Matrix Alegbra

Syllabus

Instructor

Instructor: Dr. Greg Mayer

Course Description:

This course takes you through roughly three weeks of MATH 1554, Linear Algebra, as taught in the School of Mathematics at The Georgia Institute of Technology.

Your ability to apply the concepts that we introduced in our previous linear algebra course is enhanced when you can perform algebraic operations with matrices. At the start of this class, you will see how we can apply the Invertible Matrix Theorem to describe how a square matrix might be used to solve linear equations. This theorem is a fundamental role in linear algebra, as it synthesizes many of the concepts introduced in the first course into one succinct concept.

You will then explore theorems and algorithms that will allow you to apply linear algebra in ways that involve two or more matrices. You will examine partitioned matrices and matrix factorizations, which appear in most modern uses of linear algebra. You will also explore two applications of matrix algebra, to economics and to computer graphics.

Students taking this class are encouraged to first complete the first course in this series, linear equations.

Course Learning Outcomes

- Apply matrix algebra, the matrix transpose, and the zero and identity matrices, to solve and analyze matrix equations.
- Apply the formal definition of an inverse, and its algebraic properties, to solve and analyze linear systems.
- Characterize the invertibility of a matrix using the Invertible Matrix Theorem.
- Apply partitioned matrices to solve problems regarding matrix invertibility and matrix multiplication.
- Compute an LU factorization of a matrix and apply the LU factorization to solve systems of equations.
- Apply matrix algebra and inverses to solve and analyze Leontif Input-Output problems.

- Construct transformation matrices to represent composite transforms in 2D and 3D using homogeneous coordinates.
- Construct a basis for a subspace.
- Calculate the coordinates of a vector in a given basis.
- Characterize a matrix using the concepts of rank, column space, and null space.
- Apply the Rank, Basis, and Matrix Invertibility theorems to describe matrices, subspaces, and systems.

Topics Covered

- Matrix Operations
- Inverse of a Matrix
- Invertible Matrices
- Partiioned Matrices
- The LU Factorization
- The Leontif Input-Output Model
- Computer Graphics
- Subspaces
- Dimension and Rank

Grades

Final grades are calculated using the following grade weighting.

Module 1 Quiz	20%
Module 2 Quiz	20%
Module 3 Quiz	20%
Final Exam	40%

A passing grade is 70% and above.

Attendance Policy

- This is a fully online course.
- Log in on a regular basis to complete your work, so that you do not have to spend a lot of time reviewing and refreshing yourself regarding the content.

Plagiarism Policy

Plagiarism is considered a serious offense. You are not allowed to copy and paste or submit materials created or published by others, as if you created the materials. All materials submitted and posted must be your own. Any background materials you use should be cited.

Quizzes and Test Procedures

The purpose of the Module Quizzes to help students gain a deeper understanding of course concepts, and help students become more aware of their level of understanding of course material. Solutions to Module Quizzes will be provided to students.
The Final Exam is a summative assessment: the purpose of the Final Exam is to help students become more aware of their level of understanding of course material, and to assess student learning.

Students will have unlimited attempts to take each quiz. Students will have 30-minutes to take each quiz each time they start an attempt. Students will have 60 minutes to take the Final Exam after they have started it, and will have unlimited attempts.

Student Honor Code

All Audit and Verified learners are expected and required to abide by the letter and the spirit of the edX honor code.

- Ethical behavior is extremely important in all facets of life.
- Review the edX Honor Code https://www.edx.org/edx-terms-service
- You are responsible for completing your own work.
- Any learners suspected of behavior in violation of the Honor Code will be subject to any/all of the actions listed in the edX Honor Code.

Communication

All learners should ask questions, and answer their fellow learners' questions, on the course discussion forums. Often, discussions with fellow learners are the sources of key pieces of learning.

Netiquette

- Netiquette refers to etiquette that is used when communicating on the Internet. When you are communicating via email, discussion forums or synchronously (real-time), please use correct spelling, punctuation and grammar consistent with the academic environment and scholarship.

- We expect all participants (learners, faculty, teaching assistants, staff) to interact

respectfully. Learners who do not adhere to this guideline may be removed from the course.

Course Schedule

Module	Topic	Lesson
Module 1: Matrices and The Matrix Inverse	Topic 1: Matrix Operations	Lesson 1: Matrix Addition and Scalar Multiplication
		Lesson 2: Matrix Multiplication
		Lesson 3: Matrix Transpose and Powers
	Topic 2: Inverse of a Matrix	Lesson 1: The inverse of a 2x2 matrix
		Lesson 2: The Inverse of an *nxn* Matrix
		Lesson 3: Elementary Matrices
Module 2: The Invertible Matrix Theorem and Applications	Topic 1: Invertible Matrices	Lesson 1: The Invertible Matrix Theorem
	Topic 2: Application: Partitioned Matrices	Lesson 1: Partitioned Matrices and Matrix Multiplication
		Lesson 2: Partitioned Matrices and the Matrix Inverse
	Topic 3: Application: The LU Factorization	Lesson 1: Solving Linear Systems with the LU Factorization
		Lesson 2: Computing the LU Factorization
	Topic 4: Application: The Leontif Input-Output Model	Lesson 1: The Leontif Input-Output Model
Module 3: Computer Graphics and Subspaces	Topic 1: Computer Graphics	Lesson 1: Homogeneous coordinates
		Lesson 2: 3D Transformations
	Topic 2: Subspaces of R^n	Lesson 1: Subsets and Subspaces
		Lesson 2: Column Space and Null Space
		Lesson 3: Basis of a Subspace
	Topic 3: Dimension and Rank	Lesson 1: Coordinate Systems
		Lesson 2: The Dimension of a Susbpsace
		Lesson 3: Rank and Invertibility

Course Materials

- All content and course materials can be accessed online
- There is no required textbook but students may find the following textbook a helpful companion to the course: Interactive Linear Algebra, by D. Margalit and J. Rabinoff. The textbook is available as a downloadable PDF in the course.

Technology/Software Requirements

- Internet connection (DSL, LAN, or cable connection desirable)
- Adobe Acrobat PDF reader (free download; see https://get.adobe.com/reader/