

Indian Institute of Science

Neural Networks and Learning Systems-I

Instructor: Shayan Srinivasa Garani

Home Work #2, Fall 2020

Late submission policy: Points scored = Correct points scored $\times e^{-d}$, $d = \#$ days late

Assigned date: Nov. 19th, 2020

Due date: Dec. 3rd, 2020, 11:59 pm

PROBLEM 1: In the class, we sketched the main ideas behind the multi-class logistic regression based on the likelihood function. From first principles, derive the complete solution for the multi-class logistic regression for the M-class problem where the model parameters are determined from the likelihood function through the gradient descent algorithm. You can assume that the training samples are $\{(\mathbf{x}_i, d_i)\}_{i=1}^N$ i.e., each data point $\mathbf{x}_i \in \mathbf{R}^d$ has an associated scalar label d_i . (30 pts.)

PROBLEM 2: Solve problems 4.2 and 4.3 from Haykin's book. (10 pts.)

PROBLEM 3: Consider the Iris data set <https://archive.ics.uci.edu/ml/datasets/iris>. We are interested in constructing the multilayer perceptron (MLP) for this data.

- (1) Develop the software code from first principles and train the MLP using the backpropagation algorithm (BPA). Experiment using $\tanh(\cdot)$ and logistic activation functions with 80% training set samples and 20% test set.
- (2) Configure the procedure in (1) to operate in online and batch modes. Provide a plot of the error trajectory as a function of iteration steps/epochs for both online and batch modes. Sketch the final decision boundaries after convergence. Experiment your results by shuffling the data points every epoch. What are your conclusions?
- (3) What was your network configuration in terms of the number of hidden layers and the associated hidden nodes to get the algorithm working? You may want to make a movie to demo your results using Matlab or other software tools. You need to attach all the software in an Appendix.

(60 pts.)