

ROB 537
Learning Based Control
Fall 2017
HW #1: Neural Networks
Due: 10/2 at 11:59PM

Use your favorite programming language to implement a one hidden-layer feed forward neural network to classify products into “pass” or “fail” categories. The neural network classifier will assume the role of quality control for a manufacturing plant. We use a simplified dataset for this assignment.

Compressed file ***Homework/hw1_data.zip*** contains five data files. Each file has the number of data points listed on the first line, followed by one data point on each line where the data points have five inputs (x_1, x_2, x_3, x_4, x_5) and two outputs (y_1, y_2):

$x_1, x_2, x_3, x_4, x_5, y_1, y_2$

In this case, (x_1, x_2, x_3, x_4, x_5) are *features* of products, such as specifications for dimensions, weight, and functionality. These features have been quantified by the values x_1 through x_5 . The values y_1 and y_2 denote the *classification* of the product (pass or fail), where ($y_1 = 0, y_2 = 1$) indicates the product has passed, and ($y_1 = 1, y_2 = 0$) indicates the product has failed.

train1.csv contains 200 training patterns (100 pass and 100 fail)

train2.csv contains 200 training patterns (20 pass and 180 fail)

test1.csv, test2.csv, and test3.csv contain 200 test patterns each, with varying proportions of pass vs. fail samples.

Use the gradient descent algorithm to train a five input, two output (one for each class) neural network using file *train1.csv*. Write a report addressing the following questions (you should run experiments to support each of your answers):

- 1- Describe the training performance of the network:
 - a. How does the number of hidden units impact the results?
 - b. How does the training time impact the results?
 - c. How does the learning rate impact the results?
 - d. What other critical parameters impacted the results?
 - e. Did performance differ on different test sets (*test1, test2, or test3*)? If so, why?

Note, this is a classification problem, meaning that each data pattern (x_1, x_2, x_3, x_4, x_5) belongs to one of two classes (y_1 or y_2). Consequently, use correct classification percentage (instead of MSE) to report your results. You will still use MSE to train the neural networks; you will simply report the classification percentage (or classification error) to assess the performance of the neural networks.

- 2- Use *train2.csv* to train another neural network. Answer questions a-e from above for the test set. What conclusions can you draw from your results? What do you think is causing the difference in performance? Suggest a method to fix this.