ROB 537
Learning Based Control
Fall 2019
HW #1: Neural Networks
Due: 10/7 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 ***hw1_data.zip*** contains four data files. Each file has one data point on each line where the data points have two inputs (x1, x2) and two outputs (y1, y2):

x1, x2, y1, y2

In this case, (x1, x2) are *features* of products, such as specifications for dimensions, weight, or functionality. These features have been quantified by the values x1 and x2. The values y1 and y2 denote the *classification* of the product (pass or fail), where (y1 = 0, y2 = 1) indicates the product has passed, and (y1 = 1, y2 = 0) indicates the product has failed.

train1.csv contains 100 training patterns (50 pass and 50 fail)
test1.csv, test2.csv, and test3.csv contain 100 test patterns each.

Use the gradient descent algorithm to train a two 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 number of training steps impact the results?
   c. How does the learning rate impact the results?
   d. What other critical parameters impacted the results?
   e. Show the performance on all three test sets (*test1, test2, or test3*)?
   f. Did performance differ on different test sets? If so, provide hypotheses for the differences between the three test sets, supported by your results.

   Note, this is a classification problem, meaning that each data pattern (x1, x2) belongs to one of two classes (y1 or y2). 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.