**Q1]**

* **System Specification:**

**Epoch = 40**

**η = 0.01**

I tried for various η and Epoch.

Best two trails were:

* For η = 0.01 and Epoch = 51 where True Positives were 79 and False Positives were 20.
* For η = 0.01 and Epoch = 41 where True Positives were 74 and False Positives were 12. Here a better result was produces with lower epoch and thus these values were selected.

Lower values of η like 0.005 required more than 150 Epoch and still did not perform substantially better and needed longer training times.

* **Results**:

1. Heatmap of Original weights and weights after training:

Chart

Description automatically generated with low confidence

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

*(b)*

*(a)*

1. Plot of Precision, Recall and F1 score and ROC curve:

Chart, line chart

Description automatically generated

*Fig 1.2 Graph of Precision, Recall and F1 score for evaluation of model after testing it on 100 samples of 0s and 1s each shuffled together.*

Chart, line chart

Description automatically generated

*Fig 1.3 Graph of False Positives on X axis and True Positives on Y axis to determine optimal θ.*

The θ was selected as 24 as at that θ the False Positives were very less for a minimum compromise in True Positives. At θ = 23, True positives = 74 and False positives = 12. The value, θ = 22 saw in rise in False positives with a lesser increase in True positives. So, at this point the slope is less than 1.

1. Result of Challenge Set:

Graphical user interface, application

Description automatically generated

*Fig 1.4 The performance of neuron on the challenge set when the theta was set to optimal value.*

* **Analysis of Result:**

The heatmap of weights after training explicitly showcased change as compared to the original random weights declared earlier. Weights after training were close to what could be identified as 1. The graph of Precision, Recall and F1 score was plotted. The graph intersected at one point and F1 was high. ROC curve was plotted to find the optimal θ when test set was feed to the neuron. The value of θ where the number of True positives were much greater than the False negatives and number of True positives was fairly compromisable was chosen and with a slope less than 1. The optimal θ was fed to challenge set and tested for input of 9 and 7 and True Positives True Negatives False Positives and False negative for the same were studied.

**Q2]**

* **System Specification:**

**Epoch = 40**

**η = 0.01**

* **Results**:

1. Heatmap of Original weights and weights after training:

A picture containing chart

Description automatically generated

*Fig 2.1 (a) Heatmap of weights before presynaptically-gated Hebb rule neuron training. Fig 2.1(b) Heatmap of weights after presynaptically-gated neuron training.*

*(b)*

*(a)*

1. Plot of Precision, Recall and F1 score and ROC curve:

Chart, line chart

Description automatically generated

*Fig 2.2 Graph of Precision, Recall and F1 score for evaluation of model after testing it on 100 samples of 0s and 1s each shuffled together.*

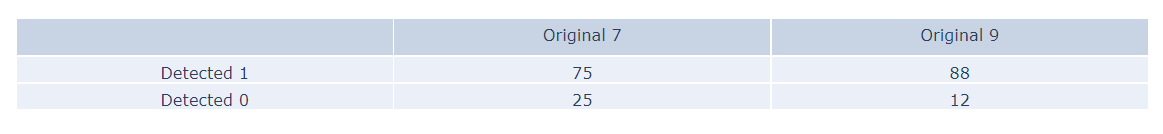
Chart, line chart

Description automatically generated

*Fig 2.3 Graph of False Positives on X axis and True Positives on Y axis to determine optimal θ.*

The θ was selected as 28 as at that θ the False Positives were very less for a minimum compromise in True Positives. At θ = 28, True positives = 74 and False positives = 16. The value, θ = 29 saw in rise in False positives with a lesser increase in True positives. So, at this point the slope is less than 1.

1. Result of Challenge Set:



*Fig 2.4 The performance of neuron on the challenge set when the theta was set to optimal value.*

* **Analysis of Result: [Comparison]**

The training of neuron in second question was done with presynaptically-gated Hebb rule. The neuron weights were not sharp as for first threshold neuron. This can be clearly seen in the heatmap plotted for earlier trained weights and these weights. The Roc curve did not have maximum to zero transition unlike the last ROC curve which had initial values as 100 to last values as 0. The optimal θ, was decided based on ROC curve, which was higher than the earlier θ. When the neuron was fed with challenge set the overall performance was similar. The neuron performed much better for not identifying the numbers 7,9 as 0.