Project 4: Analysis Q5 and Q6

The code for Q5 and Q6 can be found in Testing.py. To run the experiment, add Q5() or Q6() to the file and run the command python Testing.py on your terminal.

Q5

The Pen data set was run several times with random restarts using its normal conditions; 16 inputs, 10 outputs, and 24 hidden layers. The net was trained with a training set of size 7494. The testing set was of size 3498. The table below shows the testing accuracy for each iteration. The overall max, average and standard deviation is also reported below.

Table 1. Training Accuracy for each Iteration for Pen dataset

Iteration	Test Accuracy
1	0.904803
2	0.907947
3	0.899943
4	0.901086
5	0.899371

Max Testing Accuracy: 0.907947398513
Average Testing Accuracy: 0.902630074328
Standard Deviation: 0.00326251403492

The same was done for the Car data set. With this dataset, the net was given 21 inputs, 4 outputs, and 16 hidden layers. The net was trained with a training set of size 1528. The testing set was of size 200. The table below shows the testing accuracy for each iteration. The overall max, average and standard deviation is also reported below.

Table 2. Training Accuracy for each Iteration for Car dataset

Iteration	Test Accuracy
1	0.97
2	0.97
3	0.96
4	0.955
5	0.96

Max Testing Accuracy: 0.97
Average Testing Accuracy: 0.963
Standard Deviation: 0.006

Q6

For this experiment, the number of perceptrons at each layer was increased by steps of 5. Similar to Q5, five iterations were run and the average test accuracy, the overall max and the standard deviation is reported. This was done for both the Pen dataset and the Car dataset.

Table 3. Results of Experiment 6 for Pen dataset

Number of Perceptrons	Average Test Accuracy	Overall Max	Standard Deviation
0	0	0	0
5	0.841909663	0.853630646	0.007095297
10	0.886049170955	0.894511149	0.007135726
15	0.902115495	0.906232133	0.002456552
20	0.901543739	0.907375643	0.004254105
25	0.906460835	0.909090909	0.001975661
30	0.904288165	0.907375643	0.001690308
35	0.904974271	0.908233276	0.002476433
40	0.90217267	0.904802744	0.002040774

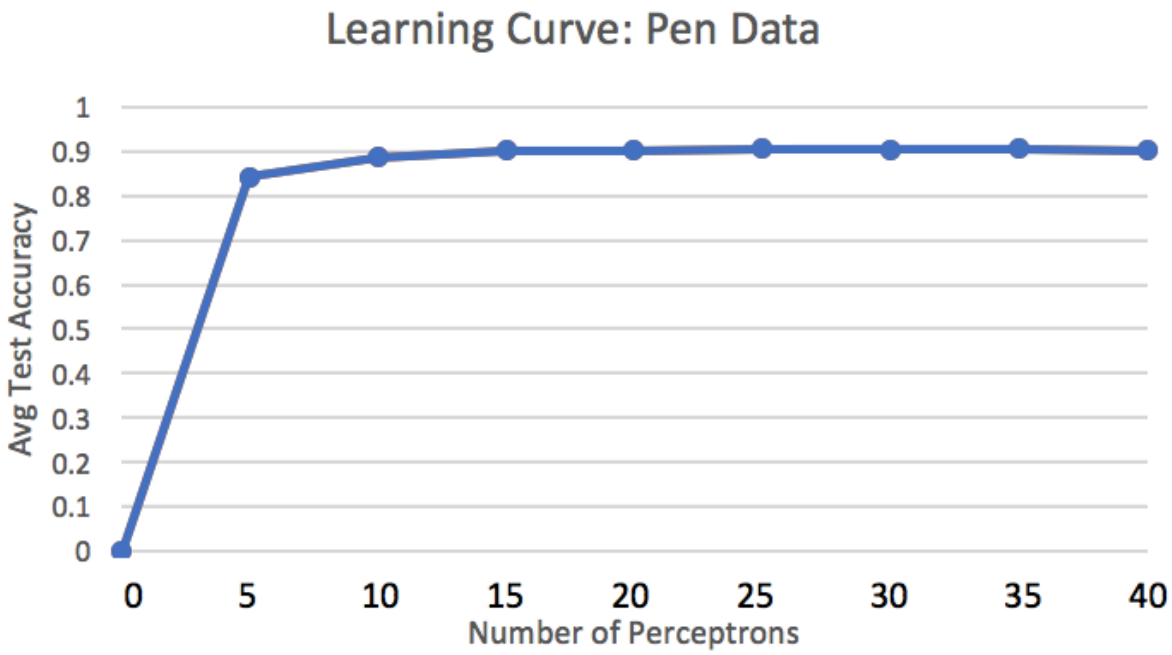
Table 4. Results of Experiment 6 for Car dataset

Number of Perceptrons	Average Test Accuracy	Overall Max	Standard Deviation
0	0.705	0.705	0
5	0.963	0.97	0.009797959
10	0.978	0.99	0.008717798
15	0.981	0.985	0.005830952
20	0.986	0.99	0.004898979
25	0.978	0.98	0.002
30	0.971	0.975	0.003741657
35	0.973	0.985	0.008717798
40	0.975	0.985	0.006324555

A learning curve for the Pen and Car dataset are shown in the next page. In both curves, you can see that the accuracy increases dramatically with the addition of more hidden layers. The net is better able to represent and model the trends in the data with higher complexity.

For the Pen dataset, the accuracy levels off with around 0.901 – 0.906. You can see that after 25 hidden layers, the addition of more hidden layers decreases the accuracy, but not very significantly. This can be that the net is starting to overfit the data but not significantly. This could be because the Pen data set is large in size, so you would probably need more than 40 hidden layers to see a significant trend downwards for overfitting. In the car dataset, the same occurs with the accuracy staying around 0.97. The neural net achieves the highest accuracy (98.6%) at 25 hidden layers and there a small decrease in accuracy from there. This could be due to overfitting but again, it is very insignificant. Since the Car dataset has a smaller test set, the net was able to achieve a higher test accuracy than the Pen dataset.

Graph 1: Learning Curve for Pen Data



Graph 2: Learning Curve for Car Data