WORKSHOP NEURAL NETWORK :

I strongly encourage using online/offline Discussions to discuss exercises with other students. However, do not look at any source code written by others or share your source code with others.

Whorkshop Context:

Automated handwritten digit recognition is widely used today - from recognizing zip codes (postal codes) on mail envelopes to recognizing amounts written on bank checks. This workshop will show you how the methods you've learned can be used for this classification task.

Dataset Description:

You are given a data set in WRKSP-NN-DATA.mat that contains 5000 training examples of handwritten digits. Each training example is a 20 pixel by 20 pixel grayscale image of the digit. Each pixel is represented by a floating point number indicating the grayscale intensity at that location. The 20 by 20 grid of pixels is "unrolled" into a 400-dimensional vector. Each of these training examples becomes a single row in our data matrix X. This gives us a 5000 by 400 matrix X where every row is a training example for a handwritten digit image. The second part of the training set is a 5000-dimensional vector y that contains labels for the training set.

You will use logistic regression and neural networks to recognize handwritten digits (from 0 to 9).

I- One vs-all classification:

First of all, you will apply your previous implementation of logistic regression : one-vs-all classification to classify hand digits. As you have implemented one-vs-all classification by training multiple regularized logistic regression classifiers, (one for each of the 4 classes), apply the same code on our dataset In the handwritten digits dataset, K = 10.

I hope you have implemented your functions in the last Workshop as a vectorized version. A fully vectorized version (MEANS THAT your code should not contain any loops).

What is the training set accuracy?

II-Neural Network Classification:

However, logistic regression cannot form more complex hypotheses as it is only a linear classifier. In this part of the workshop, you will implement a neural network to recognize handwritten digits using the same training set as before. The neural network will be able to represent complex models that form non-linear hypotheses. Your goal is to implement the Forward algorithm to use our given weights(WRKSP-NN-WEIGHTS) instead of random for prediction. Then you will write the backpropagation algorithm for learning the neural network parameters.

Model representation

Our neural network is shown in Figure 2. It has 3 layers – an input layer, a hidden layer and an output layer. Recall that our inputs are pixel values of digit images. Since the images are of size 20×20, this gives us 400 input layer units (excluding the extra bias unit which always outputs +1). As before, the training data will be loaded into the variables X and y.

You have been provided with a set of network parameters ($\Theta(1),\Theta(2)$) already found for you. These are stored WRKSP-NN-WEIGHTS.mat . The parameters have

dimensions that are sized for a neural network with 25 units in the second layer and 10 output units (corresponding to the 10 digit classes)

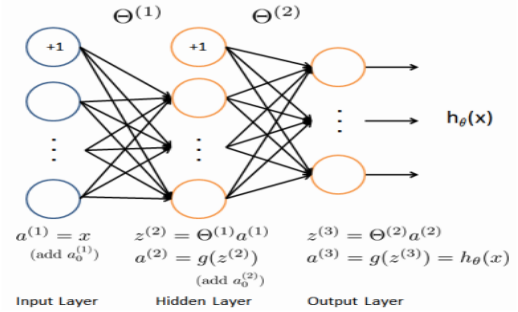

Figure 2: Neural network model.

What is the obtained accuracy.

Give conclusions.