CS1762: Experiment 4

Maximum Marks: 10

Submission deadline: 18 September, 2020

Implement Back-propagation algorithm to experiment with the use of Neural Networks for a multi-class classification problem, and try and interpret the high-level or hidden representations learnt by it..

To experiment with the use of Neural Networks for a binary and multiclass classification problem, and try and interpret the high-level or hidden representations learnt by it. Also, to try and understand the effects of various parameter choices such as the number of hidden layers, the number of hidden neurons, and the learning rate.
[https://github.com/HBevilacqua/neural_network_backprop_fromscratch/blob/master/backpropagation.py]

1. **Binary classification:**

Investigate Artificial Neural Network on the randomly generated data sets and the *Data set* provided for binary classification using various hyper-parameters. Study the effects of changing the different parameter values, including the type of activation function being used in neural network. How do they affect the accuracy?

2. Multiclass classifications

(Marks is not associated with this section and it is only for practice)

In this section you will work with the data set from previous Assignments, consisting of images of handwritten digits taken from the MNIST database. Your task is to try and learn a Neural Network classifier for the images, starting with the raw pixels as input features, and thereby also to assess the usefulness of the different representations that your Neural Network constructs. Here is how you should proceed: (a) Familiarise yourself with a Neural Network library of your choice. One suggestion is PyBrain (http://pybrain.org/) for Python, but you can find many others. Figure out how you can set various parameters, such as the number of hidden layers, the number of hidden neurons in each layer, the nonlinear activation function to be used, and the learning rate for gradient descent. You may wish to play with a simple toy data set to get a feel for using the library, before you move on to the actual data for this assignment. Attempt to train a neural network to recognise the images of handwritten digits given to you. Set aside some of the data for validation, or ideally, use cross-validation. Assess the accuracy and speed (both training and testing) of the neural net for different settings of the various parameters mentioned above. Identify cases of overfitting or underfitting; use regularisation to get better results, if you think it will help. Once you have obtained a good model, try to visualise and interpret the representations being learnt by the hidden neurons. Can you make sense of them? Also, take a look at the images which are being misclassified by the network. Can you see what's going wrong?