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. 19^{th}, 2020 **Due date:** Dec. 3^{rd}, 2020, 11:59 pm

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PROBLEM 1: In the class, we sketched the main ideas behing 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(.) 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.)