Machine Learning 2003

Assignment 3: Face recognition using multilayer perceptrons with backpropagation.

- Due by: Part A: 23h59 on 20/03/2003; Part B: 23h59 on 27/03/2003.
- Remember that discussion and conclusions are the most important part of an assignment!
- Note: this is **not** a team project. Your implementation and experiments should be your own work.

1 Part A: Implementation and testing

Implement the error backpropagation learning algorithm for multilayer perceptrons (MLPs). Test your implementation by training a MLP with 2 input, 10 hidden, and one output neuron to distinguish the interior from the exterior of a circle.

Show that the "circle" network is able to generalize to previously unseen data by graphically displaying the network's classification of the areas inside and outside of the circle, respectively.

1.1 Deliverables

1. Working program (demonstration)
2. Description of data used for testing the program (in report)
3. Graphical representation of results (in report). Hint: gnuplot and octave (which uses gnuplot) are software packages that can be used to produce plots.
4. Discussion of results (in report)
5. Conclusions (in report)

2 Part B: Application to face recognition

Train a MLP to recognize faces. The face database on the course website contains 10 black-and-white images of each of 40 individuals. The readme file will tell you that the data format is Sun standard raster: use the internet to find out what this means. The following websites may prove useful:

http://www.geocities.com/marcoschmidt.geo/java-image-coding.html
http://www.dcs.ed.ac.uk/home/mxr/gfx/2d/RAS.txt
http://scv.bu.edu/Tutorials/ImageFiles/image101.html

You may reuse a library for loading the data into your program. The files contain images of 384×287 pixels: this is probably too large for a neural network (training examples will be too few and training time will be too long), so it is suggested that you subsample the images by averaging over blocks of 24×41 pixels, leaving an image of $16 \times 7 = 112$ blocks, which will be the length of the feature vector.

2.1 experiments

1. Construct a training set consisting of 5 images for each individual from the face database. Run the following experiments: (1) randomly initialize all weights to values drawn from the interval (a) [-1.0, 1.0], (b) [-0.1,0.1], and (c) [-0.01, 0.01]. Perform the remaining steps for each set of initial weights. (2) Train the network. (3) Test the network generalization performance on all remaining images. (4) Repeat the experiment 10 times (for a total of 30 experiments). What do you observe?

2. Train a MLP on 1, 2, 3, ..., 9 images per individual using random initial weights drawn from the interval [-0.1, 0.1] and test the network's generalization on the remaining images. Record the results in a performance curve. What do you conclude about the effect of the amount of training data?