DSCI 552: Programming Assignment 5 [Neural Networks]

Part 1: Implementation [7 points]

In the directory **gestures**, there is a set of images[1] that display "down" gestures (i.e., thumbs-down images) or other gestures. In this assignment, you are required to implement the Back Propagation algorithm for Feed Forward Neural Networks to learn the down gestures from training instances available in **downgesture_train.list**. The label of an image is *1* if the word "down" is in its file name; otherwise the label is *0*. The pixels of an image use the gray scale ranging from *0* to *1*. In your network, use one input layer, one hidden layer of size *100*, and one output perceptron. Use the value *0.1* for the learning rate. For each perceptron, use the sigmoid function $\Theta(s) = 1/(1+e^{-s})$. Use *1000* training epochs; initialize all the weights randomly between *-0.01* and *0.01* (you can also choose your own initialization approach, as long as it works); and then use the trained network to predict the labels for the gestures in the test images available in **downgesture_test.list**. For the error function, use the standard squared error. Output your predictions and accuracy.

The image file format is "pgm" <http://netpbm.sourceforge.net/doc/pgm.html>. Please follow the link for the format details. You can either use a third-party library to read these image files or easily read them yourself.

You can write your programs in any programming language. However, you will have to implement the algorithms yourself instead of using library functions (except for reading "pgm" image files). In your report, please provide a description of the data structures you use, any code-level optimizations you perform, any challenges you face, and of course, the requested outputs.

Part 2: Software Familiarization [Optional - No Credit]

Do your own research and find out about library functions that offer good implementations of the Back Propagation algorithm for Feed Forward Neural Networks. Learn how to use them. Compare them against your implementations and suggest some ideas for how you can improve your code. Describe all this in your report.

Part 3: Applications [Optional - No Credit]

Do your own research and describe some interesting applications of Neural Networks in general.

Submission Guidelines

In your report, please include the names of all group members and mention their individual contributions. The maximum number of the members in a team is 2. The report should be in a PDF format. Your submission should include the code as well as the report and is due before **04/05**, **11:59pm** in an archive in a zip, tar.gz or tar.xz format. Only one submission is required for each group by one of the group members. Please submit your homework on **D2L** (do NOT email the homework to the instructor or the TA).

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[1] source: http://www.cs.cmu.edu/~tom/faces.html