Linear Algebra Research Project

Linear Algebra
Spring 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 March 27th
  (A group may select its own topics or get a topic from the instructor).
- Outline due April 4th
- First Draft due April 12th at midnight
- Presentations on April 23rd and April 25th
- Final Draft due April 26th at midnight

Topic Selection and Instructor Consultation

You need to select a group leader; that person will schedule a meeting with the instructor on March 25th, 26th, or 27th. 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 [TBA] 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