Mathematics 2270-05
Fall, 2019

Instructor: Kelly A. MacArthur
she/her/hers pronouns
preferred name/address: Kelly

Class Mission Statement: This is a kind, inclusive, brave and failure-tolerant class.

Class Time and Place: 10:45-11:35 am
Mondays, Tuesdays, Wednesdays and Fridays
in LCB 225 (MWF) and LCB 215 (T)

Office Hours: Mondays, 9:00-10:00 am
Wednesdays, 9:30-10:30 am
Fridays, 1:30-2:30 pm
or by appointment.
Office Location: JWB 218
E-mail address: macarthur@math.utah.edu
Class Web Page: http://www.math.utah.edu/~macarthu   (go to Current Teaching and our class)

Text: (1) *Linear Algebra and Its Applications*, 5th edition, by D. Lay, S. Lay and J. McDonald
ISBN: 13-9780321982384

(2) My class notes which will be posted on our public class web page. You will need to print those out and bring them to class, because I'll refer to them regularly. (Please note: You can print them in the Math Computer Lab for no cost.)

Course Information: Math2270, Linear Algebra is a 4-credit semester course.

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 and linear programming, eigenvalues and eigenvectors, and diagonlization.

Prerequisite: 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).
Important Note: The mathematics department DOES enforce prerequisites for all our undergraduate courses. If you were able to register for this class based on your enrollment in the prerequisite course last semester, and you did not receive the minimum grade in that course

to continue on with your math classes, then you will be dropped from this class on Friday of the first week of classes. If that is the case for you, then it is in your best interest to drop yourself from this class before you are forcibly dropped and get into a class for which you have the prerequisites.

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.

    1. Students will understand the connection between Ax and a linear combination of vectors.

    2. Students will conceptualize matrices as linear transformations and as encoding bilinear forms (inner products).

    3. 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.

    1. 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.

    2. Students will calculate matrix-vector and matrix-matrix products and think about these processes in the context of linear transformations.

    3. 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.

    4. 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.

    1. Students will develop approximations using orthogonal projection and Gram-Schmidt orthogonalization.

    2. 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.

Additional Learning Outcomes (for this particular course instructor):
- Collaborate, analyze and address mathematical problems with colleagues.
- Articulate and discuss mathematical ideas, via written, oral and/or video expression.
- Engage in diverse problem-solving with other classmates.
- Expand your knowledge, skills and attitudes about how mathematics can prepare you to be global citizens.

Tutoring Lab: T. Benny Rushing Mathematics Student Center (adjacent to JWB and
LCB), Room 155
M - Th   8 a.m. - 8 p.m.
F   8 a.m. - 6 p.m.
(closed Saturdays, Sundays and holidays)
They are also offering group tutoring sessions. If you're interested, inquire
at the Tutoring Lab.   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 JWB233.

Computer Lab: also in the T. Benny Rushing Mathematics Student Center, Room 155C.
M - Th   8 a.m. - 8 p.m.
F 8 a.m.- 6 p.m.
Link to computer lab is http://www.math.utah.edu/ugrad/lab.html

Grading: The grades will be calculated as follows:

FFT (Friday Food for Thought)	5%
Homework	15%
Projects	20%
Midterms*	35%
Final Exam	25%

*There will be two midterms. The lowest scoring midterm will count for 15% and the highest scoring midterm will count for 20%.

Course Structure Overview: There is much research to date regarding active-learning classrooms in STEM courses, at the collegiate level, that suggests strongly that active-learning classrooms can provide a more equitable class, particularly for typically underserved students, including womxn, students of color and first-generation students. The research I've read, and my own experience from teaching with active-learning classrooms for many years now, also is suggestive that no one is not well-served in this way. In other words, an active-learning classroom, statistically, serves students much better than traditional lecture courses. Compared to a traditional lecture format, literally any amount of active, engaged learning that happens in class is better, for STEM courses. Much research continues to prove that claim. Due to this research and my own experiences in teaching for many years, our class will be one where you are doing mathematics every day in class, not just copying down what I write and I will expect all students to participate boldly, bravely and in an inclusive manner. ***(Note: womxn is spelled that way intentionally, to include cis-women, trans-women, women of color, Native women, etc. It's intended to be an inclusive term.)***

Growth Mindset, Making Mistakes and Failure:
> The best mathematicians, engineers and scientists fail big and fail often. I strive to kindly challenge you in class and to push you into perhaps an uncomfortable zone, in order to help you grow mathematically. Sometimes you'll be able to solve the problems we are working on and sometimes you won't. Sometimes you'll be able to solve the problems on your own and other times, you'll need the support of your class colleagues to get the work done. This is the nature of doing mathematics. I ask that you don't get discouraged by that process and instead consider having a growth mindset, focusing on your own growth and improvement. Always remember this motto: mathematics is not an innate ability; it is a skill we learn and refine through work and persistence.

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 working on the problems within your group. 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).

Homework: Homework will be assigned weekly from the textbook. Homeworks will be assigned on Wednesdays and collected the following Wednesdays in 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 the public class web page. Homeworks will be completed outside of class and all students must turn in their own homework assignments. The lowest two homework scores will be dropped. No late homeworks will be accepted. The homeworks will be graded partially for completeness and partially for correctness.

Projects: There will be two projects assigned throughout the semester. The project assignments will be posted on the public class web page at least three weeks before the due date. These projects will likely require some use of programming (Matlab or Python or any object-oriented language will be fine to use). Group work will be encouraged, but not necessary. However, each student will need to turn in their own project, and it needs to be clear that no copying was done for the project. Late projects will not be accepted, so please plan accordingly.

Midterm Exams: There will be two midterm exams. The dates for these exams are fixed and in the course outline for this class. 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. The groups will be semi-randomly assigned by me, and put in the People tab in Canvas at least a week before each exam. There will be no retakes of exams and I will not offer the exam at a later date. Please plan accordingly.

Final Exam: The final exam for this class is comprehensive and it will occur on **Monday, December 9th, from 10:30 am to 12:30 pm.** 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.

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.

Calculators: You may find it helpful to have a graphing calculator for your own personal use. However, if I allow calculators on exams or quizzes, I will only allow scientific calculators (no graphing or programmable calculators will be allowed ever). This will be discussed more in class with each exam.

Grading Scale: Although I'm not philosophically opposed to curving grades, I find it's rarely necessary. The grade scale will be the usual:
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).
If I do need to curve the grades, I will simply shift everything down by a few points (whatever is necessary).

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 & Access (CDA), 162 Olpin Union Building, 581-5020 (V/TDD). CDA will work with you and me to make arrangements for accommodations. All information in this course can be made available in alternative format with prior notification to CDA.

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

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

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.

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.

Classroom Social Equity: I strive to be ethical, kind, fair, inclusive and respectful in my classroom and expect students to behave likewise. In this regard, I have these requests of you:
1. Please do tell me, discreetly, if you have any sort of anxiety disorder, TBI, PTSD, C-PTSD, or any other challenge that would cause psychological harm to you by me calling on you in class. I want students to feel a little uncomfortable and stretched during class, while working on problems as a large or small group,

but I definitely don't want to cause any human being harm. So, please tell me if that is the case for you and I will confidentially accommodate your request.

2. If your preferred name is different than your legal first name (*the preferred name you chose does indeed show up in CIS on my roll sheet, but not yet in Canvas*), please log into Canvas and go to Account (on far left)-->Settings and change your Display Name to be the name you prefer to be addressed by. This will help me greatly to know students' names, and to address you correctly when responding to Canvas quiz comments.

3. If there is ever a time that you feel this course or the curriculum is not equitable, please email me, interrupt me in class on the spot, or meet with me to discuss your concerns so I have a chance to address that.

4.

Teaching Philosophy: I believe strongly that mathematics, at its core, is the art/experience/science of problem solving and pattern recognition. It is inherently a creative process, one to be struggled with, repeated, and enjoyed. The process requires imagination, persistence, courage, processing time, a failure-tolerant attitude and ultimately produces experiential, mathematical skill. It is from this perspective that I teach. I'm not as concerned with the destination, i.e. the answer, as I am about the journey of problem-solving and mathematical exploration since it is exactly the entirety of the journey that creates the answer. And, self-confidence and mastery are then natural by-products of the mathematical journey.

Additional Policies: Due to experience, I have decided to make some additional policies regarding my classroom administration and grading.

• I do <u>not</u> allow the use of laptop computers (where the screen is perpendicular to the desk) in my classroom, in order to minimize student distractions. At this point, it's almost impossible to type notes for a math class on a laptop in real time. Thus, it is unnecessary in class. If you are using a tablet or ipad or some similar device to take notes and the screen lies parallel to your desk, that is totally fine.

• There will be no retakes of exams, for any reason.

• If you have an emergent, extenuating circumstance that makes it necessary to take an alternate exam, it is your responsibility to discuss that with me, before the exam occurs, or as soon as possible. In general, I allow exams to be taken early, but not late.

• If you have crisis-level extenuating circumstances which affect your class performance and you need guidance/advice/ideas, please communicate with me as soon as possible so I can help you in some manner, which I'm truly happy to do. The longer you wait to communicate with me, the less I can and am willing to do to help.

• I will provide and expect respectful behavior in my classroom. Examples of disrespect include, but are not limited to, reading a newspaper or magazine in class, social chatting with your friend in class, text-messaging during class, excessive use of your cell phone, or cuddling someone else in class. If you choose to be disrespectful with distracting behavior during our class, please keep in mind that you put me in a position of choosing between protecting/taking a stand for you OR for the other students or myself whom you are disrupting. I can guarantee I will choose to stand for the students who are there to learn without disruptions and I will thus

take action to terminate your distracting behavior, and that action may not be desirable for you.

- There shall be no cursing nor negative ranting (for example, "math sucks") on any written work turned in, as it's unprofessional behavior. The penalty for such things on your written work will be a zero score on that assignment or test.

- I will regularly post announcements to the class in Canvas and will hold you accountable for receiving that information. Be sure to turn on your notifications in Canvas so you are alerted to announcements I make in Canvas as well as grade changes, discussion posts, etc.

- If you have questions about any exam/assignment grade, or you want to appeal the grading of the exam/assignment, you must turn it in to me (either on paper or in Gradescope depending on how the assignment/exam was graded) within one week of the exam/assignment being turned back in class. I'm happy to look over your appeal and/or questions and give my feedback in order to benefit your learning. But, it must be done in this timeframe of a week from when I hand back the exam/assignment.

- If you cheat on any homework, project, quiz or exam, I will automatically give you a zero for that grade. Depending on the severity of the cheating, I may decide to fail you from the class. Please note that the use (or even just pulling it out of your pocket) of a cell phone or any other electronic device during any in-class exam is considered cheating and cause for receiving an automatic zero. Also, if you exhibit any other behaviors that are unethical, like offering me a bribe to give you a better grade (even if you later claim you were joking), I will report your behavior to the Dean of Students.

- Please make sure you do your best throughout the semester, knowing the grading scheme and what's expected of you, and come talk to me if you need further study strategies. I will be happy to brainstorm ideas to help you maximize your study strategies and improve your mathematical understanding. I will offer an extra credit opportunity on every midterm and final exam, to help make up for arithmetic or math grammar mistakes for which you lost points. But, I will not offer any additional extra credit at the end of the semester or any other way for you to improve your grade at that time. Please respect this and do not ask for special favors or extra credit or some way to get a higher grade (however you want to word it) when you realize you don't like your grade. Your need to get into a certain program, or needing a specific grade for your work or scholarship or not wanting to upset whomever is paying for your college are all your own personal dilemmas that are truly independent from how I assign grades. The only way to "better your grade" at the end of the semester is to retrieve your final exam, compare it to the solutions, and see if you have any grading appeals. If you do have grading appeals on the final exam, please turn it in to me. I'm happy to look over those and possibly give points back, if it's warranted. Other than that, I consider it disrespectful of me and my time for you to ask for a higher grade than you earned, or for some possible way to increase your grade, at that point.

I reserve the right to change my policies stated in this syllabus at some point in the semester. If I do make a change to a policy, I will announce it in class and post an Announcement on Canvas about it.