

# Linear Algebra Research Project

Linear Algebra

Fall 2019

## Description of Project

For the project, choose a topic of your interest that utilizes the concepts from linear algebra. Together with your group you should research the topic, prepare a well written exposition, and a 6-minutes presentation. Further description will be given during class.

## Timeline

- Topics must be selected and approved by October 23<sup>rd</sup>  
(A group may select its own topics or get a topic from the instructor).
- Outline due October 30<sup>th</sup>
- First Draft due November 8<sup>th</sup> at midnight
- Presentations on December 2<sup>nd</sup> and 4<sup>th</sup>
- Final Draft due December 6<sup>th</sup> at midnight

## Topic Selection and Instructor Consultation

You need to select a group leader; that person will schedule a meeting with the instructor on October 21<sup>st</sup>, 22<sup>nd</sup>, or 23<sup>rd</sup>. You should have an idea for your topic, as well as a 20 second oral proposal of what you would like to research and how you hope to relate this course to the content in other courses you've studied previously.

## Exposition Organization

- Introduction
- Context
- Main points of the paper
- Concluding remarks
- Bibliography

## Other Specifications

- The write-up should be 4-8 pages.
- This is a group project (minimum 2; maximum 4 people).
- The project should be typed and saved as a PDF,
  - The paper must look good. While not required, you are highly encouraged to use LaTeX.
  - The penalty for incorrect submission format is 20% of the maximum score.
- Cite any sources that you use – plagiarism will result in a 0% grade.
- The project is due on Blackboard on [see above] at midnight. Assignments submitted late will receive a late penalty of 0.4% per hour.

**Paper Outline**

You should have a scaffold of what the paper will look like. Your outline should fill in key details and references. The idea is that I want to see that you have a roadmap for researching and writing the first draft.

**Frist Draft**

The first draft should be a completed first draft. It is graded on the exact same criteria as the final draft. A “rough draft” that is trash will be traded accordingly. This is not a rough draft. It is a first draft of the final project.

**Final Draft**

The completed final project

**Presentation**

See rubric for grading criteria.

- Maximum 6 minute time limit.
- Up to 2 minutes for questions afterward.
- Every group member must have a speaking role in the presentation.

## Sample Project Topics

You do not need to choose a topic from this list; it is here just for reference. Any application of linear algebra is acceptable.

### *Business/industry applications*

- Purchasing or scheduling multipurpose machines.
- Optimizing production of products that use multiple supplies.
- Comparing business model options.
- Movement of robotic arms
- Predicting future customer base

### *Logistics application*

- Reconstructing traffic flow from incomplete data

### *Environmental applications*

- Predator-prey modeling

### *Economics applications*

- Input-output modeling

### *Physics applications*

- Analyzing electrical networks
- Analyzing forces
- Rotating images
- Reference angles and choice of coordinates
- Projections
- Optics
- Acoustics
- Mixtures

### *Prediction*

- Predicting future weather patterns
- Predicting population growth

### *Mathematical applications*

- Volume of a deformed shape
- Cryptography: the Hill cypher
- Systems of first order linear differential equations
- Polyomino tiling
- Coding theory: linear codes
- QR Factorization
- Quadratic Forms
- Function Representation
- Curve Fitting
- Linear Programming (Optimization technique)
- Adjacency matrices (graph theory)

### *Computer Science applications*

- Cryptography: the Hill cypher
- Image Compression
- Ray Tracing