring: University Tutoring Services, 330 SSB (they offer inexpensive tutoring). There is also a list of tutors at the Math Department office in JWB 233.

Computer lab: In the T. Benny Rushing Mathematics Student Center, Room 155C.
M - Th 8AM - 8PM
F 8AM - 6PM
(closed Saturdays, Sundays and holidays)
Link to computer lab is http://www.math.utah.edu/ugrad/lab.html. You can print math-related content for free.

**Classroom Etiquette:** Please turn off your cell phones while you are in class. I will expect respectful behavior in my classroom. If I think that your behavior is disrespectful or distracting, I will ask you to leave the class.

**Cheating:** If you cheat on any homework or exam, I will give you a grade of zero for that work. Depending on the severity of the cheating, I may decide to fail you from the class. In all cases, I will report the incident to the Dean of Students, and to the International Students Office in the case of an international student.

**Disclaimer:** If I do any modification to this syllabus, I will let you know in class and update the webpage.

**Some important dates for this class:**

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday, January 6th</td>
<td>First day of class</td>
</tr>
<tr>
<td>Friday, January 10th</td>
<td>Last day to add without permission</td>
</tr>
<tr>
<td>Friday, January 17th</td>
<td>Last day to drop and add class</td>
</tr>
<tr>
<td>Monday, January 20th</td>
<td>Martin Luther King Jr. Day holiday</td>
</tr>
<tr>
<td>Wednesday, February 5th</td>
<td><strong>Midterm 1</strong>, group portion</td>
</tr>
<tr>
<td>Friday, February 7th</td>
<td><strong>Midterm 1</strong>, solo portion</td>
</tr>
<tr>
<td>Monday, February 17th</td>
<td>Presidents’ Day holiday</td>
</tr>
<tr>
<td>Friday, March 6th</td>
<td>Last day to withdraw</td>
</tr>
<tr>
<td>March 8th - March 15th</td>
<td>Spring break</td>
</tr>
<tr>
<td>Wednesday, March 18th</td>
<td><strong>Midterm 2</strong>, group portion</td>
</tr>
<tr>
<td>Friday, March 20st</td>
<td><strong>Midterm 2</strong>, solo portion</td>
</tr>
<tr>
<td>Tuesday, April 21st</td>
<td>Last day of class</td>
</tr>
<tr>
<td>Friday, April 24th</td>
<td><strong>Final exam</strong> (8:00-10:00AM)</td>
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