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# Linear Algebra with Applications

Applied Math (APMA) 0300

Fall 2017

Wilson Hall 309

Mon Wed Fri, 1:00 - 1:50pm

Canvas Homepage: <https://canvas.brown.edu/courses/300>

**Instructor:** Veronica Ciocanel

**Contact info:**

- **Office:** Room 209, 170 Hope Street
- **Email:** veronica\_ciocanel@brown.edu
- The two **TAs** for this class will be TA1 and TA2. They will be holding separate office hours, TBA.
- You may expect to receive responses to email inquiries in 2-3 days.

**Office Hours:** Wednesdays 3:30-5:30, and by appointment.

**I Course Description:**

In this essential course in mathematics and applied mathematics, students will learn the theory of linear algebra and will understand how these methods apply to solving problems in other fields. Linear algebra is a field of mathematics that studies systems of linear equations and properties of matrices. This course will provide undergraduate students interested in majoring in mathematics or other quantitative sciences with the basic linear algebra tools for approaching problems in various disciplines. The class will cover topics on matrix and vector operations and properties, which have a wide range of applications. Students will learn to rigorously prove mathematical results and will apply linear algebraic techniques to analyze models in the biological and physical sciences. Recommended prerequisites for this course are Math 180 (Intermediate Calculus), 200 (Intermediate Calculus for Physics/Engineering) or 250 (Honors Calculus). This course is a requirement for most advanced courses in Mathematics and Applied Mathematics.

**II Course Goals and Learning Outcomes:**

By the end of the course, students will be able to:

- Identify theorems and results on vector/matrix properties needed for solving linear algebra problems.
- Interpret and represent linear algebra techniques and results as geometric operations in multi-dimensional space.

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- Develop short and rigorous proofs of true mathematical statements and construct counterexamples for false statements.
  - Recognize situations where linear algebra techniques are applicable and use these techniques to answer questions in different mathematical fields and other disciplines.

### III Course Materials:

Linear Algebra: A Geometric Approach [2nd edition]

T. Shifrin and M. Adams, published by W.H. Freeman and Company, New York.

Obtaining the textbook is recommended.

### IV Course Requirements:

#### Homework assignments (25%)

- Homework will be assigned most weeks on Wednesday and will be due Wednesday of the following week. The assigned homework problems will be available online on Canvas.
- The homework will occasionally include application problems to get students comfortable with applying linear algebra techniques to other disciplines.

#### Group problem sessions (10%)

- Throughout the course there will be several (3-4) class problem sessions. These consist of structured group assignments that should be completed during class time. These assignments will be exploratory allowing students to work in a group while working through a rigorous proof or exploring an application of the material.

#### Quizzes (5%)

- Short (5-10 minute) quizzes will be occasionally given at the beginning of the class to assess understanding of that week's topics.

#### Midterms (30%: 15% each)

- There will be two in-class exam throughout the semester. These exams will test the material covered in class up to that point (see Tentative Course Schedule).

#### Final Exam (30%)

- There will be a final comprehensive in class exam at the end of course. This exam will be cumulative (but with slightly more focus on material covered in the latter third of the course).

### V Grading Policy:

The class may be taken pass/fail. In order to pass, students must aim for a 70% or more average grade in the course, and must not miss the final examination. Students will be awarded pass with

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Graded work	Weight
Homework	25%
Group problem sessions	10%
Quizzes	5%
Midterm exam 1	15%
Midterm exam 2	15%
Final examination	30%

Provisional grading scheme	
Grade	Percentages to aim for
A	90 - 100%
B	80 - 89%
C	70 - 79%

distinction if they average 90% or more in the course. Note that the above grading scale is in accordance to the Brown University Grading System.

The grading scale above is subject to adjustment, especially in borderline cases; adjustments may take into account class and group problem session participation and improvements in performance over the semester. Minimum percentages for grade cut-offs will be approximately as (and no higher than) in the tentative scale above.

Plagiarized homework assignments will receive an automatic penalty grade of zero points.

## VI Policies and Expectations of Students:

### Homework:

- Late homework assignments will not be accepted. You will be given a limited free pass (you can turn in 10 out of 12 assignments), but it is highly recommended (i.e., essential) that you work through all assignments to be able to keep up with the material.
- Students can collaborate on homework assignments: however, assignments must be written up separately and individually.
- You can expect to spend about 3-5 hours on homework each week.

### Exams:

- Exams will be given for individuals at times other than the scheduled slots only in cases of illness, emergency or some other urgent situation; documentation verifying the excuse will be required. You must contact me as soon as you can, before the exam whenever possible, if a serious conflict arises.

### Group problem sessions:

- In group problem sessions, students will be divided into 3-person groups and work on practice problems, the details of a proof, or applications related to the concepts introduced that week.

- Attendance of the group problem sessions is required. These sessions will provide extra preparation for assignments and exams, push your knowledge further, as well as help you make friends in the class. If for any reason you cannot attend a group problem session, notify me as early as possible so as to arrange a make-up assignment.
- You are expected to work on the problems with your group, and encouraged to use the board whenever needed. Make sure you understand all steps of the problems that you are solving with your group, and that you rotate the person summarizing the solution approach to the group in each problem/subproblem.
- These sessions will be facilitated by the instructor and the TAs.

## VII Tentative Course Schedule

Week	Topic/Assignment
1	Introduction to Linear Algebra, Gaussian Elimination HW (homework)
2	Matrix operations HW
3	Special types of matrices, Determinants HW
4	Properties of the determinant Class problem session HW
5	2- and 3-dimensional vectors Midterm exam
6	n-dimensional spaces HW
7	Vector spaces, Linear independence Class problem session HW
8	Bases and dimension, Linear independence and span HW
9	Matrix rank, Inner products HW
10	Cauchy-Schwartz inequality Midterm exam
11	Orthonormal basis, Gram-Schmidt HW
12	Class problem session HW
13	Eigenvalues and eigenvectors, Diagonalization HW
14	Linear transformations HW
15	Final exam

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### VIII Accommodations for Students with Disabilities:

Brown University is committed to full inclusion of all students. Students who, by nature of a documented disability, require academic accommodations should contact me during office hours or by appointment, and we will determine a plan for completing their assignments throughout the semester. Students may also speak with Student and Employee Accessibility Services to discuss the process for requesting accommodations. Visit [Student and Employee Accessibility Services \(SEAS\)](#) for more information.

### IX Academic Support:

[TA Office Hours](#) will be posted on the website. You are encouraged to take advantage of this resource available for the class.

The [Math Resource Center](#) hours are available at <https://www.math.brown.edu/mrc/>.

### X Inclusion and Diversity Statement:

Brown University does not discriminate on the basis of sex, race, color, religion, age, disability, status as a veteran, national or ethnic origin, sexual orientation, gender identity, or gender expression in the administration of its educational policies, admission policies, scholarship and loan programs, or other school administered programs.

I intend to support an inclusive classroom environment where diverse perspectives are recognized, respected, and seen as a source of strength. I encourage you to learn from your fellow students, who may be applying mathematical techniques in different fields, as this will allow you to appreciate your new knowledge even more. I also recommend that you ask many questions, whether in the classroom or during office hours, to ensure that you understand the material throughout the semester.

### XI Academic Honesty:

As mentioned in Brown University's Academic Code, "Academic integrity protects and promotes the University's pursuit of its academic mission. Membership in the Brown community thus carries with it a responsibility for upholding the University's principles. All members of the Brown community are expected to conduct themselves with integrity in their learning, teaching, research, and writing. It is also incumbent on those who know or suspect that someone else has violated Brown's academic code to report their knowledge or suspicions to the appropriate University authorities." Consult <http://www.brown.edu/academics/college/degree/policies/academic-code> for the full policies.