

MA 405 (601) - Introductory Linear Algebra and Matrices

SPRING SEMESTER 2024

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Basic Information

Instructor: Kylan Schatz (they/them)

Email: kaschatz@ncsu.edu

Office hours: By appointment; slots available Monday, Wednesday, and Thursday.

Office location: Zoom Meetings

Course meetings: This course is an asynchronous Distance Education course.

Course Website: found on <https://wolfware.ncsu.edu/courses/my-wolfware/>

Catalog Description

This course offers a rigorous treatment of linear algebra, including systems of linear equations, matrices, determinants, abstract vector spaces, bases, linear independence, spanning sets, linear transformations, eigenvalues and eigenvectors, similarity, inner product spaces, orthogonality and orthogonal bases, factorization of matrices. Compared with MA 305 Introductory Linear Algebra, more emphasis is placed on theory and proofs. MA 225 is recommended as a prerequisite. Credit is not allowed for both MA 305 and MA 405.

Prerequisite: MA 241 (MA 225 recommended); Corequisite: MA 341 is recommended

Learning Outcomes

Upon successful completion of this course, students will be able to:

1. **Use Mathematical Notation and Terminology.**

The students will demonstrate mastery in using the mathematical notation and terminology

of linear algebra. Students will read, interpret, and use the vocabulary, symbolism and basic definitions.

2. Understand and Describe the Fundamental Concepts of Linear Algebra.

Students will identify and apply the theorems about abstract vector spaces and linear transformations; will gain a clear understanding of the basic concepts of linear algebra, such as linear independence of vectors, spanning sets, basis, similarity, eigenvalues and eigenvectors.

3. Identify and Utilize Linear Algebra Tools.

The students will be able to apply course material along with techniques and procedures covered in this course to solve problems. Students will master techniques for solving linear systems by various matrix methods, compute the determinant and the inverse of a square matrix, compute various factorizations of matrices, apply the Gram-Schmidt process, calculate and analyze the characteristic equation of a matrix to determine its eigenvalues and eigenvectors. Moreover, students will apply properties and theorems about vector spaces to specific mathematical structures that satisfy the vector space axioms, will analyze the differences and similarities between spanning sets, bases, and orthogonal bases and will use the knowledge gained in this course to determine appropriate methods of proof for specific problems.

4. Develop Cognitive Skills.

Students will demonstrate the ability to reason with abstract linear algebra concepts, to read and comprehend mathematical arguments utilizing direct and indirect proof, case analysis, and mathematical induction. Students will develop familiarity with axiomatic approaches in mathematics through the study of vector spaces and linear transformations. They will acquire a level of proficiency in manipulating linear algebra concepts, in analyzing and evaluating their applicability in their future studies, including graduate work, in academic areas requiring linear algebra as a prerequisite for work in occupational fields requiring a background in linear algebra.

Course Structure

Lecture Materials

Linear algebra provides one of the cornerstones for much of modern mathematics, and has important applications in physics, engineering, and economics. The main purpose of this course is to introduce the basic concepts from linear algebra, explain the underlying theory, the computational techniques, and study how these concepts and results can be productively used in other areas of mathematics and physical sciences, especially in applied mathematics where multivariable models are involved. Among the topics covered in this course will be: solving systems of linear equations using Gauss elimination, row echelon form, determinants, vector spaces, linear independence, bases, dimension, linear transformations, orthogonality, eigenvalues, and reduction of matrices to diagonal forms.

The subject involves a mixture of both the practical and the theoretical, and will provide in particular a good introduction to mathematical proofs. For this reason, the course is considered to be a

difficult one in undergraduate mathematics, and the student should be prepared to invest a considerable amount of time in understanding the class material and doing homework.

All course learning materials and resources are housed in Moodle. The video lectures are pre-recorded and made available in Moodle, along with the pdf course notes. The lectures should be viewed according to the schedule on Moodle.

Problem Sessions

Every Tuesday from 10:00 - 11:00 am, I will host a Zoom problem session. During this session, I will work through problems related to the last week of instructional material. I plan to record these problem sessions and post them online, sharing the link on Moodle. If possible, please post on the forum or email any questions beforehand.

Textbook

There is no required textbook for this course. However, several textbooks available through the NC State Libraries are good resources, and specific chapters will be recommended for each course unit. You can also find links to these resources on Moodle:

1. Olver P.J., Shakiban C. (2018) *Applied Linear Algebra*. Undergraduate Texts in Mathematics. Springer.
Find it here: <https://catalog.lib.ncsu.edu/catalog/NCSTU4441965>
2. Nair M.T., Singh A. (2018) *Linear Algebra*. Springer.
Find it here: <https://catalog.lib.ncsu.edu/catalog/NCSTU4443257>
3. Said-Houari B. (2017) *Linear Algebra*. Compact Textbooks in Mathematics. Birkhäuser.
Find it here: <https://catalog.lib.ncsu.edu/catalog/NCSTU4062886>
4. Axler, S. (2015) *Linear Algebra Done Right*. Springer.
Find it here: <https://catalog.lib.ncsu.edu/catalog/NCSTU3313726>
5. Chahal, J.S. (2019) *Fundamentals of Linear Algebra*. CRC Press, Taylor & Francis Group.
Find it here: <https://catalog.lib.ncsu.edu/catalog/NCSTU4847033>

Homework

Homework will consist of both written, hand-graded and computational, automatically graded assignments. Written assignments will be posted to Gradescope, and solutions should be uploaded there as well. Online, computational assignments are completed using WeBWorK linked to Moodle. Each assignment must be accessed first through Moodle to be able to see it in WeBWorK. Your lowest homework grade will be dropped. Use this drop wisely.

The links to the homework assignments are available in Moodle. WeBWorK homeworks are due before the associated midterm. The due dates for Gradescope assignments are listed on Gradescope. Recommended due dates are detailed in the course Road Map.

Tests

Exams will be written, with free response (proof-type) questions, administered in-person, and hand-graded. Students will take their exams at DELTA, which has locations on both main and centennial campuses. For students that live more than 50 miles from NC State campus, remote proctoring is also available. **Sign up your preferred time/date now, time slots fill up fast! Failure to schedule a test with DELTA during the given testing window will result in an automatic 10 point deduction from that test, so make sure to schedule tests early!**

Dates

- **Test 1** Wednesday 1/31 - Friday 2/2
- **Test 2** Wednesday 3/6 - Friday 3/8
- **Final Exam** Thursday 4/25 - Friday 4/26, and Monday 4/29

Make-Up Examinations

Students who miss an exam **with an excused absence** may reschedule their exam at a later date with no penalty. Students are required to verify their absence through DASA and are expected to communicate with the instructor within 24 hours of the missed exam.

<https://dasa.ncsu.edu/support-and-advocacy/find-help/absence-notification/>

Testing Accommodations

DELTA is able to accommodate students with disabilities. It is the student's responsibility to share accommodation letters both with the instructor and DELTA. Accommodations may be shared with the instructor through the DRO portal, and with DELTA via request form. Please view the following for more information on DELTA testing accommodations:

<https://testing-services.delta.ncsu.edu/testing-accommodations/>

Calculators

You may use scientific calculators on exams. These calculators must have **no graphing capabilities**. If you are on-campus, you may rent a suitable calculator from the library:

<https://www.lib.ncsu.edu/devices/calculators>.

Regrading

Answer keys for all tests will be posted on Moodle when the exams are returned via Gradescope. If a grading error is found after looking at the posted answer key, then **provide a written explanation of the grading error through Gradescope within one week**. The entire test may be regraded and the test grade is subject to remain the same, increase, or decrease at the discretion of the instructor.

Proctors

All examinations will be proctored through [DELTA](#). You will either take your exam with DELTA, or coordinate remote proctoring with DELTA, according to which situation best describes you:

- **If you live less than 50 miles away from Raleigh, NC**, then you will take your tests on our campus through the Distance Education Testing Centers. Students should be mindful of closing hours for both Testing Centers, and give themselves plenty of time to complete their exams. For information, please visit:

<https://testing-services.delta.ncsu.edu/testing-services-on-campus/>

- **Those students who live more than 50 miles away from Raleigh, NC** do not have to take their tests on NCSU campus. They may use a proctor in their town for testing. The proctor must be approved in advance through the Distance Education office. It can take up to 1 week to verify a proctor and set up all needed contact info, so please do this early! Please visit the remote proctor website at:

<https://testing-services.delta.ncsu.edu/testing-services-remote/>

General Class Expectations

Your responsibilities

1. **Course Structure:** This class is an online class so you will need to take responsibility for your own learning and set your own pace within our guidelines.
 - a. Watch the **video lectures** for each week.
 - b. Complete the **homework assignments**.
 - c. *Recommended:* Participate in the course forum and attend office hours.
2. Check your email and Moodle site regularly. Any announcement made by email is saved under Announcements on our Moodle page.
3. Be respectful and professional. Treat everyone in class (other students and myself) with respect and courtesy. In problem sessions, be active and engaged and come prepared. In office hours, be prepared to ask questions and work with others that are in the office hours' time too.
4. Be accountable for your own education. You are responsible for resolving confusion about assignments, due dates, exam dates, accommodations, etc.
5. Do not submit work that is not yours. **It is understood that your name or signature on any assignment or attached to any online submission indicates your adherence to the NC State Honor Pledge: "I have neither given nor received unauthorized aid on this test or assignment."**

6. **No graphing calculators or cell phones or other devices that go to the internet** are allowed during exams. You may have a simple non-graphing calculator. It is an honor code violation if you use a graphing calculator on an exam. It is also an honor code violation to access the internet in any way (phones, watches, etc) during an exam.

Diversity, Equity, and Inclusion

Diversity, equity, and inclusion are important to the success of our students at NC State. Every student, every faculty member, and every staff member who comes to NC State enriches us through their varied perspectives, knowledge, and backgrounds. Our classroom is one in which every student is respected and feels heard.

Trans/Nonbinary/GNC Students

In an effort to affirm and respect the identities of transgender students in the classroom and beyond, please contact me if you wish to be referred to using a name and/or pronouns other than those listed in the student directory.

I welcome any suggestions you have for making our classroom more welcoming and inclusive.

Tutoring Centers

There is free help available on campus for courses numbered 100-300 at the [Math Multimedia Center](#) in SAS Hall 2105; however, it is possible that the graduate students in the MMC will be able to help you with MA 405. This room has many computers available so that you can work on your assignments. The room is a low-stress environment: you may work quietly in the room without engaging a tutor, or you may ask questions of the graduate tutors when they are available.

Grading

Grade Weighting and Numerical Conversion

Your grade will be determined by the following break down:

- **Participation** (Yellowdig): 5%
- **Homework**: 20%
- **Tests**: 50% (2 x 25%)
- **Final**: 25%

A student's numerical average will be converted to a letter grade as follows (do not expect any additional rounding or curves):

A+	97 - 100	A	93 - 96.99	A-	90 - 92.99
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B+	87 - 90	B	83 - 86.99	B-	80 - 82.99
C+	77 - 80	C	73 - 76.99	C-	70 - 72.99
D+	67 - 70	D	63 - 66.99	D-	60 - 62.99
F 0 - 59					

Requirements for Credit-Only (S/U) Grading

In order to receive a grade of S, students are required to take all exams, complete all assignments, and earn a grade of C- or better. Conversion from letter grading to credit only (S/U) grading is subject to university deadlines. Refer to the Registration and Records calendar for deadlines related to grading. For more details refer to:

<http://policies.ncsu.edu/regulation/reg-02-20-15>.

Requirements for Auditors (AU)

Information about and requirements for auditing a course can be found at:

<http://policies.ncsu.edu/regulation/reg-02-20-04>.

Policies on Incomplete Grades

If an extended deadline is not authorized by the instructor or department, an unfinished incomplete grade will automatically change to an F after either (a) the end of the next regular semester in which the student is enrolled (not including summer sessions), or (b) the end of 12 months if the student is not enrolled, whichever is shorter. Incompletes that change to F will count as an attempted course on transcripts. The burden of fulfilling an incomplete grade is the responsibility of the student. See the university policy on incomplete grades:

<http://policies.ncsu.edu/regulation/reg-02-50-3>.

Tentative Course Schedule

The sections on our course site are organized by dates. You can find the videos and assignments under each module's header. Additionally, near the top of Moodle is a tentative schedule covering the major topics in the course and assignment due dates.

Please find the general NC State Academic Calendar here:

<https://studentservices.ncsu.edu/calendars/academic/>

for holidays and other university closures. Our exams are already scheduled with Delta. In past semesters, there have been students who failed to schedule a final exam because they were waiting to learn what their exam schedule was. This situation is preventable and does not merit a make-up final. Your final exam schedule is already determined; find it here:

<https://studentservices.ncsu.edu/calendars/exam/>

Additional Information

Student Expenses

There are no materials to purchase for this course.

Late Assignments

Students may submit their written homework up to a week late for a 20% penalty. Late WeBWork will only be accepted in the case of an **excused absence**. These include:

- official university duties or trips during which the student represents the university,
- required court attendance, required military duties,
- religious observances,
- short-term illness, or death or serious illness in the family.

The following are **NOT excused**, but **may** be approved at the discretion of the instructor:

- conferences, field trips,
- club sports, dance teams,
- travel,
- weather, or
- work.

You should contact me by email before any anticipated excused absence. You should verify all unanticipated excused absences within one week of returning to class, and all anticipated excused absences a week before the expected absence. All excused absences need to be **verified by DASA**, through the following link:

<https://dasa.ncsu.edu/support-and-advocacy/find-help/absence-notification/>

For complete attendance and excused absence policies, please see:

<https://policies.ncsu.edu/regulation/reg-02-20-03-attendance-regulations/>.

If an exam is missed with an **excused absence**, a make-up proctoring date will be scheduled through DELTA. If an exam is missed for an unexcused absence, that exam will be given a score of 0 and no make-ups will be allowed. Documentation for an excused absence must be provided within 1 week of returning to class.

Attendance

Since this course is an asynchronous online course, there is no daily attendance. Instead, each student's participation in Moodle is tracked.

Academic Integrity

Students are required to comply with the university policy on academic integrity found in the Code of Student Conduct:

<http://policies.ncsu.edu/policy/pol-11-35-01>.

Your signature on any test or assignment indicates **I have neither given nor received unauthorized aid on this test or assignment**. Violations of academic integrity will be handled in accordance with the Student Discipline Procedures ([NCSU REG 11.35.02](#)). Below are guidelines specific to this course:

- **Tests:** The in-person midterms are closed book assessments. You may use one 8.5" x 11" page of notes (front and back—two sides total) for the final exam. You may not consult any internet resources or receive help from anyone else. You may use a non-graphing calculator on your tests.
- **Homework:** You may consult your notes, the textbook, each other, or online resources. You may not post the problem on any website (Ex. Chegg) but you may post questions on our course forum.

Disability Resources

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with the Disability Resource Office at Holmes Hall, Suite 304, 2751 Cates Avenue, Campus Box 7509, 919-515-7653. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation ([NCSU REG 02.20.01](#)).

Digital Course Components

Because of the way our course is structured, students need internet connectivity in order to read course materials and complete assignments. NC State's Online and Distance Education provides [technology requirements and recommendations](#) for computer hardware.

Digitally hosted course components will include but are not limited to Moodle, Zoom, Piazza, and WebAssign.

Software

- > [Moodle and Wolfware](#): Our course is hosted online on Moodle, where you can find lecture materials, course information, assignments, and instructor contact information.
 - [Moodle Accessibility Statement](#)
 - [Moodle Privacy Policy](#)
 - [NCSU Privacy Policy](#)
- > [Yellowdig](#): this site hosts our class forum. Please post all questions regarding lecture or homework there. There is the option to post anonymously if desired. Yellowdig will be used as a form of participation for the class, and you are encouraged to use it to build a community for this class.
 - [Yellowdig Accessibility Statement](#)
 - [Yellowdig Privacy Policy](#)
 - [Yellowdig Support](#)
- > [Zoom](#): for synchronous office hours.
 - [Zoom Accessibility Statement](#)
 - [Zoom Privacy Policy](#)
 - [Zoom Support](#)
- > [Gradescope](#): We will use Gradescope for written homework and exam feedback.
 - [Gradescope Accessibility Information](#)
 - [Gradescope Privacy Policy](#)
 - [Gradescope Help Center](#)
- > [WebWork](#): We will use WebWork for homework.
 - [WebWork Accessibility Guide](#)
 - [WebWork Privacy Policy](#)
- > [Panopto](#): Class recordings are hosted on Panopto.
 - [Panopto Accessibility Features](#)
 - [Panopto Privacy Policy](#)
 - [Panopto Support](#)

You must address the accessibility of these websites for yourself during the course drop/add period.

The instructor is not responsible for ensuring privacy or accessibility of electronic materials that are not required components of the course (e.g., links to supplemental information that is not part of the required reading list). However, the instructor will judiciously consider the privacy, copyright, and accessibility of supplemental links provided to students and warn them of any known issues or concerns in this regard. See Online Course Material Host Requirements ([NCSU REG 08.00.11](#)).

Electronically Hosted Components

Please be advised this course is being recorded for current and potential future educational purposes. By your continued participation in this recorded course, you are providing your permission to be recorded. If you would like for your likeness to be edited out of a recorded video, please contact me and I will edit the video accordingly.

Required Statement

Students may be required to disclose personally identifiable information to other students in the course, via digital tools, such as email or web-postings, where relevant to the course. Examples include online discussions of class topics, and posting of student coursework. All students are expected to respect the privacy of each other by not sharing or using such information outside the course.

Additional NC State Rules and Regulations

Your rights and responsibilities

Students are responsible for reviewing the NC State University Policies, Rules, and Regulations (PRRs) which pertain to their course rights and responsibilities, including those referenced both below and above in this syllabus:

- Equal Opportunity and Non-Discrimination Policy Statement

<https://policies.ncsu.edu/policy/pol-04-25-05>

with additional references at

<https://oied.ncsu.edu/equity/policies/>

- Code of Student Conduct

<https://policies.ncsu.edu/policy/pol-11-35-01>

- Grades and Grade Point Average

<https://policies.ncsu.edu/regulation/reg-02-50-03>

- Credit-Only Courses

<https://policies.ncsu.edu/regulation/reg-02-20-15>

- Audits

<https://policies.ncsu.edu/regulation/reg-02-20-04>

Non-Discrimination Policy

NC State University provides equality of opportunity in education and employment for all students and employees. Accordingly, NC State affirms its commitment to maintain a work environment for all employees and an academic environment for all students that is free from all forms of discrimination. Discrimination based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation is a violation of state and federal law and/or NC State University policy and will not be tolerated. Harassment of any person (either in the form of quid pro quo or creation of a hostile environment) based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation also is a violation of state and federal law and/or NC State University policy and will not be tolerated. Retaliation against any person who complains about discrimination is also prohibited. NC State's policies and regulations covering discrimination, harassment, and retaliation may be accessed at

<http://policies.ncsu.edu/policy/pol-04-25-05> or http://www.ncsu.edu/equal_op/.

Any person who feels that they have been the subject of prohibited discrimination, harassment, or retaliation should contact the NC State Office for Equal Opportunity (OEO) at 919-515-3148.

Support

Everyone is encouraged to take care of themselves and their peers. If you need additional support, there are many resources on campus to help you:

1. [Counseling Center](#)
2. [Health Center](#)
3. [Share a Concern](#)
4. [Pack Essentials](#)

Course Evaluations

ClassEval is the end-of-semester survey for students to evaluate instruction of all university classes. The current survey is administered online and includes 12 closed-ended questions and 3 open-ended questions. Deans, department heads, and instructors may add a limited number of their own questions to these 15 common-core questions.

Each semester students' responses are compiled into a ClassEval report for every instructor and class. Instructors use the evaluations to improve instruction and include them in their promotion and tenure dossiers, while department heads use them in annual reviews. The reports are included in instructors' personnel files and are considered confidential.

Online class evaluations will be available for students to complete during the last two weeks of the semester for full semester courses and the last week of shorter sessions. Students will receive an

email directing them to a website to complete class evaluations. These become unavailable at 8am on the first day of finals.

- > Contact ClassEval Help Desk: classeval@ncsu.edu
- > [ClassEval website](#)
- > [More information about ClassEval](#)

Syllabus Modification Statement

Our syllabus represents a flexible agreement. It outlines the topics we will cover and the order we will cover them in. Dates for assignments represent the earliest possible time they would be due. The pace of the class depends on student mastery and interests. Thus minor changes in the syllabus can occur if we need to slow down or speed up the pace of instruction.

• Last update: January 4th, 2024 •

This syllabus has been designed to meet the standards in REG 02.20.07 (Last Revised: May 27, 2020), found at <https://policies.ncsu.edu/regulation/reg-02-20-07/> according to the May 27, 2020 revision.
