**CS454 Homework 3: Single- and Multi-Layer Perceptrons for Regression**
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# Report

In the homework, 4 different networks were trained with online learning and models were created. The Single-layer Perceptron was created using the equation y = x0w0 + x1w1 where x0 = 1, resulting in a linear model from the equation ax + b. For Multi-layer Perceptrons, a curve was created using the outputs obtained from the training model. Suitable weights were determined using backpropagation. Then, the error of this curve was calculated, and the appropriate coefficient (which is 3) of the curve was determined by comparing the results obtained when inputting the data with the weight obtained from the training model. As shown in the figures, polynomial curves fitted on 3 different Multi-layer Perceptrons with one hidden layer of 10-20-50 hidden units are shown on both the test and train datasets.

When looking at the MSE, it is seen that the model obtained from the Single Layer Perceptron has a higher error in both the train and test data compared to Multi-layer perceptrons. For Multi-layer perceptrons, MSE decreases from 10 layers to 50 layers. At the same time, when the MSE of the train and test data is compared, it is seen that the error in the test data is higher.

**The appropriate learning rate for network models has been determined as 0.025. The epoch number was also set as 2000. All the models shown below were obtained using these values.

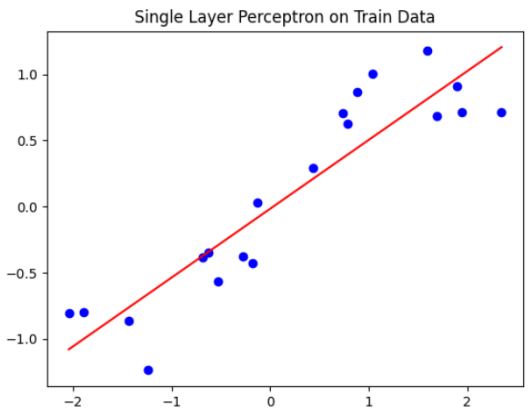


*Figure 1*

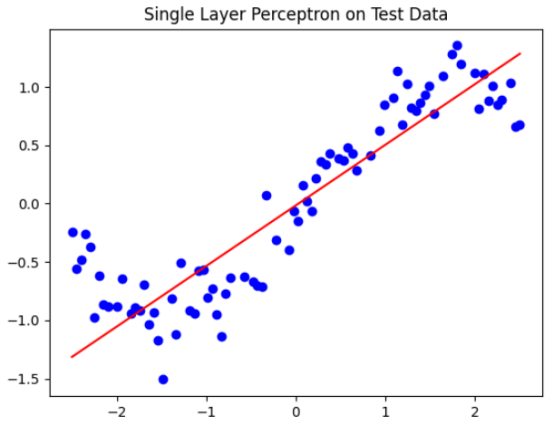


*Figure 2*

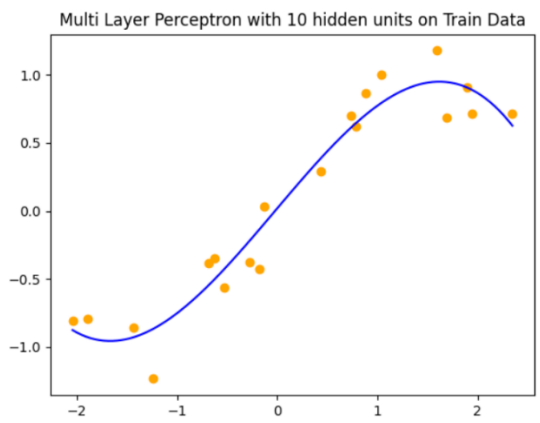


*Figure 3*

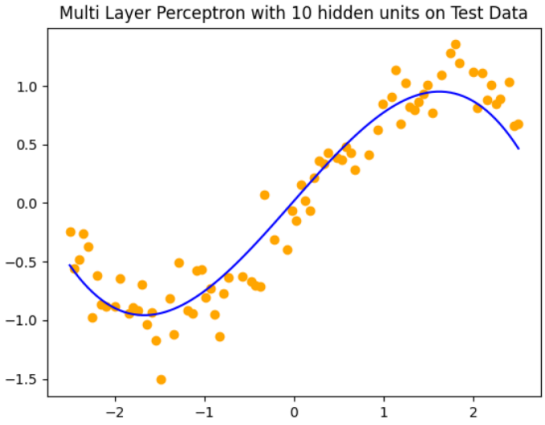


*Figure 4*

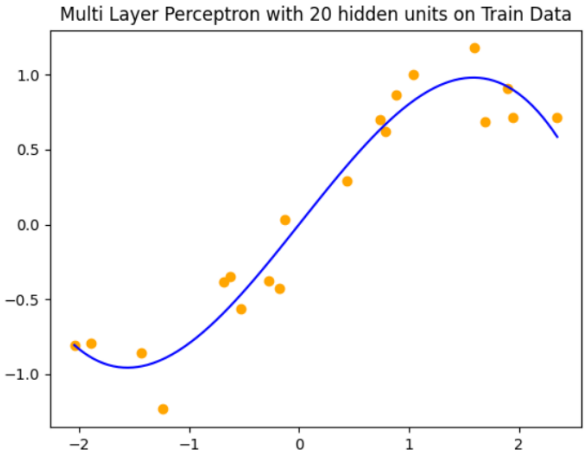


*Figure 5*

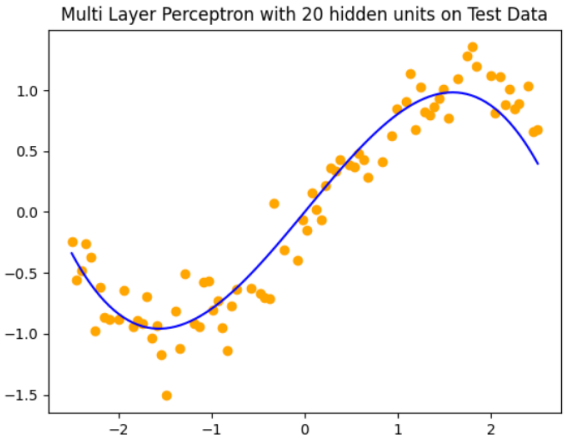


*Figure 6*

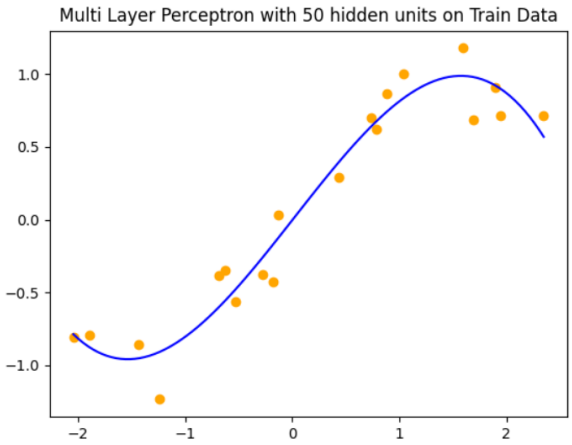


*Figure 7*

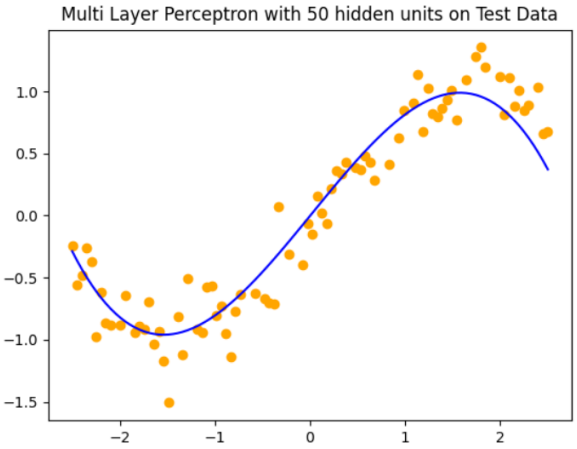


*Figure 8*

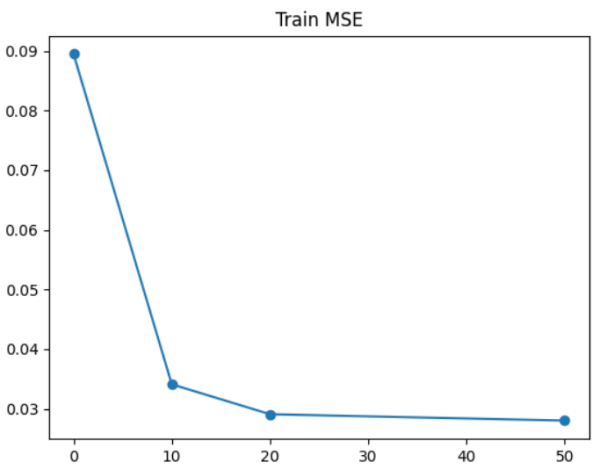


*Figure 9*

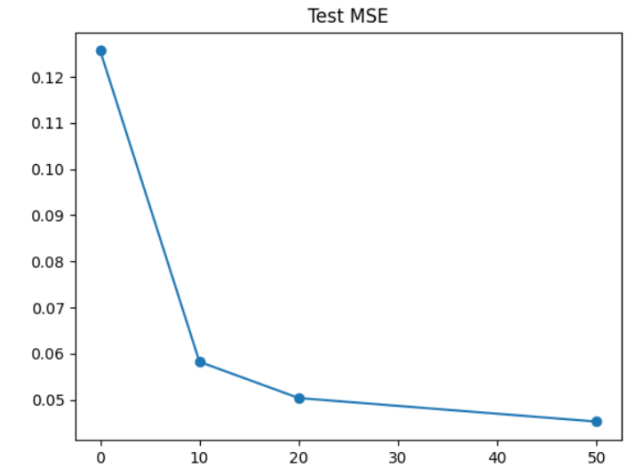


*Figure 10*

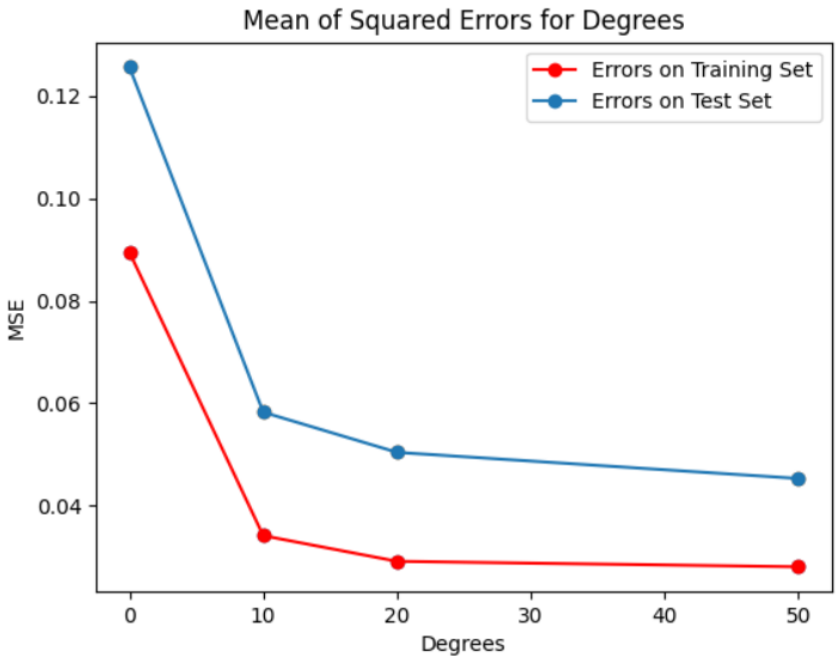


*Figure 11*