

# MMAE 500: Data Driven Modeling

## Homework 1

Assigned: 15 Jan 2023

Due: 25 Jan 2023

**Homework is to be submitted on Blackboard. Please submit your answers and code/working/reasoning. If you use an AI assistance tools, please show your work by providing prompts that you used and responses that were generated.**

1. Consider the data contained in the file data.txt. This file contains a two-dimensional array with 3 columns.
  - (a) Which column is the largest with respect to the  $l_1$  norm?
  - (b) Which column is the largest with respect to the  $l_2$  norm?
  - (c) Which column is the largest with respect to the  $l_\infty$  norm?
2. Consider the data generated by the file hw1Q2.m (in Matlab) or hw1Q2.ipynb (Python notebook), which is assembled into the matrix  $X$ . Each row of  $X$  corresponds to a spatial location, while each column corresponds to a time.
  - (a) Compute the *Frobenius norm* of this matrix (this is the norm of a matrix that was discussed briefly in Lecture 2). You are welcome to use inbuilt functions in Matlab and Python for this.
  - (b) Reshape the data into a single vector, and compute the (standard) norm of this vector. Verify that you obtain the same answer as part (a).
  - (c) We will now consider the column vectors of  $X = [\mathbf{x}_1, \mathbf{x}_2, \dots, \mathbf{x}_n]$ , where  $\mathbf{x}_i$  denotes the  $i$ -th column of  $X$ . Write code to find the index  $i > 1$  that minimizes  $\|\mathbf{x}_i - \mathbf{x}_1\|$ .
  - (d) Find the index  $i > 1$  that maximizes the (standard) inner product  $\langle \mathbf{x}_i, \mathbf{x}_1 \rangle$ . How does this compare with part (c)? Plot  $\mathbf{x}_1$  and this  $\mathbf{x}_i$  against the spatial coordinate,  $y$ , on the same plot.