

ME 4990/6990 02 – Spring 2025
Homework #4 – Neural Networks

- Please submit any Python code used as a separate file in addition to a text document (Word) which provides answers to the below problems. Writing should be in complete sentences with enough detail to demonstrate a thoughtful consideration of what is asked

Included with the homework is a file containing a number of metrics for different models of car. The columns are, in order, the fuel economy in MPG, number of cylinders, displacement, horsepower, weight, acceleration, model year, and place of origin (1=USA, 2=Europe, 3=Japan). The goal of this assignment will be to create a neural network regression model that can predict fuel economy.

1. You will notice some of the horsepower values are missing. Remove those entries from the database. For the remaining database, construct a neural network that takes the 7 non-MPG values as an input. To begin with, use a single hidden layer of 64 neurons and an 80/20 train/test split and try to minimize the mean squared error for a test set of data (not the data you trained on). Show the evolution of the training and validation error as a function of epoch.
2. Vary the batch size over at least an order of magnitude and see how it affects the training. What batch size converges fastest? What differences do you observe in the training.
3. Vary the number of hidden layers (up to at least 3) and the number of neurons in each layer (up to at least 256). What relationship do you observe between these metaparameters and training time, accuracy, validation accuracy, and overfitting?
4. Construct the best architecture you can for fitting the provided dataset. You will want to use an 80/10/10 train/validation/test split. Remember, the validation set is for comparing different metaparameters, while the test set gives you the accuracy of your final result. What is the best model you can make and what is its error?