Assignment 0

This assignment is to be done individually.

Important Note: The university policy on academic dishonesty (cheating) will be taken very seriously in this course. You may not provide or use any solution, in whole or in part, to or by another student.

You are encouraged to discuss the concepts involved in the questions with other students. If you are in doubt as to what constitutes acceptable discussion, please ask! Further, please take advantage of office hours offered by the instructor and the TA if you are having difficulties with this assignment.

DO NOT:

• Give/receive code or proofs to/from other students

• Use Google to find solutions for assignment

DO:

• Meet with other students to discuss assignment (it is best not to take any notes during such meetings, and to re-work assignment on your own)

• Use online resources (e.g. Wikipedia) to understand the concepts needed to solve the assignment.

Submitting Your Assignment

The assignment must be submitted online on Canvas. You must submit a report in **PDF format**. You may typeset your assignment in LaTeX or Word, or submit neatly handwritten and scanned solutions. We will not be able to give credit to solutions that are not legible.

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1 Linear Algebra

a) Find the inverse of the following matrices:

$$A = \begin{bmatrix} 2 & 0 \\ 0 & 0.5 \end{bmatrix} \qquad B = \begin{bmatrix} 4 & 3 \\ 2 & 1 \end{bmatrix} \qquad C = \begin{bmatrix} 1 & -2 \\ -2 & 1 \end{bmatrix}$$

b) Compute BC and CB.

c) Find the eigenvalues and eigenvectors of C.

2 Calculus

Suppose $\vec{x} = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \in \mathbb{R}^2$. Furthermore, define a function $f(\vec{x}) = \vec{x}^\top A \vec{x}$, where $A = \begin{bmatrix} 4 & 2 \\ 2 & 0 \end{bmatrix}$.

a) Compute $\frac{\partial f}{\partial x_1}(1, 3)$ and $\frac{\partial^2 f}{\partial x_2 \partial x_1}(2, 4)$.

b) Compute the gradient and Hessian of $f(\vec{x})$.

3 Probability

Let X be the random variable representing the outcome of rolling a fair die (equal probability to roll the integers 1 to 6 inclusive).

a) Write down the probability mass function (pmf) and cumulative distribution function (cdf) for X.

b) What is $P(X = 1 | X \text{ is odd})$?

c) Let S be the summation of outcomes of rolling this fair die n times independently. Compute the expected value and variance of S.