### **CSCE 584 - Neural Networks and Their Applications Fall 2025**

### Homework 2

### September 28th, 2025

### Introduction:

This homework assignment delves into a comprehensive review of **backpropagation**, starting with the foundational concepts presented in two influential papers. Furthermore, I delved into applying these principles to the design, training, and practical implementation of both one- and two-layer neural networks, with Part-C covering the derivative for the **weight update rules** of the back propagation algorithm for 2-layer feed-forward neural network architectures.

### Solutions:

Following the guidance, a one-pager has been created. The table below links to the **Pseudocode** and **Code** from the Colab Notebook.

|  |  |  |
| --- | --- | --- |
| Topics | Reference | Code |
| **Part A:**   1. Learning representations by back-propagating errors 2. Efficient backprop. In Neural networks: Tricks of the trade | [Link](https://www.nature.com/articles/323533a0.pdf)  [Link](http://yann.lecun.com/exdb/publis/pdf/lecun-98b.pdf) | [1] - [Link](https://github.com/VenkatesanNadimuthu/CSCE584HW2/blob/main/Paper%201_Nature_Learning%20representations%20by%20back-propagating%20errors.pdf)  [2] - [Link](https://github.com/VenkatesanNadimuthu/CSCE584HW2/blob/main/Paper%202_Efficient%20BackProp.pdf) |
| **Part B:**   1. One-layer Neural Network 2. Two-layer Neural Network 3. Course project | [1] - [Link](https://github.com/VenkatesanNadimuthu/CSCE584HW2/blob/main/One%20layer%20Neural%20Network.pdf)  [2] - [Link](https://github.com/VenkatesanNadimuthu/CSCE584HW2/blob/main/Two-layer%20Neural%20Networks.pdf) | [1] - [Link](https://colab.research.google.com/drive/1OqHmC1T4qZLiGBsgLmn7ybwU47Kn1TC9?usp=sharing)  [2] - [Link](https://colab.research.google.com/drive/1SBkfpHZHw9FxIAkiCvBHFRMnMU7PRJ8Q?usp=sharing)  [3] - [Link](https://github.com/VenkatesanNadimuthu/CSCE584HW2/blob/main/Course%20Project%20Overview.pdf) |
| **Part C:** Backpropagation algorithm for a 2-layer feedforward NN | N/A | [Link](https://github.com/VenkatesanNadimuthu/CSCE584HW2/blob/main/WeightUpdateRulesfor2layernetwork_final.pdf) |

### Conclusion:

Homework 2 helped with an in-depth exploration of foundational neural network concepts, including **backpropagation**, **gradient descent**, and activation functions like the **hyperbolic tangent (tanh)**. I've gained practical experience by applying backpropagation to build and train both single- and two-layer neural networks. This hands-on work, particularly the derivation of weight update rules, has been instrumental in bridging the gap between theoretical principles and practical application.