**Q1]**

* **System Specification:**

**Epoch = 21**

**η = 0.005**

**initial weights = randomly between 0 to 0.8**

I tried for various η and Epoch.

* For η = 0.001 and Epoch = 10
* For η = 0.005 and Epoch = 10
* For η = 0.005 and Epoch = 21
* For η = 0.01 and Epoch = 40

I started off with η = 0.001 and then 0.005 for lesser number of epochs this gave all score around 0.9. Then I tried with increasing learning rate which gave me a better result keeping the epochs close to earlier. For the η = 0.05 I tried with epochs 10 and 21, the results were similar thus 0 error was observed at epoch=20 and so was chosen.

* **Results**:

1. Heatmap of Original weights and weights after training:

Chart

Description automatically generated

*(b)*

*(a)*

*Fig 1.1 (a) Heatmap of weights before training. Fig 1.1(b) Heatmap of weights after training.*

1. Plot of Precision, Recall and F1 score:

Chart, bar chart

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*Fig 1.2Bar Graph of Precision, Recall and F1 score for evaluation of model before and after testing it on 400 samples of 0s and 1s each shuffled together.*

*P = Precision R = Recall F1 = F1 Score*

As before training all weights are randomly assigned above 0, all outputs are classified as 1 thus Recall is 100% and Precision is 50%.

Chart

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*Fig 1.3 Graph of Error fraction calculated on 800 training points and 100 test points on 21 epochs.*

The graph shows dropping Error fraction for training set which settles at 0.0 on 20th epoch [Blue]. The second line graph is the performance on test set on same epochs and the Error rate drops from 0.035 to 0.015.

1. Result of Challenge Set:

Table

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*Fig 1.4 The performance of perceptron on the challenge set.*

* **Analysis of Result:**

The perceptron performs better on a learning rate same as threshold neuron on nearly half of epoch size. The precision, F1 and recall of unity was achieved on this epoch and learning rate. The change of bias weight in perceptron with error from the actual provides better learning capacity that the variation in theta done in Pr1 of HW2.

Perceptron is preferred over the neuron oh HW2 because of high precision, recall and f1 scores along with lower computation time and epochs.