Course Syllabus for Math 21 – Linear Algebra, Summer Session I 2019, UCSC

Instructor Information:

Name:	**Natalya Jackson**
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Office Hours:	**MF 1pm-2pm, McH 1292**

TA Information:

Name:	**Alejandro Bravo Doddoli**
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Office Hours:	**W 1pm-3pm, McH 4112**

Class Information:

Days:	**MWF**
Times:	**9:30am – 11:50am**
Location:	**PhySci 130**

Section Information:

Days:	**TuTh**
Times:	**12pm-1pm**
Location:	**SocSci1 149**

Textbook Information:

Title:	*Elementary Linear Algebra, an eText (4th Edition)*
Author:	Bruce Cooperstein
Access:	Purchase link can be found here.

Prerequisites:

Although the official prerequisites include a beginning calculus course, we will computationally use only high school algebra. Some conceptual references to calculus ideas will be made. Prerequisites are waived for visiting students in Summer Session, but the student assumes responsibility for success in the course.

Course Objectives:

In this course, you will learn many algorithmic computations (such as Gaussian elimination, determinants via cofactor expansion, and change of basis, to name a few), but the computations alone are not the desired outcome of the course. Instead, we emphasize the building of a conceptual framework which allows you to critically analyze a variety of problems to which the computations can be applied. As you internalize the logical progression of definitions and theorems, you will recognize how the information in a problem suggests the appropriate computation to perform. You will then use this framework to contextually interpret the results of the computation. Additionally, you will cultivate geometric interpretations of the concepts by actively engaging with the material from a variety of perspectives. This is an active-learning course, so the role of the instructor is primarily to facilitate your exploration of the concepts.

Grading:

Final letter grades are based on percentage of total available points, with usual standard cutoffs. There are 800 total available points, distributed as indicated. A short description of each category follows.

	40 points	(5%)	Definitions and Theorems Journal
	120 points	(15%)	Quizzes
	160 points	(20%)	Homework
	200 points	(25%)	Midterm Exam
	280 points	(35%)	Final Exam
TOTAL:	**800 points**	**(100%)**	

Definitions and Theorems Journal (DTJ):

As you read the text before coming to class (sections listed in "Schedule of Topics and Learning Outcomes" and also in Canvas), write down the definitions and theorems. There will be 8 "random checks" of your DTJ, each worth 5 points, for a total of 40 points possible (5% of your grade). This assignment serves three purposes:

- Emphasizes the importance of the logical progression of definitions and theorems in this course;
- Helps you learn the definitions and theorems by writing them out in your own writing;
- Allows us to spend our time, in this fast-paced course, actively engaging with examples.

Quizzes:

There will be a short quiz during nearly every lecture. Quizzes will focus primarily on definitions; however, some brief computations or geometric interpretations may be included as well.

Homework:

Homework will be available on Canvas at the beginning of each week, to be worked on throughout the week to help you gauge your progress with the week's Learning Outcomes. Homework will be collected weekly on Mondays at the beginning of lecture, with the exception of the last homework set, which will be collected before the Final Exam. Points will be awarded based on completeness only. However, many of your exam questions will be taken (directly or indirectly) from the homework, so it is in your best interest to be sure you are able to complete the problems correctly (please see the "Getting Help" section). Pay close attention to "non-computational" problems, which are designed to reinforce concepts and allow you to practice effectively communicating mathematical ideas.

Midterm Exam:

The Midterm Exam is during our usual lecture time on Monday, July 8th, assessing Learning Outcomes from Chapters 1-3. There will not be a Quiz the day of the Midterm Exam, but Homework 2 is due on this day.

Final Exam:

The Final Exam is during our usual lecture time on Friday, July 26th. The Final Exam will be cumulative, but will more heavily emphasize Learning Outcomes which were not assessed on the Midterm Exam. There will not be a Quiz the day of the Final Exam, but Homework 5 is due on this day.

Policy Regarding Late or Missed Assignments:

Definitions/Theorems Journal: Missed points on a "random check" day can only be made up if the points are missed due to absence ***with a doctor's note***.

Homework: If you are absent ***with a doctor's note*** the day a homework assignment is due, you may turn it in at the next lecture. Otherwise, no late homework will be accepted.

Quizzes/Exams: If you are absent ***with a doctor's note*** you may email me to make arrangements for a makeup quiz/exam. Quizzes/exams may not be made up for other reasons.

Note: In some circumstances, a note from Counseling and Psychological Services (CAPS), or a similar provider, will be accepted in place of a doctor's note. Additionally, the instructor acknowledges that healthcare access creates educational barriers along class lines when documentation from a healthcare provider is required for late or missed assignments. If you believe this is an issue affecting your ability to succeed in this class, please contact me by email.

Policy Regarding Children in Class:

If you find yourself needing to choose between bringing a child to class or not attending class at all, please choose a seat near the door so you can attend their needs if necessary. Let me know if I can assist in any way!

Note: This instructor's policy does not necessarily reflect the official policy of the Mathematics Department, the Division of Physical & Biological Sciences, or the University as a whole.

Schedule of Topics and Learning Outcomes

Day	Sections	Topics Covered	Learning Outcomes
6-24	1.1, 1.2	• Linear systems of equations • Nature of solutions to linear systems • Matrix representation of a linear system • Gaussian elimination algorithm • Free variables, leading variables • Echelon forms of matrices	• Understand relationship between a linear system of equations and matrix which represents it • Fluently transition between the two perspectives to solve linear systems algorithmically • Classify number and nature of solutions of a linear system by analyzing computational results • Interpret solutions of linear systems geometrically from the "row perspective" (intersection of lines)
6-26	2.2, 2.3	• Introduction to n-vectors • Addition and scalar multiplication of vectors • Linear combinations • Structure of the space R^n • Span in R^n (as a verb or a noun)	• Develop intuition for operations in R^n • Connect questions of "span" to linear systems, deduce answers by inspecting solutions • Interpret solutions of linear systems geometrically from the "column perspective" (linear combinations of vectors)
6-28	2.4, 2.5	• Linear independence in R^n • Subspaces in R^n • Basis of a vector space or subspace in R^n • Dimension	• Connect questions about linear dependence to questions about linear systems • Answer questions about linear dependence by inspecting solutions of linear systems • Identify subspaces in R^n • Relate questions about "basis" to questions about "span" and "linear independence" • Interpret questions of "dimension" in terms of questions about "basis"
7-1	2.6, 3.1	• Dot product • Orthogonality in R^n • Measurement of lengths and angles in R^n , projection • Linear transformations • Matrix of a linear transformation • Product of a matrix and a vector	• Connect questions about orthogonality to questions about linear systems via dot product • Interpret orthogonality and projection geometrically • Identify linear transformations and use properties of linear transformations to draw conclusions • Construct the matrix of a linear transformation • Interpret questions about linear transformations in terms of the product of a matrix and a vector
7-3	3.2, 3.3	• Properties of matrix-vector multiplication • Nullspace of a matrix • Affine subspaces • Addition of matrices • Mutliplication of matrices	• Connect questions about nullspaces to questions about solutions to homogeneous linear systems • Interpret general solution of a linear system as an affine subspace (translation of the nullspace) • Use equivalent properties of matrices to draw conclusions about linear dependence, spanning, nullspace, and column space • Develop familiarity with matrix addition/multiplication
7-5	3.4, 3.5	• Invertible matrices • Equivalent conditions for invertibility of matrices • Elementary matrices	• Connect questions about invertibility to questions about span and thus to solutions of linear systems • Infer relationship between invertibility and equivalent conditions (on nullspaces, pivots, etc) • Illustrate how relationship between elementary row operations and elementary matrices facilitates decomposition of an invertible matrix
7-8	N/A	(MIDTERM)	(ASSESSMENT OF ALL OUTCOMES TO DATE)

7-10	4.1, 4.2	• Computation of determinants • Properties of determinants • Relationship of determinants to invertibility of matrices	• Use geometric interpretation of determinant to infer relationship of determinants to invertibility • Identify most efficient method for computing the determinant of a matrix (by observation of zeros) • Integrate structural properties of determinants into problem solving strategies
7-12	5.1, 5.2, 5.3	• Abstract vector spaces (AVS) • Span in AVS • Linear dependence in AVS • Basis in AVS	• Extend familiar concepts from R^n to AVS (matrices and polynomials as prototype spaces) • Relate questions about span, linear dependence, basis, etc in AVS to questions about linear systems, thus to related questions in R^n
7-15	5.4. 5.5	• Coordinates with respect to bases • Change of basis • Rank and nullity of a matrix	• Use coordinate vectors to consider questions in AVS as questions in R^n • Interpret calculations in R^n as providing information about AVS via coordinates • Formulate change of basis matrices by considering associated linear systems • Understand "preservation by change of basis" • Relate rank and nullity to previous ideas about span, linear dependence, and dimension
7-17	6.1, 6.2, 6.3	• Linear transformations of AVS • Direct sums and projections • Kernel and range of linear transformations in AVS • Matrix of linear transformations with respect to bases in AVS	• Identify linear transformations in AVS • Use coordinates to consider questions about projections onto subspaces in AVS as questions about projections onto subspaces in R^n • Use range and kernel to determine if a linear transformation is injective, surjective, bijective • Represent linear transformations of AVS as matrices using coordinates in R^n • Infer answers to questions about injectivity, surjectivity, bijectivity in AVS by considering equivalent questions in R^n using matrices
7-19	7.1	• Eigenvalues • Eigenvectors • Characteristic polynomial	• Identify eigenvectors and eigenspaces by considering invariant subspaces by inspection, or by computation of an appropriate nullspace • Illustrate the connection between the definition of an eigenvector and the characteristic polynomial in computing eigenvalues
7-22	7.2	• Algebraic and geometric multiplicity of eigenvalues • Diagonalization	• Distinguish between algebraic and geometric multiplicity of an eigenvalue (using nullspace) • Understand relationship between geometric multiplicity and diagonalization • Explore larger idea of "conjugacy classes" of matrices and "invariants" on those classes
7-24	8.1, 8.3, REVIEW	• More on orthogonality • Distance-preserving linear transformations	• Understand importance of orthonormal bases • Geometrically interpret common method of computing an orthonormal basis (Gram-Schmidt) • Illustrate geometric relationship between orthogonormal bases and distance-preserving linear transformations
7-26	N/A	(FINAL)	(ASSESSMENT OF ALL OUTCOMES TO DATE)

Getting Help:

There are many resources available to help you succeed in this course. The instructor is available by email, but please allow 24-48 hours for a response. For homework questions, please include details regarding your thought process about the question, what you have tried so far, and how I can assist your learning process. Attending section regularly, as well as the office hours for both the instructor and the TA, provide opportunities to actively engage with the material. Additionally, small group tutoring is available through Learning Support Services. Please visit Learning Support Services for more information.

General Information:

Important 2019 Deadlines:

Session 1: Drop: Monday, July 1 Request for "W": Friday, July 12
Session 2: Drop: Monday, August 5 Request for "W": Friday, August 16
8-Week: Drop: Monday, July 8 Request for "W": Friday, July 26
10-Week: Drop: Monday, July 8 Request for "W": Friday, July 26

Neither Summer Session nor instructors drop students for non-attendance or non-payment. Students must drop themselves. Dropping results in full tuition reversal/refund. Withdraw posts a W for the grade and full tuition is charged (no refund).

For all dates and deadlines, including 'change of grade option' (P/NP) and grades due, here is the summer academic calendar: https://summer.ucsc.edu/studentlife/index.html

For questions about dropping, requesting a W grade for a course, or withdrawing from the summer quarter, email summer@ucsc.edu.

DRC Accommodations:

Personal Message from the Instructor: "My goal is for this class to be an inclusive and supportive learning environment for all students. Please contact me by email as soon as possible if you require accommodations for quizzes and/or exams, or if you have any other concerns regarding accommodations or any other aspect of the course."

The Disability Resources Center reduces barriers to inclusion and full participation for students with disabilities by providing support to individually determine reasonable academic accommodations. If you have questions or concerns about exam accommodations or any other disability-related matter, please contact the DRC office, located in Hahn 125 or at 831-459-2089 or drc@ucsc.edu.

Academic Dishonesty:

Academic integrity is the cornerstone of a university education. Academic dishonesty diminishes the university as an institution and all members of the university community. It tarnishes the value of a UCSC degree. All members of the UCSC community have an explicit responsibility to foster an environment of trust, honesty, fairness, respect, and responsibility. All members of the university community are expected to present as their original work only that which is truly their own. All members of the community are expected to report observed instances of cheating, plagiarism, and other forms of academic dishonesty in order to ensure that the integrity of scholarship is valued and preserved at UCSC. In the event a student is found in violation of the UCSC Academic Integrity policy, he or she may face both academic sanctions imposed by the instructor of record and disciplinary sanctions imposed either by the provost of his or her college or the Academic Tribunal convened to hear the case. Violations of the Academic Integrity policy can result in dismissal from the university and a permanent notation on a student's transcript. For the full policy and disciplinary procedures on academic dishonesty, students and instructors should refer to the Academic Integrity page at the Division of Undergraduate Education.

Title IX:

The university cherishes the free and open exchange of ideas and enlargement of knowledge. To maintain this freedom and openness requires objectivity, mutual trust, and confidence; it requires the absence of coercion, intimidation, or exploitation. The principal responsibility for maintaining these conditions must rest upon those members of the university community who exercise most authority and leadership: faculty, managers, and supervisors.

The university has therefore instituted a number of measures designed to protect its community from sex discrimination, sexual harassment, sexual violence, and other related prohibited conduct. Information about the Title IX Office, the online reporting link, applicable campus resources, reporting responsibilities, the UC Policy on Sexual Violence and Sexual Harassment and the UC Santa Cruz Procedures for Reporting and Responding to Reports of Sexual Violence and Sexual Harassment can be found at titleix.ucsc.edu.

The Title IX/Sexual Harassment Office is located at 105 Kerr Hall. In addition to the online reporting option, you can contact the Title IX Office by calling 831-459-2462.