

# Introduction to Linear Algebra

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## 1 Course Overview

Welcome to the Introduction to Linear Algebra course. This course is designed for first-semester mathematics students and will cover essential topics in linear algebra over ten weeks, followed by a week of revision before the final assessment.

### 1.1 Teaching Team

The teaching team consists of:

- Andreas Grotto - Specializes in applied mathematics and optimization.
- Cordelia - Focuses on geometric aspects of mathematics.
- Eric Horman - Background in physics and network analysis.

## 2 Course Structure

The course is structured as follows:

- **Pre-reading:** Students are expected to complete assigned readings from the course textbook before lectures.
- **Lectures:** Held on Thursdays and Fridays, these interactive sessions will utilize a flipped classroom approach.
- **Reading Quizzes:** Online quizzes will be conducted on Mondays to assess understanding of the reading material.
- **Workshops:** Held on Tuesdays, these sessions will involve problem-solving with a tutor.
- **Assessed Quizzes:** At the end of each week, quizzes will assess comprehension of the week's topics.

## 2.1 Assessment Breakdown

The course assessment consists of:

- Weekly quizzes (40%)
- Hand-in assessments (30%)
- Synoptic assessment covering the entire course (30%)

To pass the course, a weighted average of 40% across all components is required.

## 3 Flipped Classroom Approach

The flipped classroom model requires students to prepare for lectures by completing readings and engaging with the material beforehand. During lectures, students will have opportunities to ask questions and discuss concepts with peers.

## 4 Introduction to Linear Algebra

Linear algebra primarily deals with vectors and matrices. The course will cover:

- Solving linear equations
- Understanding vector spaces
- Matrix operations and transformations
- Eigenvalues and eigenvectors

### 4.1 Key Concepts

- **Linear Equations:** Equations of the form  $ax + by = c$ , where  $a$ ,  $b$ , and  $c$  are constants.
- **Vector Spaces:** A collection of vectors that can be added together and multiplied by scalars.
- **Matrices:** Rectangular arrays of numbers that represent linear transformations.

## 5 Applications of Linear Algebra

Linear algebra has numerous applications across various fields:

- **Computer Graphics:** Ray tracing in video games relies heavily on linear algebra for rendering images.
- **Machine Learning:** Techniques such as Principal Component Analysis (PCA) and Singular Value Decomposition (SVD) are based on linear algebra concepts.
- **Network Analysis:** Graphs can be represented as matrices, allowing for the analysis of connections and communities within networks.

## 5.1 Example: Google PageRank

The PageRank algorithm, which ranks web pages in search results, is based on eigenvalue decomposition of matrices representing the web's link structure.

## 6 Support and Resources

Students are encouraged to utilize available resources:

- **Workshops:** Engage with tutors and peers to deepen understanding.
- **Math Base:** A drop-in center for additional help.
- **Online Forum (Piazza):** A platform for asking questions and sharing knowledge.

## 7 Conclusion

This course aims to build a solid foundation in linear algebra, equipping students with essential skills for future mathematical studies. Students are encouraged to actively participate, seek help when needed, and engage with the material to succeed.