Machine Learning Class Task Two:

Category: *Supervised Learning*

Sub-Category: *Regression*

ML Model: *Artificial Neural Network*

Alternative Models: *K-Means, K-Medians*

Problem Definition:

You wish to develop an intelligence application to help you evade traffic by predicting the waiting time on *Waiyaki* Way coming in to CBD in the morning. You have collected the below training data for the past two weeks. Using ANN with the provided initial weights matrix and *Back Propagation Algorithm*, demonstrate how you can come up with the intelligent agent by using the last 3 days data to predict todays traffic waiting time.

DAY	WAITING TIME IN TRAFFIC IN MINUTES (Waiyaki Way)
Monday	30
Tuesday	40
Wednesday	50
Thursday	20
Friday	15
Saturday	60
Sunday	70
Monday	50
Tuesday	40

Level One Weights

$$\begin{array}{c} \\ Node1 \\ Node2 \\ Node3 \end{array} \begin{array}{c} \begin{array}{cc} J & I \end{array} \\ \begin{pmatrix} 0.2 & 0.1 \\ 0.3 & 0.1 \\ 0.2 & 0.1 \end{pmatrix} \end{array}$$

Level Two Weights

$$\begin{array}{c} \\ J \\ I \end{array} \begin{array}{c} \begin{array}{c} K \end{array} \\ \begin{pmatrix} 0.5 \\ 0.1 \end{pmatrix} \end{array}$$

Performance Measure Technique: if $\boldsymbol{x}$ is the truth (Gold Standard) and $\boldsymbol{x'}$ is the result of the model then

error $\boldsymbol{\epsilon = x - x'}$

We can then sum all the errors and find their mean $\frac{\sum_{i=1}^{n} \epsilon_i}{n}$ however by doing this, positive and negative errors cancel, giving you no way to know how good your model actually performs

Therefore, we do measure the following: *NB:* $\boldsymbol{R^2}$ *is the standard mostly used*

Squared error:

$$\mathrm{SE} = \sum_{i}^{n} \epsilon_i^2$$

Mean squared error:

$$\mathrm{MSE} = 1/n \times \mathrm{SE}$$

Root mean squared error:

$$\mathrm{RMSE} = \sqrt{\mathrm{MSE}}$$

Relative mean squared error (do not confuse this for the RMSE, root mean squared error):

$$\mathrm{rMSE} = \frac{n-1}{n} \frac{\sum_i^n \epsilon_i^2}{\sum_i^n (x_i - \mathbb{E}(x))^2} = \frac{\mathrm{MSE}}{Var(x)}$$

R^2:

$$\mathrm{R}^2 = 1 - \mathrm{rMSE}$$