Linear Algebra Project

Fall 2017

Due Dates

Project Presentations: December 4th and 6th, 2017 during class hours. Each group gets 10 minutes for presentation and Q&A.

Presentation Slides: You will have to upload your (Microsoft PowerPoint or Google Slides) as a PDF to Blackboard before your presentation.

1-Page Executive Summary Report & One Complete Report (4 to 6 pages): You will have to upload these as a PDF to Blackboard by 11:59pm on December 7th

General Description

For the project, choose a topic of your interest, preferably from your major field, for which you should use the concepts from Linear Algebra & Matrices to model and to analyze the results. The project requires you to synthesize all the material from the course. Hence, it's one of the best ways to solidify your understanding of Linear Algebra & Matrices. Your project will be presented through an oral presentation, in a report form of at least 4 pages and a 1-page executive summary report. Groups cannot have more than 4 people. You should get started on the project as early as possible.

Project Grading Guidelines

Your project will be graded based on the following characteristics (using the accompanying rubric):

- Individual contribution and understanding of the entire project
- Presentation (contents, results, conclusions, time-limit, and answering questions)
- Report (Structure and content) + 1 page summary

Some suggestions for scoring high on these criteria, and suggestions you should keep in mind whenever you write anything:

- Be selective with computer output (figures) to help clarity.
- If you are using techniques we learned in class, you do not have to re-explain the techniques.
- If you are using techniques that we did not cover in class, you should definitely explain the techniques.
- Use the equation builder in Office, or use LaTeX to typeset math symbols, expressions, and equations. DON'T USE IMAGES FOR SYMBOLS, TABLES, AND EQUATIONS.

Guidelines for Making an Impressive Complete Report

An impressive final report communicates your project in a clear and concise fashion. The report should address the following points:

- ***Title:*** As short as possible (one sentence and not more than one line) for your project (e.g. Image reconstruction using matrices)

- ***Abstract:*** Describe the questions you address and any key issues surrounding the questions and what have you done in the project.
- ***Introduction:*** Describe the context of your problem, motivation, and importance.
- ***Analyses:*** Describe the analyses you did, especially, the linear algebra concepts you used in your project. Be ready to explain why you believe these methods are justified.
- ***Results:*** Present your results. Include tables and/or graphs that support your analyses (be judicious here--too many tables and graphs hurts the clarity of your message).
- ***Discussion & Future Work:*** Discuss your results in plain English (without any mathematics). Explain how linear algebra helped you solved the problem. What could be done to improve your project if someone wants to continue or extend it in the future?
- ***Conclusions:*** Conclude your findings, importance of the model and its limitations.
- ***References:*** Relevant references.

Guidelines for Making an Impressive 1-Page Summary

- Title: As short as possible (one sentence and not more than one line) for your project
- Description, results (may include some math equations & one figure), and conclusions in two or three paragraphs.
- See the AMS posters in classroom notice board (on the left of the main whiteboard)

Some Ideas for 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