Homework 3

Oct. 12, 2023

Task:

Classify patients' survival (0: survived; 1: dead) using 108 features (a mixture of numeric and binary variables) from their Intensive Care Unit (ICU) records, such as age, BMI, height, weight, heart rate, blood pressure, etc. (Detailed descriptions available in the data folder.)

Goal:

- Find a public package for MLP in Python for the classification task. Make observations on the learning procedures, performances and effects of optional choices on the performance.

Data:

Please check the "data1forEx1to4" folder for the following datasets.

Datasets	Sample size	Feature data file	Class label file
TrainingSet-1	5000	train1_icu_data.csv	train1_icu_label.csv
TestSet-1	1097	test1_icu_data.csv	test1_icu_label.csv

Requirements:

1) Design an MLP classifier with the public package. Use TrainingSet-1 to train the MLP. Show the learning curve. Calculate the training error and the cross-validation error on the training set. Then apply the trained MLP classifier on TestSet-1. Calculate the test error. Try some different choices in the experiment (such as the design of the MLP, the hyperparameters in the training, or the pre-processing of some features) to study their effects on the model performance. Discuss on your observations in the experiments.

2) 【optional】For a three-layered MLP model (with one hidden layer): The MLP model is for multi-class classification. The hidden nodes all use the ReLU activation function

$$f(net_j) = \max(0, net_j)$$

but the output nodes use the SoftMax function:

$$y_j = \frac{e^{w_j \cdot O_h}}{\sum_{k=1}^{K} e^{w_k \cdot O_h}}, j = 1, \ldots, K$$

where K is the number of classes (therefore the number of output nodes), O_h is the output vector of the last hidden layer that emits to the output layer, and w_j is the weight vector of output node j. Derive the weight-updating formula of the BP algorithm for this MLP.

Experiment Report:

- Write an experiment report to describe and analyze the experiment observations.
- Provide detailed supplementary materials that should include at least the following:
  - A readme file containing information on all supplementary files, programming environment and parameters used in the experiments (if any)
  - Experiment result files

Due date: Oct. 18 (Wed.) 23:59 Beijing time