

# Intro ML Homework 6

Jaskin Kabir

Student Id: 801186717

GitHub:

[https://github.com/jaskinkabir/Intro\\_ML/tree/main/HM6](https://github.com/jaskinkabir/Intro_ML/tree/main/HM6)

November 2024

# 1 Housing Price Regression

## a. Single Layer Neural Network

Using a single hidden layer of 8 neurons, the model was able to achieve a validation loss of  $2.02 \times 10^6$  after 5000 epochs. Training took 5.6 seconds. The model's training and validation loss curves can be seen in Figure 1.

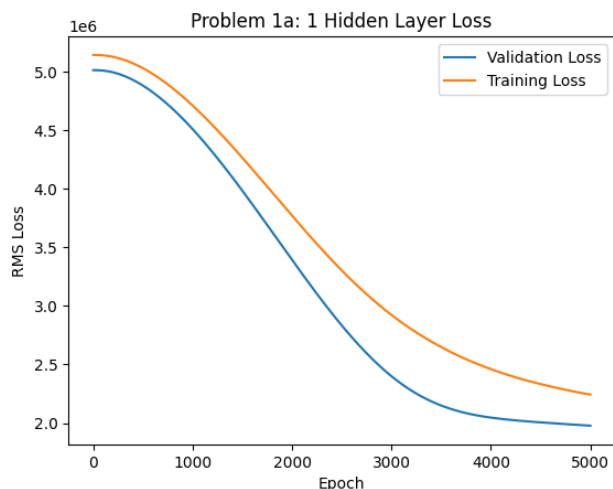


Figure 1: P1a: Single Layer Neural Network Loss Curves

This performed significantly better than the linear regression model from Homework 2, which was only able to achieve a loss of  $5.78 \times 10^{11}$  after 5000 epochs.

## b. Triple Layer Neural Network

By increasing the number of hidden layers to 3, the model was able to achieve a validation loss of  $1.88 \times 10^6$  after 5000 epochs. This is a small increase in performance over the single layer network. Training took 7.8 seconds. The model's training and validation loss curves can be seen in Figure 2.

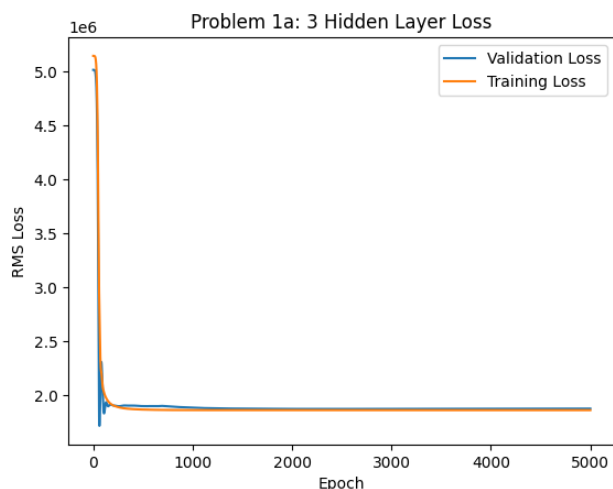


Figure 2: P1b: Triple Layer Neural Network Loss Curves

Looking closely at this graph, the training loss is lower than the validation loss, which indicates that overfit did occur in this model.

## 2 Breast Cancer Classification

Using a single hidden layer of 32 neurons, the model was able to achieve a training loss of  $7.98 \times 10^{-4}$  after 5000 epochs. Training took 4.5 seconds.

By increasing the number of hidden layers to three, the training loss was reduced to  $7.98 \times 10^{-4}$ , while keeping roughly the same training time of 4.4 seconds. A comparison of these two models against the Logistic and SVM Classical models can be seen in Table 1

	Single Layer	Triple Layer	Logistic	SVM
<b>Accuracy</b>	0.97	0.98	0.96	0.98
<b>Precision</b>	0.97	0.98	0.96	0.97
<b>Recall</b>	0.97	0.98	0.99	1.00
<b>F1 Score</b>	0.97	0.98	0.97	0.99

Table 1: Breast Cancer Classifier Comparison

The triple layer classifier network outperformed the logistic classifier and was outperformed by the SVM classifier.

## 3 CIFAR-10 Classification

### a. Single Layer Classifier

Using a single hidden layer of 256 neurons, the model was able to achieve a training loss of 1.86, validation loss of 1.99, and an accuracy of 47.4%. The training process of 100 epochs took 22 minutes and 50 seconds.

### b. Triple Layer Classifier

By increasing the number of hidden layers to 3, the model was able to achieve a training loss of 1.73, validation loss of 2.00, and an accuracy of 45.32%. The training process of 100 epochs took 23 minutes and 16 seconds.

Surprisingly the triple layer model was outperformed by the single layer model. This is likely due to the increased complexity of the model leading to overfit, which can be seen in the significant improvement in training loss from the single layer to the triple layer model.