ECE 477/595 Artificial Neural Networks

Department of Electrical and Computer Engineering

University of Dayton

Fall 2022

Assignment 6 (*Due Date: 11/10/2022*)

Hopfield Neural Network

Design a fully connected recurrent network-based **pattern association** learning system.

Task #1: Choose a set of 10 binary images *(+1 and -1*) representing handwritten digits (*0, 1...., 9*) from the MNIST database for testing the pattern association capability of the recurrent network (*Create binary images by appropriate thresholding*). The input data to be stored will be a set of binary values *(+1 and -1*) representing 28×28 images of handwritten digits.

Create a set of corrupted images by adding salt-and-pepper noise to the selected handwritten digits (*0, 1...., 9*) in the training set to evaluate the pattern recall capability of the pattern associator. Create four test sets by adding 5%, 10%, 15% and 20% salt-and-pepper noise to the images.

Plot the percentage error in testing your pattern association system (*recalling the stored handwritten digits*) with the 4 test data sets (*data sets with 5%, 10%, 15% and 20% salt-and-pepper noise added to the images*).

Task #2: Repeat Task #1 with a set of 100 binary images *(+1 and -1*) representing handwritten digits (*0, 1...., 9*) from the MNIST database for testing the pattern association capability of the recurrent network. Use approximately the same number of data samples (*images*) for each digit in the training/testing processes.

Task #3: Repeat Task #1 with a set of 10 orthogonal patterns.
Repeat Task #3 for large amount of salt-and-pepper noise to the orthogonal patterns.

You may refer to the sample codes provided in the **Resources** for Task #1 and for generating orthogonal patterns.

Notes:

- The project should be implemented in MATLAB.
- The project report should include the methodology, program outline with flow chart and/or illustrations, implementation results with sample data sets, comments/discussions on the obtained results, and appropriate technical references and the report should be submitted on **Isidore**.
  (*Report Format: single column, single space, 11-point Times New Roman font*).
- The program codes along with the dataset used for testing and validation should be submitted through **Isidore**.
- **Late submissions will not be accepted**.