

MTH 309 – Fall 2022 Syllabus

Lecture Information (16878):

Credit hours: 4

Instructor: Richard Hollister (He, Him, His)

Classroom: Clemens 17 (in the basement)

Class time: Tuesdays and Thursdays 12:30 – 1:50 PM

Final Exam: Thursday, December 15th at 11:45 AM

Office hours: Thursdays 2:00 – 4:00 PM

Office location: 321 Math Building (third floor)

Text book: “Introduction to Applied Linear Algebra: Vectors, Matrices, and Least Squares” by Boyd and Vandenberghe. You can find the book at <https://web.stanford.edu/~boyd/vmls/> for free as a downloadable PDF.

Learning Goals:

- Construct a system of linear equations from an application.
- Represent a system of linear equations in matrix form.
- Solve a system that is presented as either a system of equations or a matrix equation.
- Determine if a given set of vectors is a subspace of \mathbb{R}^n .
- Find a basis for a given subspace of \mathbb{R}^n and determine its dimension.
- Find a matrix representation of a linear transformation between \mathbb{R}^n and \mathbb{R}^m .
- Add, multiply, transpose matrices.
- Determine if a matrix is invertible.
- Identify if a transformation or matrix is orthogonal.
- Construct a QR factorization of a matrix and use it to solve the corresponding system.
- Identify if a given set of vectors is orthogonal.
- Construct an orthonormal basis for a given subspace.
- Compute the orthogonal projection of a vector onto a subspace.
- Calculate the area of a parallelogram using determinant.
- Understand how determinant is related to linear transformations.
- Calculate the eigenvalues and eigenvectors of a matrix.
- Understand the connection between eigenvalues/vectors and systems of LODEs.
- Solve the least squares problem.
- Compute the singular value decomposition.
- Understand how to use computer software to do the above.

Instructor Information:

I am a mathematician specializing in linear algebra research. I also have an interest in numerical analysis and approximation theory.

This is my third year at UB, and I am looking forward to teaching linear algebra. I am also teaching MTH 337, so I am quite familiar with Python if you have any questions.

Outside of academics, I enjoy hiking, biking, snowboarding, XC skiing, and playing MMORPGs on my Xbox.

Recitation Information:

Instructor: Matthew Rantanen

Recitation 16879: Thursdays 9:30 – 10:20 AM in Norton 209

Recitation 16880: Thursdays 11:00 – 11:50 AM in Hochstetter 307

Instructor office hours: Tuesdays and Wednesdays 3:00 – 4:00 PM in 130 Math Building

Grade Information:

Grades will be calculated as follows:

Homework	Recitation Participation	Proficiency Exams	Final Exam
20%	10%	50%	20%

Using a 4-pt grade scale.

A	A-	B+	B	B-	C+	C	C-	D+	D	F
3.8 – 4.0	3.5 – 3.8	3.2 – 3.5	2.8 – 3.2	2.5 – 2.8	2.2 – 2.5	1.8 – 2.2	1.5 – 1.8	1.2 – 1.5	0.8 – 1.2	0.0 – 0.8

Homework: We will be using [UBx](#) for homework. There will be seven homework assignments, each broken up into two parts. You will be expected to do one part each week, but assignments will be due every other week. The lowest homework assignment grade will be dropped.

UBx uses Python to automatically generate and grade questions. There are also questions that will require you to do a little programming yourself using Jupyter Notebook. In order to answer these questions, you will need to download and install the latest version of [Anaconda](#). Don't worry, any programming you will need to do will be thoroughly explained in the question.

Recitation Participation: Participation will be evaluated by the TA on a weekly basis.

Proficiency Exams: Exams in this class will be handled differently than what you may be used to. Instead of having a handful of long exams covering multiple chapters of material, we will

have short exams **during the first 30 minutes of every Thursday class**, every other week covering only the material from those two weeks.

These exams will be graded on a pass/fail basis, and you will need to score a 2.5 (out of 4) on the exam to pass. If you fail a proficiency exam, you will have the opportunity to take it again, up to two more times. This means you will have three opportunities to take each proficiency exam. **The retakes will be during the first 30 minutes of class on Tuesdays.**

Your aggregate score for the proficiency exams portion of the final grade will be the average of the individual exams grades (4.0 for passing, 0.0 for failing). There will be a total of seven proficiency exams, so to get a C (for the exam portion of the grade), **you must pass at least four** of the seven proficiency exams.

Final Exam: We will also have a final exam that will be cumulative. The final exam will take place on Thursday 12/15 at 11:45 AM, and you will be given two hours to complete it.

Topics by Week (tentative):

Week (with dates)	Topics, HW schedule, Proficiency Exams
Week 1 (Aug 29 – Sep 2)	Systems of linear equations and solutions <i>Wed:</i> UBx Intro
Week 2 (Sep 6 – Sep 9)	System matrices and applications <i>Wed:</i> HW 1 <i>Thurs:</i> Proficiency Exam 1
Week 3 (Sep 12 – Sep 16)	Vector spaces and subspaces <i>Tues:</i> Proficiency Retake 1 <i>Wed:</i> HW 2 (Part 1)
(Sep 19 – Sep 23)	Basis and dimension <i>Tues:</i> Proficiency Retake 1 <i>Wed:</i> HW 2 (Part 2) <i>Thurs:</i> Proficiency Exam 2
(Sep 26 – Sep 30)	Linear transformations and matrices <i>Tues:</i> Proficiency Retake 2 <i>Wed:</i> HW 3 (Part 1)
(Oct 3 – Oct 7)	1-1 and onto <i>Tues:</i> Proficiency Retake 2 <i>Wed:</i> HW 3 (Part 2) <i>Thurs:</i> Proficiency Exam 3
(Oct 10 – Oct 14)	Matrix algebra <i>Tues:</i> Proficiency Retake 3 <i>Wed:</i> HW 4 (Part 1)
(Oct 17 – Oct 21)	More with matrices and applications <i>Tues:</i> Proficiency Retake 3 <i>Wed:</i> HW 4 (Part 2) <i>Thurs:</i> Proficiency Exam 4

(Oct 24 – Oct 28)	Vector geometry (norms and inner products) <i>Tues:</i> Proficiency Retake 4 <i>Wed:</i> HW 5 (Part 1)
(Oct 31 – Nov 4)	Orthogonality <i>Tues:</i> Proficiency Retake 4 <i>Wed:</i> HW 5 (Part 2) <i>Thurs:</i> Proficiency Exam 5
(Nov 7 – Nov 11)	The determinant <i>Tues:</i> Proficiency Retake 5 <i>Wed:</i> HW 6 (Part 1)
(Nov 14 – Nov 18)	Eigenvalues, Eigenvectors, and Systems of LODEs <i>Tues:</i> Proficiency Retake 5 <i>Wed:</i> HW 6 (Part 2) <i>Thurs:</i> Proficiency Exam 6
(Nov 21 – Nov 22)	Least squares problems <i>Tues:</i> Proficiency Retake 6 <i>Wed:</i> HW 7 (Part 1)
(Nov 28 – Dec 2)	Singular value decomposition <i>Tues:</i> Proficiency Retake 6 <i>Wed:</i> HW 7 (Part 2) <i>Thurs:</i> Proficiency Exam 7
(Dec 5 – Dec 9)	Review <i>Tues:</i> Proficiency Retake 7 <i>Thurs:</i> Proficiency Retake 7
(Dec 12 – Dec 16)	Final Exam, Thursday 12/15/22 at 11:45 AM

Proficiency Exams and HW Assignments by Topic:

Exam 1	Systems of linear equations, solutions of systems, matrix equations, applications.
Exam 2	Vector spaces, subspaces, basis, dimension.
Exam 3	Linear transformations.
Exam 4	Matrix algebra, applications.
Exam 5	Vector geometry, norms, inner products, orthogonality.
Exam 6	The determinant, eigenvalues and eigenvectors, systems of LODEs.
Exam 7	Linear least squares, SVD, applications.

Academic Integrity:

Academic integrity is critical to the learning process. It is your responsibility as a student to complete your work in an honest fashion, upholding the expectations your individual instructors have for you in this regard. The ultimate goal is to ensure that you learn the content in your courses in accordance with UB's academic integrity principles, regardless of whether instruction is in-person or remote. Thank you

for upholding your own personal integrity and ensuring UB's tradition of academic excellence. The academic integrity policy is available at buffalo.edu/academic-integrity.

Accessibility Resources:

If you have any disability which requires reasonable accommodations to enable you to participate in this course, please contact the Office of Accessibility Resources in 60 Capen Hall, 716-645-2608 and also the instructor of this course during the first week of class. The office will provide you with information and review appropriate arrangements for reasonable accommodations, which can be found on the web at: <http://www.buffalo.edu/studentlife/who-we-are/departments/accessibility.html>.

Public Health Compliance in Classroom setting:

As indicated in the [Student Compliance Policy for COVID-19 Public Health Behavior Expectations](#), in our classroom you are required to:

1. Students are required to obtain and wear a high-quality, tight-fitting, high-filtration mask when aboard a UB bus or shuttle or in a clinical health care setting in accordance with current [health and safety guidelines](#). Masks indoors and in other public campus settings are optional.
2. Stay home if you are sick.
3. Abide by New York State, federal and Center for Disease Control and Prevention (CDC) travel restrictions and precautionary quarantines.
4. Follow campus and public health directives for isolation or quarantine.
5. Should you need to miss class due to illness, isolation or quarantine, you are required to notify the course instructor and make arrangements to complete missed work.
6. You are responsible for following any additional directives in settings such as labs, clinical environments etc.

Students who are not complying with the public health behavior expectations will be asked to comply. Should the non-compliant behavior continue, course instructors are authorized to ask the student to leave the classroom. Non-compliant students may also be referred to the Office of Health Promotion to participate in an online public health class to better educate them on the importance of these public health directives for the entire community.

Sexual Violence

UB is committed to providing a safe learning environment free of all forms of discrimination and sexual harassment, including sexual assault, domestic and dating violence and stalking. If you have experienced gender-based violence (intimate partner violence, attempted or completed sexual assault, harassment, coercion, stalking, etc.), UB has resources to help. This includes academic accommodations, health and counseling services, housing accommodations, helping with legal protective orders, and assistance with reporting the incident to police or other UB officials if you so choose. Please contact UB's Title IX Coordinator at 716-645-2266 for more information. For confidential assistance, you may also contact a Crisis Services Campus Advocate at 716-796-4399.

Mental Health

As a student you may experience a range of issues that can cause barriers to learning or reduce your ability to participate in daily activities. These might include strained relationships, anxiety, high levels of stress, alcohol/drug problems, feeling down, health concerns, or unwanted sexual experiences.

Counseling, Health Services, and Health Promotion are here to help with these or other issues you may experience. You can learn more about these programs and services by contacting:

Counseling Services:

120 Richmond Quad (North Campus), 716-645-2720

202 Michael Hall (South Campus), 716-829-5800

Health Services:

4350 Maple Rd, Amherst, NY 14226, 716-829-3316

Health Promotion:

114 Student Union (North Campus), 716-645-2837