**UNIVERSITY OF VICTORIA**

**Department of Electrical and Computer Engineering**

**ECE 403 Optimization for Machine Learning**

**LABORATORY REPORT**

Experiment No: 2

Title: One-Versus-All Multi-Class Classification

Date of Experiment: June 16, 2020

Report Submitted on: June 23, 2020

To: Lei Zhao

Names: Ashlynn Steeves (V00850631)

**1. Objective**

The objective of this experiment is to gain experience with one-versus-all multi-class classification. linear models by implementing a system to predict the fuel consumption of automobiles. This experiment also reinforces the concepts of testing and training a model as it provides a dataset of 392 samples which must subsequently be broken into subsets in order to train and test the system.

**2. Introduction**

**3. Implementation and Results**

**3.1. Implementation**

This experiment was implemented using a MATLAB script that followed these steps:

**3.2. MATLAB code**

The MATLAB code used for this experiment is shown below. Please note that this script was generated as a MATLAB live script which allows multipul functions to be included in a single file. Furthermore, this script calls function grad\_desc\_Lab1() which is not shown here as it was provided and can be found at https://studentweb.uvic.ca/~leizhao/code.html

This script in its entirety can be found at https://github.com/ashlynns/ECE403/tree/master/Lab1

**3.3. Results**

**Results for 3.5** - Evaluation of the RMSE on the training and testing dataset

RMSE\_train = 3.5668 RMSE\_test = 2.6662

**Results for 3.6 –** Plot of the true vs predicted values of a cars fuel consumption

Figure 1 - True vs Predicted Values of Fuel Consumption

**Comments –** Visual inspection of the plot generated in 3.6 suggests that the model is able to predict a vehicles fuel consumption quite well, it is worth noting that it does seem to have more trouble acuratley predicting fuel consumption values that are above average.

**4. Discussion**

RMSE\_train = 3.7783 RMSE\_train = 2.9793

Number of itterations performed = 38297

The results obtained from this experiement were as expected. Based on the relativley low RMSE values calculated in 3.5 we expect that the optimized model does a fairly good job of predicting a cars fuel consumption. This is further validated by the plot generated in 3.6 which shows the predicted values closeley following the true values.

**5. Conclusion**

In this experiment a least squares linear regression was implemented to predict the fuel consumption of a given vehicle. This was executed in a MATLAB script using a dataset containing 392 samples which was divided into a training set and a testing set. The optimal weight and bias were generated from the training data, the accuracy of which was evaluated using the root-mean squared error. This method performed well as it returned low RSME values. This was visually validated by the generation of a plot of the true values of fuel consumption vs the predicted values where it was clear the model was regularly able to accuratley predict a cars fuel consumption.

**6. References**

[1] Lu, W., 2020. *Laboratory Manual - OPTIMIZATION For MACHINE LEARNING*. [PDF] Victoria. Available at: <https://www.ece.uvic.ca/~wslu/403/403pass/Trans/Exp1-2020.pdf> [Accessed 2 June 2020].