MTH 420 – Abstract Linear Algebra

Course Syllabus

Course information

Catalog description: Topics in advanced linear algebra.

Credits: 4

Section number: TBA

Section format: Lecture

Class times: MWF 1:00 – 1:50 PM

Class location: 150 Math Building

Textbook: "Linear Algebra" by Hoffman and Kunze, second edition.

Instructor information

Instructor: Richard Hollister Ph.D. (He, Him, His)

Email: rahollis@buffalo.edu

Office hours: MWF 2:00 – 3:00 PM

Office location: 326 Math Building

About me: I graduated with my PhD in Mathematics from Western Michigan University in 2020. My research interests include Linear Algebra, Matrix Theory, and Numerical Analysis. This is my second year as a visiting Assistant Professor here at UB, and I am teaching MTH 420 and MTH 337 this semester. Outside of academics, I enjoy teaching snowboarding at all skill levels and coaching track and field.

Lecture information

Grades

Grades will be distributed as follows:

Homework	Reading Quizzes	Final Project
60%	15%	25%

Grades will be available to view online here, and will be listed by the alias you have given me in the course survey. If you have not given me an alias, I will not list your grades in the online document. Class notes will be available online here.

Homework

Homework will consist of weekly problem sets from the book, due at the beginning of lecture every Friday. The homework will be graded on a 4-pt scale. Homework assignments can be found each week by following the link to the online notes. The two lowest homework grades will be dropped at the end of the semester.

Quizzes

Each recitation period will begin with a short reading quiz covering topics and definitions from the previous week's lectures. Quizzes will be graded on a 4-pt scale, and the lowest two quiz grades will be dropped at the end of the semester to compensate for circumstances out of your control that may cause you to miss recitation.

Final Project

We will not have any exams or a final exam in this course. Instead, you will be required to write an in-depth survey paper exploring an advanced application of linear algebra. This paper will be due on the last day of classes. Some examples of possible topics include

- Artificial Intelligence,
- Quantum Physics,
- Data Science,
- Network Analysis.

Some important dates regarding the survey paper:

Topic Choice deadline	Outline due	Draft due	Final paper due
February 25	March 18	April 18	May 13

A portion (10%) of the grade of the final paper will be based on meeting these deadlines.

Recitation information

17901

Instructor: Jiseong Kim

Meeting time: T 5:00 – 5:50 PM

Meeting location: 88 Alumni Building

Office hours: 2:00 – 4:00 PM in 125 Math Building

24215

Instructor: Jiseong Kim

Meeting time: R 5:00 – 5:50 PM

Meeting location: 88 Alumni Building

Office hours: 2:00 – 4:00 PM in 125 Math Building

Additional information

Important dates

- Jan 31: first day of classes
- Feb 7: last day to add/drop
- March 21 – March 25: Spring recess
- April 22: Last day to resign
- May 13: Last day of classes

COVID-19 policies

Due to the continuing COVID-19 pandemic, high-quality masks must be worn at all times during class. If I notice that you do not have a mask on, I will ask you to either put one on or leave the classroom. Please make sure your mask covers both your mouth and nose and fits tightly on your face without gaps between your mask and your face. I may ask you to leave the classroom if your mask does not fit tightly. As per University policy, cloth masks, scarves, bandanas, etc. do not count as high-quality masks, please use an N95 or KN95 or similar mask. For more information at the pandemic health and safety policies, please see the Health and Safety Guidelines.

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 here.

Collaboration is encouraged on homework assignments, but **each student must write up the solutions to each problem on their own**. This means you can discuss the homework problems with each other, but you must solve the problems yourself. Quizzes must be completed one your own and without notes, formula cards, or technology, unless specified elsewise. Any student found to be in violation of academic integrity will receive a zero on the assignment or quiz in question.

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 here.

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 3 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:

- Michael Hall (South Campus), 716-829-3316

Health Promotion:

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

UB portfolio

If you are completing this course as part of your UB Curriculum requirements, please select an 'artifact' from this course that is representative of your learning and save it in a safe location with a clear title. Your final UB Curriculum requirement, UBC 399: UB Curriculum Capstone, will require you to submit these 'artifacts' as you process and reflect on your achievement and growth through the UB Curriculum. Artifacts include homework assignments, exams, research

papers, projects, lab reports, presentations, and other coursework. For more information, see the UB Curriculum Capstone website here.

Learning goals

- Gain a working knowledge of advanced topics in linear algebra such as matrix similarity, matrix equivalence, canonical forms, etc.
- Become proficient at comprehending mathematical writing, and communicating mathematics through writing.
- Become proficient with mathematical proof techniques.
- Understand the importance of linear algebra to applications in other areas of mathematics and in other subjects.

Learning outcomes

- Fundamentals of linear algebra: linear systems, vector spaces, norms, inner products, determinant.
- Special matrices and matrix groups: symmetric, skew-symmetric, orthogonal/unitary.
- Matrix similarity, eigenvalue decomposition, (real-)Jordan canonical form. Characteristic and minimal polynomials and rational canonical form.
- Matrix equivalence, SVD, reduced SVD, matrix norms, low-rank approximations.
- Matrix computation theory, unitary similarity and Schur triangularization, QR decomposition and linear systems, quadratic forms and minimax calculation of eigenvalues.