

ADTA 5560.701: Deep Learning with Big Data

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Assignment 2

1. Overview

1.1 Linear Algebra for Deep Learning

In mathematics, linear algebra is a branch that aims to describe the coordinates and interactions of planes in higher dimensions and perform operations on them.

Linear algebra can be considered an extension of algebra (dealing with unknowns) into an arbitrary number of dimensions. It provides methods for solving linear systems of equations. Rather than working with scalars, the focus is on vectors and matrices (vectors are just a special type of matrix).

1.2 TensorFlow

The Google Brain team created TensorFlow, an open-source library for numerical computation and large-scale artificial intelligence (AI) machine learning and deep learning projects. TensorFlow bundles together a broad spectrum of machine learning and deep learning models. It uses Python to provide a convenient front-end API for building applications with the framework while executing those applications in high-performance C++.

2. PART I: Biological Neural Network & Artificial Neural Network (30 Points)

Question 1.1:

Describe ([including images for illustration](#)) the human biological neural network and how it works

Question 1.2:

Describe ([including images for illustration](#)) the McCulloch-Pitt neuron model, a.k.a. Threshold Logic Unit, that is considered as the simplest neural network and how it works.

Question 1.3:

Discuss ([including images for illustration](#)) how the pioneers in the AI field did imitate the human biological brain system to conceive the first artificial neural networks.

SUBMISSION REQUIREMENT PART I

--> The answers to the above questions

3. PART II: Linear Algebra for Deep Learning: Matrices (25 Points)

TO-DO

Given the following matrices:

$$A = \begin{bmatrix} 5 & 3 & 8 \\ 2 & -1 & 7 \end{bmatrix} \quad B = ?$$

--> Provide a matrix with all the scalar elements for B and perform the dot multiplication $A * B$

SUBMISSION REQUIREMENT PART II

- > Matrix B with all its scalar elements
- > The result of $C = A * B$
- > Specify the dimensions of C
- > Explain how to get the dot product $C = A * B$

IMPORTANT NOTES:

--> *The solution to PART II questions must be done in an MS Word document to show that the student knows the fundamentals of the dot product operation of matrices, i.e., the student should not do it in Python coding.*

4. PART III: Linear Algebra for Deep Learning: Matrices (45 Points)

TO-DO

Given the following matrix as a 2D array:

$$\begin{bmatrix} 2 & 1 & 3 & 4 & 5 \\ 0 & 0 & 1 & 4 & 2 \\ 4 & 2 & 6 & 8 & 10 \\ 6 & 3 & 14 & 35 & 33 \end{bmatrix}$$

--> Question 3.1:

Let's consider this matrix as a vector of vectors.

How many **vector elements** does this matrix have, **along Axis 1**?

Show each vector element, one by one.

--> **Question 3.2:**

Let's consider this matrix as a vector of vectors.

Add 3 to the vector element (of the matrix) of the index = 1. The addition is performed **elementwise** along **Axis 1**.

Display the matrix with all its scalar elements after the operation has been done in the format of a 2D-matrix.

--> **Question 3.3:**

Continuing from Question 3.2, i.e., after the above addition of 3 has been done:

Flatten the matrix and display the result.

SUBMISSION REQUIREMENT PART III

Provide solutions to the above questions.

IMPORTANT NOTES:

--> *The solution to PART III questions must be done in an MS Word document to show that the student knows the fundamentals of vectors and matrices, i.e., the student should **not** do it in Python coding.*

5. HOWTO Submit

The student must submit the Microsoft Word document by sending it to the instructor (Thuan.Nguyen@unt.edu) as an attachment to a UNT email.

The email subject must be: “**ADTA 5560: Assignment 2 – Submission.**”

Due date & time: 11:00 PM – Wednesday 10/30/2024