Homework #1: Classification with Single Layer Neural Networks

Due date: 20th Farvardin 1400

In order to do this homework, go through theories and concepts of Discrete-neuron Perceptron and Continuous-neuron Perceptron in Single-Layer Feedforward Networks for Classification.

Part A: Discrete-neuron Perceptron

For this part of homework, you will train and test a single-layer discrete-neuron perceptron neural network to classify the English letters. In this dataset, there are 20 samples (with different fonts) of English alphabet letters, stored in 26 folders. Each letter is a PNG image file of size 60×60.

- Convert every PNG image into bipolar values of +1 for white and -1 for non-white (black) pixels. *gray*
- For this part (discrete-neuron perceptron), assume each pixel of letter as a bipolar feature (n=3600), and use them as input to Neural Network.
- Train your Neural Network model using the training data and then classify the test letters.
- To examine the generalization ability, use leave-one-out cross validation (LOOCV) *1 fold cross validatin* method and report the accuracy. In LOOCV on N data samples, each time one sample is set aside for testing the model while all remained samples are used for training it. This procedure is repeated N times until all samples are chosen as test once. The average of accuracies will be the accuracy of model.
- To examine its robustness to noise, train the network using all training letters and then test it using degraded training letters with 15% and 25% of noise (only toggle the black pixels of the letters) as new test data and report the accuracy.

Part B: Continuous-neuron Perceptron

For this part, you will train and test a single-layer continuous-neuron perceptron neural network to classify the English letters. This time, assume each letter is a 60×60 grayscale image with 256 intensities (0 to 255) for each pixel and so, use continuous-neuron perceptrons.

Notes:

- **Pay extra attention to the due date. It will not be extended.**
- **Be advised that submissions after the deadline would not be graded.**
- **Prepare your full report in PDF format and include the figures and results.**
- **You can use any library for perceptron classification in Matlab or Python.**
- **Submit your assignment using a zipped file with the name of "StdNum_FirstName_LastName.zip" to compuscien@gmail.com with NNDL-Spring 2021-HW#1 subject.**