

# LINEAR ALGEBRA

MATH-SHU 140

## 1 Course information

Semester: Fall Session - 2023 (August 28 – December 08, 2023)  
Course Name: Linear Algebra  
Course number: MATH-SHU 140  
Course Credits: 4 units  
Prerequisites: NYU SH “Calculus and Linear Algebra” placement exam,  
or a grade of C or better in MATH-SHU 9 (Precalculus).

*Course description:* This course is an introduction to linear algebra, a fundamental tool in math, as well as in a variety of other sciences such as physics, computer science, engineering, and economics. It covers both abstract theory and applications. Topics include linear systems, matrices, vector spaces, determinants, eigenvalues and eigenvectors, and orthogonality.

## 2 The team

### 2.1 Instructor Information

Name: Prof. Eric Endo  
Office: W905  
E-mail address: eoe2@nyu.edu

### 2.2 Teaching Assistant Information

Name: Dr. Andrew Shi  
Office: W902  
E-mail address: ajs1235@nyu.edu  
Name: Dr. Yizhao Zhang  
Office: W919  
E-mail address: yz9639@nyu.edu

### 2.3 Contact

Communications regarding special situations should be sent to eoe2@nyu.edu

### 3 Lectures and Recitation Hours

Lectures: Monday and Wednesday

01:15 pm – 02:30 pm      Room: QTAN N201    Section: 1

Recitations: Friday

01:15 pm – 02:30 pm      Room: QTAN E403    Section: 2

01:15 pm – 02:30 pm      Room: QTAN E402    Section: 3

All times listed in this Syllabus are in China Standard Time (CST).

### 4 Course requirements

**Required textbook:** *Linear algebra and its applications*, 5th edition, David C. Lay

**Optional textbook:** *Study guide, Linear algebra and its applications*, 5th edition, David C. Lay

### 5 Course Learning Outcomes

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

LO1: Formally define the concept of linear transformations and interpret geometrically as a matrix transformation.

LO2: Competently use matrices to find solutions of linear systems.

LO3: Compute determinants and associate with the volume of parallelepipeds.

LO4: Define Vector spaces, Null spaces, Column spaces, Row spaces, and find bases of them.

LO5: Apply coordinate system in a finite dimensional vector space to act like  $\mathbb{R}^n$ .

LO6: Compute eigenvalues and eigenvectors and diagonalize both matrices and linear transformations.

LO7: Compute inner product on  $\mathbb{R}^n$  and on vector spaces.

LO8: Apply the Gram Schmidt Process to find an orthonormal basis for any inner product space.

LO9: Find the least-squares solutions of inconsistent linear systems.

### 6 Course program and schedule

The following roadmap provisionally outlines the coverage of topics in the course.

Lecture #	Date	Topics	Textbook Sections
1	28/08	Matrix and Linear Systems	–
2	30/08	Systems of Linear Equations	1.1
3	04/09	Row Reduction and Echelon Forms	1.2
4	06/09	Vector Equations	1.3
5	11/09	The Matrix Equation $Ax = b$	1.4
6	13/09	Solution Sets of Linear Systems	1.5
7	18/09	Linear Independence	1.7
8	20/09	Linear Transformation	1.8, 1.9
9	25/09	Matrix Operations	2.1
10	27/09	The Inverse of a Matrix	2.2, 2.3
11	09/10	Determinants	3.1, 3.2
12	11/10	Cramer's Rule, Areas and Volumes	3.3
13	16/10	Vector Spaces and Subspaces	4.1
14	18/10	Review	–
–	20/10	Midterm Exam	–
15	23/10	Null Space, Column Space, Row Space	4.2
16	25/10	Linearly Independent Sets; Bases	4.3
17	30/10	Coordinate Systems, Change of Basis	4.4, 4.6
18	01/11	The Dimension of a Vector Space	4.5
19	06/11	Eigenvectors and Eigenvalues	5.1
20	08/11	Diagonalization of Matrices	5.2, 5.3
21	13/11	Diagonalization of Linear Transformations	5.4
22	15/11	Complex Eigenvalues	5.5
23	20/11	Inner Product on $\mathbb{R}^n$	6.1
24	22/11	Inner Product Spaces	6.7
25	27/11	Orthogonal Sets and Projections	6.2, 6.3
26	29/11	The Gram Schmidt Process	6.4
27	04/12	Least-Squares Problems	6.5
28	06/12	Review	–
–	–	Final Exam	–

## 6.1 Subject to Change Statement

The syllabus and course schedule may be subject to change. Changes will be communicated via email and/or in NYU-Brightspace.

**It is the students' responsibility to check email messages and course announcements in NYU-Brightspace to stay current in the phase of the course.**

## 6.2 Weekly Schedule

The course consists of two lectures and one recitation session every week, for 14 weeks. Each class lasts 75 minutes, amounting to 52.5 hours in class. Each student is enrolled in one lecture section and one recitation section. You can see your section numbers, schedule and classroom at [albert.nyu.edu](http://albert.nyu.edu). During the first two weeks there might be many adjustments.

**To avoid missing assignments, students must recheck Albert on September 04 and 11 for changes in the schedule.**

### 6.3 Lectures and Recitations

All the lectures and recitations are **mandatory** and it is the students' responsibility to attend them. The student must attend the right session (Check Albert to verify the session number).

During some lectures and recitations, the instructors will ask the students to scan QR codes to interact with the material. However, all electronic devices must be in silent mode during each class meeting. This includes phones, cameras, tablets, and laptops.

**Students are expected to actively participate in every lecture and recitation.**

## 7 Office hours

*Office hours is one of the best moment to ask questions. The student are very welcome to visit the instructors, teaching assistants, and learning assistants' office hours. It is not mandatory to attend them, but it is worth to interact with the instructors to review the learned materials.*

Office hours will be published and updated in NYU-Brightspace. Please recheck office hours every Sunday as there may be changes. If the schedule conflicts with other classes or student work shifts, students should contact the instructor who will be happy to accommodate a different time. These accommodations should take at most 30 minutes per week. Thus, we highly suggest you to prepare the questions you are interested to ask.

## 8 Academic Resources

### ARC Services

The Academic Resource Center (ARC) offers both individual, one-on-one tutoring as well as group sessions in a variety of ways, in a variety of courses. You can log on to WOnline to book an appointment with a Global Writing & Speaking Fellow or a Learning Assistant (LA). The Global Writing & Speaking Fellows conduct individual consultations on writing, speaking, reading, and academic skills coaching. LAs provide both individual and smallgroup tutoring support in over 30 STEM, Business, Economics, IMA/IMB, and Chinese Language classes. Visit [shanghai.nyu.edu/arc](http://shanghai.nyu.edu/arc) for more information about ARC services.

## 9 Grades: Assessment, Measurement and Evaluation

### 9.1 Letter Grades

Letter grades for the entire course will be assigned as follows:

Letter Grade	Percent
A	92.50% – 100%
A-	90.00% – 92.49%
B+	85.00% – 89.99%
B	80.00% – 84.99%
B-	77.50% – 79.99%
C+	72.50% – 77.49%
C	70.00% – 72.49%
C-	62.50% – 69.99%
D+	55.00% – 62.49%
D	50.00% – 54.99%
F	00.00% – 49.99%

## 9.2 Grading Evaluation Scale

NYU Shanghai follows the same grading practices as NYU New York. The following grades may be awarded: A, A-, B+, B, B-, C+, C, C-, D+, D, F. In general, A indicates excellent work, B indicates good work, C indicates satisfactory work, and D indicates passable work and is the lowest passing grade. F indicates failure. There are some additional grades – P for pass, W for withdrawal – which are awarded administratively.

## 9.3 Grade Dissemination

All grades will be published in NYU-Brightspace as punctually as possible.

## 9.4 Grading system

The grade for this course will be determined according to the following formula:

Assignments	% of Final Grade
Participation	5%
Homework	15%
Quizzes	20%
Midterm Exam	30%
Final Exam	30%

The homework and the quizzes are the average of the grade for all semester.

## 9.5 Policy of the homework

Homework will be assigned weekly (tentatively: except first week and weeks before midterm and final).

*We warmly encourage you to study in groups, but each student should work out homework problems on their own to have enough practice before taking quizzes, midterm and final. Solving exercises on your own is a crucial step in order to master both theoretical and computational aspects of the course.*

- The deadline of each homework is (tentatively) eleven days from the day that it is released (tentatively, every Wednesday).

- All the homework should be submitted via **Gradescope**.
- Students will need to upload **clear and readable scans** or photographs of their work in a **high resolution** to the platform before the deadline. **Solutions must be sent as a single pdf file.**
- Students can type up in  $\text{\LaTeX}$ (mostly, if you desire to train in  $\text{\LaTeX}$ ). Please refrain from using Word or other software not meant for scientific typesetting.
- Please, **DOUBLE-CHECK** if you are sending the right document.
- If a wrong document was sent and the student realised it after the deadline, there will be no excuse to change it, and the team will grade following the wrong document.
- The lowest homework grade will be disregarded in the computation of the final grade.

**A late submission within 48 hours of the deadline will be accepted but penalized, and no homework will be accepted after that.**

- The homework submitted within 48 hours after the deadline will be penalized by 20% of the total grade.
- No homework will be accepted 48 hours after the deadline, and the homework will earn a 0.
- The deadline of the homework will be published via NYU-Brightspace.

## 9.6 Policy of the quizzes

Four quizzes will be given throughout the semester during the recitations, on dates to be determined (tentatively: 15/09, 13/10, 10/11, and 01/12). The grades will be uploaded to Gradescope at the end of the corresponding time slot (the details will be given in NYU-Brightspace).

- The maximum total score of each of the quizzes is 20 points.
- The quizzes will be 30 minutes in length (subject to be changed) during recitations (or exceptionally during a lecture).
- All the quizzes will be taken in the beginning of the recitation.
- Quizzes will be closed textbooks, closed notes, without electronic devices, without calculators, without any consultation.
- All the quizzes will be marked via **Gradescope**.
- The lowest quiz grade will be disregarded in the computation of the final grade.

## 9.7 Policy of the midterm exam

The midterm exam will take place during the recitation session of **October 20**.

The exam will be conducted in-person and will be proctored according to the NYU policy.

- The midterm exam will cover all the material from the first half of the course (Lectures 1 to 12).
- The duration of the midterm exam will be 75 minutes in length (subject to be changed).
- The total grade of the midterm exam will be 50 points.
- The midterm exam will be closed textbooks, closed notes, without electronic devices, without calculators, without any consultation.
- The midterm exam will be marked via Gradescope.

**Bonus questions:** The midterm exam will contain bonus questions that are worth 10 points. The final grade with the additional score of the bonus questions cannot exceed 50 points. If it exceeds, the grade is 50.

## 9.8 Policy of the final exam

The final exam will take place during the final week. The final exam will be conducted in-person and will be proctored according to the NYU policy.

- The final exam will cover all the materials from Lectures 13 to 28.
- The duration of the final exam will be posted on NYU-Brightspace.
- The total grade of the final exam will be 50 points.
- The final exam will be closed textbooks, closed notes, without electronic devices, without calculators, without any consultation.
- The final exam will be marked via Gradescope.

**Bonus questions:** The final exam will contain bonus questions that are worth 10 points. The final grade with the additional score of the bonus questions cannot exceed 50 points. If it exceeds, the grade is 50.

## 9.9 Gradescope

- All the students must access Gradescope and learn how to submit assignments for the homeworks.
- All the quizzes, homeworks and exams will be marked on Gradescope.
- All the homeworks should be submitted via **Gradescope**.
- Check the NYU-Brightspace to find the **Entry Code**.
- After the grade of the quiz, homework, and exam is released, students have **one day** to request a grading review on Gradescope. After it, **requests will no longer be accepted**.

## 10 Course Policies and Student Expectations

### 10.1 Class Attendance and Participation

Attendance to all lectures and recitations is deemed mandatory.

Students must arrive before class starts and leave after it is dismissed. Students who arrive late or leave early cause unnecessary perturbations to the course development. Repeated tardiness or early departures will be noted and result in the final course grade being rounded down.

Failure to attend will not be penalized. However, if cases of poor performance are coupled with low attendance this will be used as evidence against the student, should they wish to query marks received or the ultimate passing or failure of the course. Should students fail to attend or submit any assessments or exams then a grade of 0 will be awarded with no course for retribution, unless extenuating circumstances are in play and alternative arrangements are agreed upon in advance of the assessments.

**Attendance sheet will be distributed in some lectures and/or recitations.**

Students, either as individuals or as members of student organizations are permitted to be absent from classes to participate in competitions, conferences, and presentations, either at home or out of town, as approved by the Assistant Dean for Academic Affairs provided the following conditions are met:

- All work missed must be made up to the satisfaction of the instructor concerned.
- No trip shall involve an absence of more than two days, excluding days when classes are not scheduled.
- The total number of days of absence shall not exceed six per sport or per organization annually.
- Each student will obtain an absence authorization signed by the Assistant Dean for Academic Affairs. The student will present this authorization to the instructor before the date in question. This is not an excuse for work missed.
- Making up exams: A common practice for approved absences is to have the student's teacher or supervisor proctor exams or quizzes during travel to a contest.

If students have to miss a lecture, recitation, quiz, or exam, their absence may be excused at the sole discretion of the instructor. The students must notify the instructor at [eo2@nyu.edu](mailto:eo2@nyu.edu) as soon as they are aware of the restraint, and definitely before the class or exam takes place. **The students need an extremely good reason to miss a quiz or exam.**

**Absences not communicated beforehand will not be excused under any circumstances, and the grade of the missed assignment will be 0.**

If an absence is excused and corresponds to a quiz or exam, the instructor shall decide on whether a make-up is necessary or other exams will suffice for performance assessment.

**In case the students have an excuse to arrive late, they have to send an e-mail to [eo2@nyu.edu](mailto:eo2@nyu.edu) before the class starts, as EARLY as possible.**



## 11 Library Support

### Library Services

The Library is available to support your research needs. They have access to over 27,000 print resources, 2,000 DVDs, and 1,000 databases (including over a million e-books, as well as streaming audio and video and image databases).

Librarians with expertise in your research topic are available to meet either in person or online by appointment or by email to help you navigate the research process. Our library team features experts in Business, Arts & Humanities, STEM, Social Sciences & Economics, and data tools & resources. Ask us how we can assist you in developing a research question and formulating a research strategy, to selecting databases, requesting materials, and citing your sources. Visit [shanghai.nyu.edu/library](http://shanghai.nyu.edu/library) for more information on:

- 24/7 access to e-books, e-journals, streaming media, and databases
- Booking one-on-one consultations for research help
- Asking the Library questions via chat or email

#### 11.1 University Policy on Make-up of Absence from Class due to illness

When students are ill, they are expected to notify the instructor in advance of class, if at all possible. Students should negotiate with the instructor the time and place for make-up of quizzes and/or exams missed. In cases where students are seriously ill and will miss more than a week of classes, the Office of Health and Wellness should be contacted so that the student's other professors may be contacted. The Office of Health and Wellness will not verify medical absences of under a week.

#### 11.2 Electronic devices

During the lectures and recitations, all electronic devices must be in silent mode prior to the start of each class meeting. This include phones, cameras, tablets, and laptops. If a member of the Linear Algebra team observes that the student is using the electronic device for other purposes that are not related to Linear Algebra, the team will contact the academic advisor.

**Recording the class:** photographing, filming or recording the instructor and classmates are **not allowed**.

#### 11.3 Instructional Technology

**NYU-Brightspace:** All key communication will occur via NYU-Brightspace. This includes any important announcements regarding the course.

**E-mail:** Any personal communication between the instructor and any given student will occur via e-mail.

#### 11.4 Academic Honesty/Plagiarism

All graded assessments are necessarily individual pursuits. In any case of academic misconduct (e.g. plagiarism, access to contraband) there may be a hearing and the university has the discretion to award a mark of 0% for any given assessment. All quizzes and exams are taken in-person.

**Collaboration between students on the quizzes and exams is strictly forbidden.**

### **11.5 Disability Disclosure Statement**

Academic accommodations are available for students with disabilities. Please contact the Moses Center for Students with Disabilities (212-998-4980 or mosescsd@nyu.edu) for further information. Students who are requesting academic accommodations are advised to reach out to the Moses Center as early as possible in the semester for assistance.

### **11.6 Title IX Compliance**

From the NYU Title IX website: “Title IX of the Education Amendments of 1972 (Title IX) prohibits discrimination on the basis of sex in educational programs. It protects victims of sexual or gender-based bullying and harassment and survivors of gender-based violence. Protection from the discrimination on the basis of sex includes protection from being retaliated against for filing a complaint of discrimination or harassment. NYU is committed to complying with Title IX and enforcing University policies prohibiting discrimination on the basis of sex.” Mary Signor, Executive Director of the Office of Equal Opportunity, serves as New York University’s Title IX Coordinator. The University’s Title IX Coordinator is a resource for any questions or concerns about sex discrimination, sexual harassment, sexual violence, or sexual misconduct and is available to discuss your rights and judicial options. University policies define prohibited conduct, provide informal and formal procedures for filing a complaint and a prompt and equitable resolution of complaints.

#### **Links to the Title IX Policy and related documents:**

- Sexual Misconduct, Relationship Violence, and Stalking Policy
- Resource Guide for Students
- Resource Guide for Employees
- Procedures for Complaints Against Students
- Procedures for Complaints Against Employees