CS 678 Machine Learning
Programming Assignment #4 Part C
(Ungraded – for your further learning)

Application: Neural Network for Recognition

Specification

The goal is to create a neural network capable of recognizing handwritten digits. Training data consists of digits written in different people's handwriting. Your network should be able to generalize its behavior such that it can correctly classify numerical characters that it has not seen before (i.e. the provided Test set).

Dataset

The dataset consists of image bitmaps. Each bitmap originally consisted of 32x32 = 1024 black-and-white pixels (0|1). The images have been compressed using 4x4 blocks, each holding a value 0..16 that represents the number of bits turned on in that 4x4 block. Therefore, the 32x32 = 1024 bit values are transformed into 8x8 = 64 integer values representing pixel intensities.

Each line in the file represents one image and contains 64 comma-separated integer values (0..16) and a target value (0..9).

- Training set instances: 3823
- Test set instances: 1797
- Integer data: 64 values (0..16) representing an 8x8 bitmap image of a number
- Targets: the digits 0..9

The data can be preprocessed, modified and normalized as desired.

Requirements:

Write modular code that implements the concept of perceptrons and their connections in a network, feeds forward the inputs, calculates the output function, calculates error, backpropagates error, and adjusts weights appropriately. Train your neural network using the provided training data, and test it using the provided test data.

Submit your documented code and sample output (single PDF). Include a written analysis of your project and be prepared to present your solution to the class:

- Describe data structures used and process flow
- Provide network architecture/configuration details
- Describe any interesting experiments, problems, etc.
- Demonstrate the effectiveness of your neural network, including a discussion of your results. For example:
    - Accuracy
    - Misclassification (confusion matrix)