Neural Net Report

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Question 5: Learning With Restarts

1. **testPenData**:
   - Max accuracy: 0.909949
   - Average accuracy: 0.905660
   - Standard deviation: 0.002505
2. **testCarData**:
   - Max accuracy: 0.995000
   - Average accuracy: 0.991000
   - Standard deviation: 0.003742

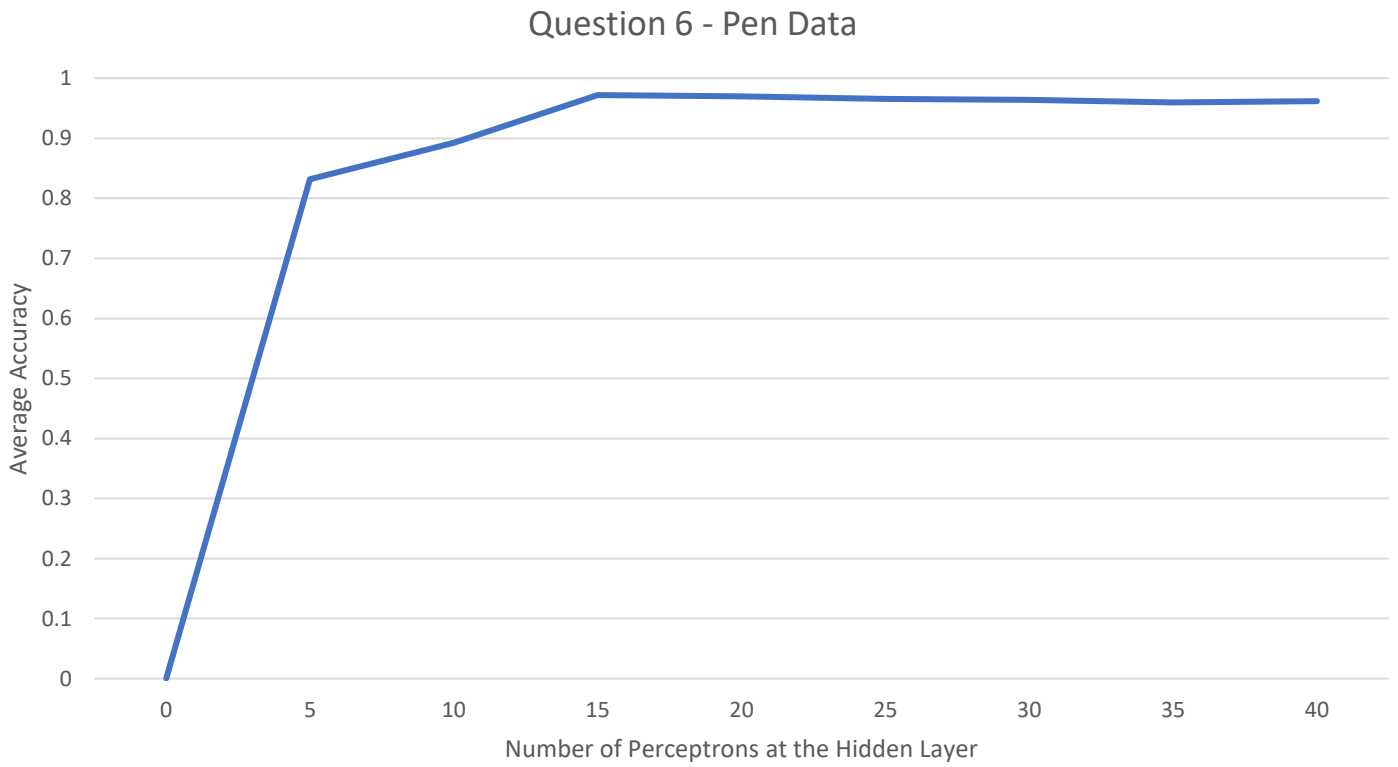
Question 6: Varying the Hidden Layers

Statistic table for **testPenData** – report the max, average, and standard deviation at various amount of perceptrons.

	Number of Perceptrons at the Hidden Layer								
	0	5	10	15	20	25	30	35	40
Max Accuracy	0	0.841052	0.899657	0.985000	0.985000	0.970000	0.970000	0.965000	0.975000
Avg Accuracy	0	0.831790	0.892796	0.972000	0.970000	0.966000	0.964000	0.960000	0.962000
Standard Deviation	0	0.007832	0.892796	0.008718	0.009487	0.003742	0.003742	0.003162	0.008124

Question 6: Varying the Hidden Layers

Create a learning curve for **testPenData** where the number of hidden layer perceptrons is the independent variable and the average accuracy is the dependent variable.



Question 6: Varying the Hidden Layers

For **testPenData**, discuss any notable trends you saw related to increasing the size of the hidden layers in your neural net.

Answer: The average accuracy appears to sharply increase between the range of 0 and 15 perceptrons in the hidden layer, hitting a ceiling at about 15 perceptrons with no meaningful difference or increase in accuracy occurring between 15 and 40 perceptrons.

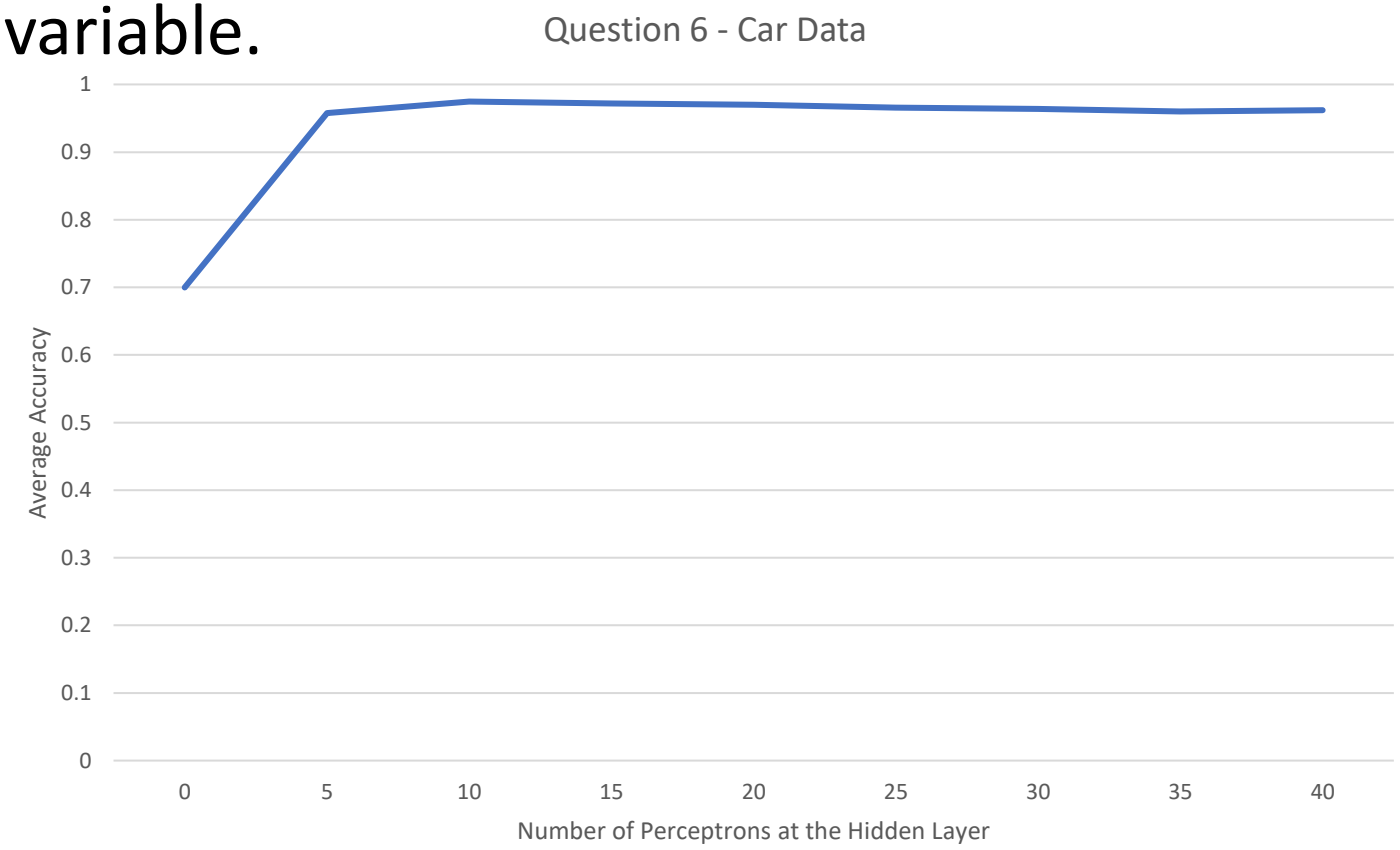
Question 6: Varying the Hidden Layers

Statistic table for **testCarData** – report the max, average, and standard deviation at various amount of perceptrons.

	Number of Perceptrons at the Hidden Layer								
	0	5	10	15	20	25	30	35	40
Max Accuracy	0.7	0.97	0.98	0.985	0.985000	0.970000	0.970000	0.965000	0.975000
Avg Accuracy	0.7	0.958	0.975	0.972	0.970000	0.966000	0.964000	0.960000	0.962000
Standard Deviation	0	0.009798	0.004472	0.008718	0.009487	0.003742	0.003742	0.003162	0.008124

Question 6: Varying the Hidden Layers

Create a learning curve for **testCarData** where the number of hidden layer perceptrons is the independent variable and the average accuracy is the dependent variable.



Question 6: Varying the Hidden Layers

For **testCarData**, discuss any notable trends you saw related to increasing the size of the hidden layers in your neural net.

Answer: There's a significant increase in average accuracy when the number of perceptrons in the hidden layer increases from 0 to 10. This time at 10 perceptrons, the neural net appears to plateau, in contrast to pen data plateauing at 15 perceptrons.

Question 7 (extra credit): Learning XOR

Report the max accuracy, average accuracy, and standard deviation of the neural net that you have trained with 1) no hidden layer, and 2) a hidden layer with various amount of perceptrons (at least 3 different amounts)

	No Hidden Layer	Hidden Layer		
		10 perceptrons	50 perceptrons	100 perceptrons
Max Accuracy	0.5	0.75	0.75	0.75
Avg Accuracy	0.5	0.55	0.55	0.6
Standard Deviation	0	0.1	0.1	0.122474

Question 7 (extra credit): Learning XOR

Report the behavior of the trained neural net **without a hidden layer**.

Answer: The neural net was able to predict the expected output of the XOR function with 2 inputs half of the time across all testing iterations, with 50% accuracy.

Question 7 (extra credit): Learning XOR

Report the behavior of the trained neural net **with a hidden layer**. Are the results what you expected? Explain your observation.

Answer: The neural slowly began to better predict the two-input XOR function up to 60% of the time being correct. However, there seems to be very little growth of accuracy even up to 100 perceptrons in a single hidden layer, given that at 50 perceptrons, the neural net was able to yield 5% better accuracy from 10 perceptrons. In theory, a neural net with at least 1 hidden layer should be able to learn XOR. The discrepancy can be due to too high of a learning rate and random weight initialization.

Question 8 (extra credit): Novel Dataset

List the name and the source of the dataset that you've chosen.

- Name: _____
- Source (e.g., URLs): _____
- Briefly describe the dataset: _____

Question 8 (extra credit): Run Stats

- Max accuracy: _____
- Average accuracy: _____
- Standard deviation: _____

Question 8 (extra credit): Novel Dataset

Describe how to run the code that you've set up to train the selected dataset.

Answer: