**Project 4 Analysis**

By: Abhinav Tirath

1. Q5 Analysis

|  |  |  |
| --- | --- | --- |
| **Metrics** | **Pen Data** | **Car Data** |
| Accuracy | 0.9021154 | 0.8328532 |
| Standard Deviation | 0.006915931 | 0.007208124 |
| Max Accuracy | 0.908233 | 0.84555 |

Figure 1. Table that displays the accuracy, standard deviation, and maximum accuracy

for the default parameters with the pen and car data.

Here, we see that both the average accuracy and maximum accuracy of the pen data are greater than those of the car data. This is likely because the training set for the pen data was much larger and allowed the neural network to learn the mapping of the input to output much better. The tradeoff, however, was that the neural network spent much longer on the pen data than the car data. Moreover, we observe that the standard deviation is very low for both datasets. This signifies that the local minima that our neural networks found are quite similar in performance to one another.

1. Q6 Analysis
   1. Pen Data

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Nodes in Hidden Layer | |  |  |  |  |  |  |  |
| **Metrics** | **0** | **5** | **10** | **15** | **20** | **25** | **30** | **35** | **40** |
| Accuracy | 0 | 0.846140652 | 0.887421384 | 0.896740995 | 0.90651801 | 0.911092053 | 0.902058319 | 0.899656947 | 0.89514008 |
| Standard Deviation | 0 | 0.00616436 | 0.010117646 | 0.005579816 | 0.004901781 | 0.021455684 | 0.002769327 | 0.00736877 | 0.006562496 |
| Max Accuracy | 0 | 0.853916524 | 0.902515723 | 0.901943968 | 0.913950829 | 0.952258433 | 0.90651801 | 0.905660377 | 0.902229846 |

Figure 2. Table that displays the accuracy, standard deviation, and maximum accuracy

for the by varying the number of nodes in the hidden layer for the pen data.

Figure 3. Displays the accuracy vs. the number of nodes in the hidden layer for the pen data.

* 1. Car Data

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Nodes in Hidden Layer | |  |  |  |  |  |  |  |
| **Metrics** | **0** | **5** | **10** | **15** | **20** | **25** | **30** | **35** | **40** |
| Accuracy | 0.70353403 | 0.857722513 | 0.847774869 | 0.855890052 | 0.843586387 | 0.845549738 | 0.843979058 | 0.85078534 | 0.834554974 |
| Standard Deviation | 0 | 0.011475109 | 0.015958928 | 0.011812057 | 0.01197483 | 0.015977167 | 0.006808799 | 0.00987331 | 0.014020518 |
| Max Accuracy | 0.70353403 | 0.876963351 | 0.878926702 | 0.871727749 | 0.861256545 | 0.863874346 | 0.852094241 | 0.867146597 | 0.852094241 |

Figure 4. Table that displays the accuracy, standard deviation, and maximum accuracy

for the by varying the number of nodes in the hidden layer for the car data.

Figure 5. Displays the accuracy vs. the number of nodes in the hidden layer for the car data.

One thing that we notice immediately is that the average accuracy is 0 with 0 hidden nodes for the pen data. Clearly, without any hidden nodes, the neural network is unable to map the inputs to the large amount of outputs (10) well. However, since the car data has only binary output, the neural network with 0 hidden nodes for the car data performs much better. We also note that the standard deviation for both datasets with 0 hidden nodes is 0, signifying there is no variation in output when you have 0 hidden nodes. Furthermore, from Figures 3 and 5, we see that the pen data converges with just 10 hidden nodes, and the pen data does the same with just 5 hidden nodes. After these points, the accuracy does not drastically increase, but the training time does.