

Machine Learning and Adaptive Systems (ECE656)

Computer Assignment 2 (Pattern Classification Using Back-Propagation NN- (Due in Three Weeks)

The purpose of this computer assignment is to design a multi-layer back-propagation neural network for pattern classification. The MATLAB neural network (NN) toolbox should be used to train and test different BPNN classifiers. The data set for this study is the “Wine” dataset (see Data Description below)

1. Randomly, divide this database into training (equal number of samples for each class), validation, and testing data sets that could be used to properly train and select optimum performing network and demonstrate its generalization property on the testing set. Standardization is suggested when classifiers are NOT scale invariant. Note that, additional data samples could also be generated, if needed, by adding random white Gaussian noise with zero mean and unity variance to each attribute to mimic error in measurements.
2. Using both the standard generalized delta rule (use variable learning rate and a momentum factor) and a fast learning algorithm (e.g., Levenberg Marquet), train various two and three-layer BPNN's on the training data and monitor the learning curve during the training after certain number of epochs to determine if the network is properly training. For each structure at least 5 random weight initializations should be tried and the best performing (on the validation set) should be chosen.
3. Provide the learning curves for those properly trained networks and determine their generalization ability on the testing data set. Provide a comprehensive benchmarking of different networks based upon their overall correct classification rates, the associated confusion matrices, number of neurons in each layer and number of layers.
4. Provide a discussion on your results and point out the advantages/disadvantages of the NN-based classification in a brief report.

Wine Recognition-Dataset Description

This data was used in many papers for comparing various classifiers (<http://archive.ics.uci.edu/ml/datasets/Wine>). In a classification context, it is a well-posed problem with somewhat "well-behaved" class structures. The dataset is the result of a chemical analysis (see paper Forina, M. et al, PARVUS - An Extendible Package for Data Exploration, Classification and Correlation. Institute of Pharmaceutical and Food Analysis and Technologies, Via Brigata Salerno, 16147 Genoa, Italy.) of wines grown in a particular region in Italy but derived from three different cultivars (or classes). The analysis determined the quantities of 13 constituents found (i.e. 13-D feature space) in each of the three types of wines. The attributes are:

- 1) Alcohol content
- 2) Malic acid
- 3) Ash
- 4) Alcalinity of ash
- 5) Magnesium
- 6) Total phenols
- 7) Flavanoids

- 8) Nonflavanoid phenols
- 9) Proanthocyanins
- 10) Color intensity
- 11) Hue
- 12) OD280/OD315 of diluted wines
- 13) Proline

Number of Instances for each class are: Class 1: 59 , Class 2: 71 and Class 3: 48, i.e. total of 178 samples. Note that the first number in each string of 14 numbers in the data file "Wine" represents the class label.