Lecture: (Section 5) Monday-Wednesday-Thursday, 1:35pm–2:40pm, Hastings Suite 101.
(Section 6) Monday-Wednesday-Thursday, 10:30am–11:35am, Richards Hall 155.

Instructor: Evan Dummit (he/him/his), edummit@northeastern.edu.

Office Hours: Monday-Wednesday 3:15pm–5:00pm or by appointment, online via Zoom.

Course Webpage: https://web.northeastern.edu/dummit/teaching_fa21_2331.html.

Course Textbook: The instructor will write lecture notes for the course (in lieu of an official textbook) as the semester progresses. The course will generally follow the presentation in "Linear Algebra With Applications" (5th ed.) by Otto Bretscher, but it is *not* necessary to purchase the textbook for the course.

Course Topics: This course is an introduction to linear algebra, one of the most widely-used fundamental tools of mathematics (rivaled only by calculus). Math 2331 emphasizes computational aspects of linear algebra, although the lectures will also discuss derivations and proofs of the results when relevant.

The course covers the following topics: systems of linear equations, echelon forms and Gaussian elimination, matrix algebra, inverses of matrices, determinants, vectors in $\mathbb{R}^n$, subspaces, span, linear dependence and independence, bases and dimension, linear transformations, geometric properties of transformations in $\mathbb{R}^n$, kernel and image, inverse transformations, matrices associated to linear transformations, change of basis and similarity, inner products, norms, orthogonality, the Gram-Schmidt procedure, QR factorization, orthogonal complements, least-squares approximation, Fourier series, eigenvalues and eigenvectors, characteristic polynomials, diagonalization, dynamical systems and Markov chains, the real spectral theorem, bilinear and quadratic forms, and singular value decomposition.

Success in this course will require facility with the basic concepts and with computational applications.

Grades: Your course grade consists of **15% WeBWorK/Quizzes** and **85% exams**.

There are four exams (three midterms and a final): each 1-hour midterm contributes 15% of your grade, while the 2-hour final contributes 40%.

The homework score consists of your total WeBWorK points divided by the total number of WeBWorK problems assigned.

An overall raw score of 92% will be **at least** an A, 90% will be **at least** an A-, 88% will be **at least** a B+, 82% will be **at least** a B, 80% will be **at least** a B-, 78% will be **at least** a C+, 72% will be **at least** a C, and 70% will be **at least** a C-.

If you feel that an assignment or exam has been misgraded, please talk to the instructor directly. Requests for regrading will not be considered more than two days past the date the assignment or exam was returned.

Exams: There will be three 1-hour midterm exams held in class and a 2-hour common final exam held during the final exam week.

If you miss an exam for any reason, you will receive a 0; make-up exams will not be given.

The midterms are scheduled for Wed October 6th, Thu November 4th, and Wed December 1st.

Homework Assignments/Quizzes: Homework assignments will be assigned weekly via WeBWorK and due at 5am, typically on Tuesdays. WeBWorK is an electronic homework-assessment system that is free for students and has been designed specifically for courses in mathematics.

It is highly recommended to start work on the assignments early, because some problems are quite lengthy. Many students like to work on the problems as soon as the corresponding material is covered in lecture. Do not fall into the trap of only starting the assignment the evening before it is due!

All problems on all assignments will be counted (no assignments or problems will be dropped), so you should do as much as you can on each assignment even if you cannot completely finish it.

You are allowed **THREE** 24-hour extensions on WeBWorK assignments during the semester. To claim an extension on a set, email the instructor within 24 hours of the due date requesting to use your extension (the 24-hour extension applies to the original due date, not to the time you request the extension) as follows: "I would like to use a 24-hour extension on Set #". You need not give any reason for requesting an extension. **Additional extensions will not be granted under any circumstances**.

If the overall coursewide WeBWorK completion rate drops below 75%, the instructor reserves the right to schedule in-class quizzes whose points will be added to the WeBWorK total. **Students who have 90% or higher on the most recent WeBWorK receive automatic full marks on such quizzes.**

Course Schedule: The course and lecture notes are tentatively organized into six chapters, as follows:

Weeks 1-3: Chapter 1 $\sim$ Matrices and Systems of Linear Equations: Systems of linear equations, row-reduction, echelon forms, Gaussian elimination, matrix algebra, inverse matrices, determinants.

Weeks 3-5: Chapter 2 $\sim$ Vectors and Vector Spaces: Vectors in $\mathbb{R}^n$, formal vector spaces, subspaces, span, linear dependence and independence, bases and dimension, computing bases (rowspace, column space, nullspace).

Week 5: Midterm 1, covers chapters 1 and 2.

Weeks 5-6: Chapter 3 $\sim$ Linear Transformations: Linear transformations, geometry of plane transformations, kernel and image, inverse transformations, associated matrices, change of basis and similarity.

Weeks 7-9: Chapter 4 $\sim$ Inner Products: Inner products, norms, orthogonality, the Gram-Schmidt procedure, QR factorization, orthogonal complements, least-squares approximation, Fourier series.

Week 9: Midterm 2, covers chapters 3 and 4.

Weeks 10-12: Chapter 5 $\sim$ Eigenvalues and Diagonalization: Eigenvalues, eigenvectors, the characteristic polynomial, diagonalization, dynamical systems and Markov chains, the real spectral theorem.

Weeks 13-14: Chapter 6 $\sim$ Quadratic Forms: Quadratic forms, diagonalization, singular value decomposition.

Week 14: Midterm 3, covers chapters 5 and 6.

Week 15: Final exam, covers chapters 1-6.

Collaboration/Technology Policy: You are free to use calculators and computer technology for homework problems, and calculators are allowed on exams **provided that they are not capable of symbolic algebra**.

Mathematics is fundamentally a collaborative endeavor, and discussing the course material with others is an excellent way to solidify your own understanding. In particular, you are allowed to work on, and discuss, homework assignments together, as long as the actual submissions are your own work.

A warning: it is critical not to outsource your learning! You cannot expect to retain knowledge if you do not solve your homework problems yourself, whether because you relied on other people to explain to you how to do the problems, or because you relied too heavily on technological assistance.

Do note: 85% of your course grade is determined by the exams, on which collaboration is not allowed!

Attendance Policy: It is expected that you will attend every class. This course moves very fast, and it is quite possible to fall behind even if you only miss one day. If you miss class for any reason, it is highly advisable to consult the course lecture notes and to watch the recording of the lecture you missed. It is your responsibility to be aware of all information announced in class, including modifications to the course syllabus or schedule, even if you are absent.

If you will be absent from a class activity due to a religious observance or practice, or for participation in a university-sanctioned event (e.g., university athletics), it is your responsibility to inform the instructor during the first week of class and provide appropriate documentation if required.

Statement on Academic Integrity: A commitment to the principles of academic integrity is essential to the mission of Northeastern University. Academic dishonesty violates the most fundamental values of an intellectual community and undermines the achievements of the entire University. Violations of academic integrity include (but are not limited to) cheating on assignments or exams, fabrication or misrepresentation of data or other work, plagiarism, unauthorized collaboration, and facilitation of others' dishonesty. Possible sanctions include (but are not limited to) warnings, grade penalties, course failure, suspension, and expulsion.

Statement on Accommodations: Any student with a disability is encouraged to meet with or otherwise contact the instructor during the first week of classes to discuss accommodations. The student must bring a current Memorandum of Accommodations from the Office of Student Disability Services.

Statement on Classroom Behavior: Disruptive classroom behavior will not be tolerated.

In general, any behavior that impedes the ability of your fellow students to learn will be viewed as disruptive. Examples of disruptive behavior include, but are not limited to, ringing cell phones, listening to an audio player during class, constant talking, eating food noisily, or laptop usage (except for note-taking), and any other disruptions of the course lectures.

Statement on Inclusivity: Faculty are encouraged to address students by their preferred name and gender pronoun. If you would like to be addressed using a specific name or pronoun, please let your instructor know.

Statement on Evaluations: Students are requested to complete the TRACE evaluations at the end of the course.

Miscellaneous Disclaimer: The instructor reserves the right to change course policies, including the evaluation scheme of the course. Notice will be given in the event of any substantial changes.