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CS 3600 – Introduction to AI

Project 4b

Question 5: (Learning with Restarts)

PenData	Test Accuracy	Mean	Max	Standard Deviation
Run 1	0.907662	0.900972	0.907662	0.006730859
Run 2	0.906804			
Run 3	0.896512			
Run 4	0.891938			
Run 5	0.901944			

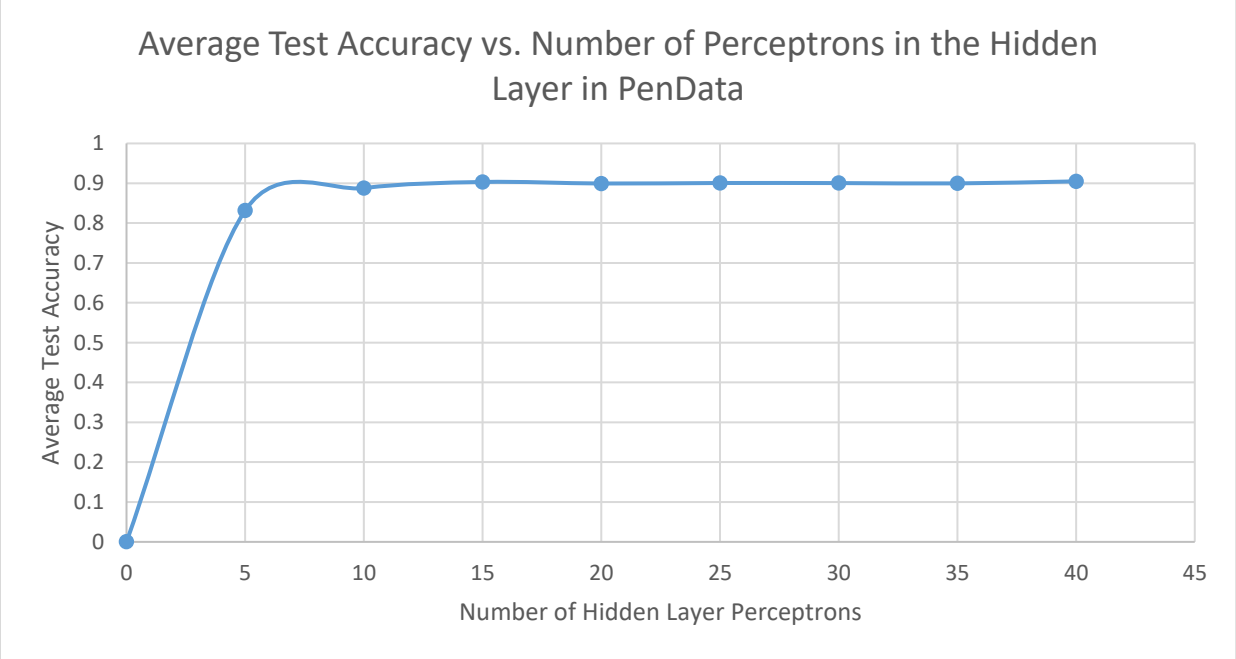
Upon running five iterations of testPenData, the mean test accuracy was 0.900972, the max test accuracy was 0.907662, and the standard deviation of the five test accuracies was 0.006730859. The low standard deviation suggests little changes between each run which corresponds to stable algorithm design and the high mean test accuracy suggests good accuracy with regards to correct classification.

Car Data		Mean	Max	Standard Deviation
Run 1	0.844241	0.855104	0.868455	0.009169125
Run 2	0.855366			
Run 3	0.857984			
Run 4	0.849476			
Run 5	0.868455			

Upon running five iterations of testCarData, the mean test accuracy was 0.855104, the max test accuracy was 0.868455, and the standard deviation of the five test accuracies was 0.009169125. Once again, the relatively low standard deviation shows stable algorithm design. The mean test average was still high, but lower than the testPenData's mean, which suggests some difficulty in the neural net's ability to tease apart the non-linearity of the data.

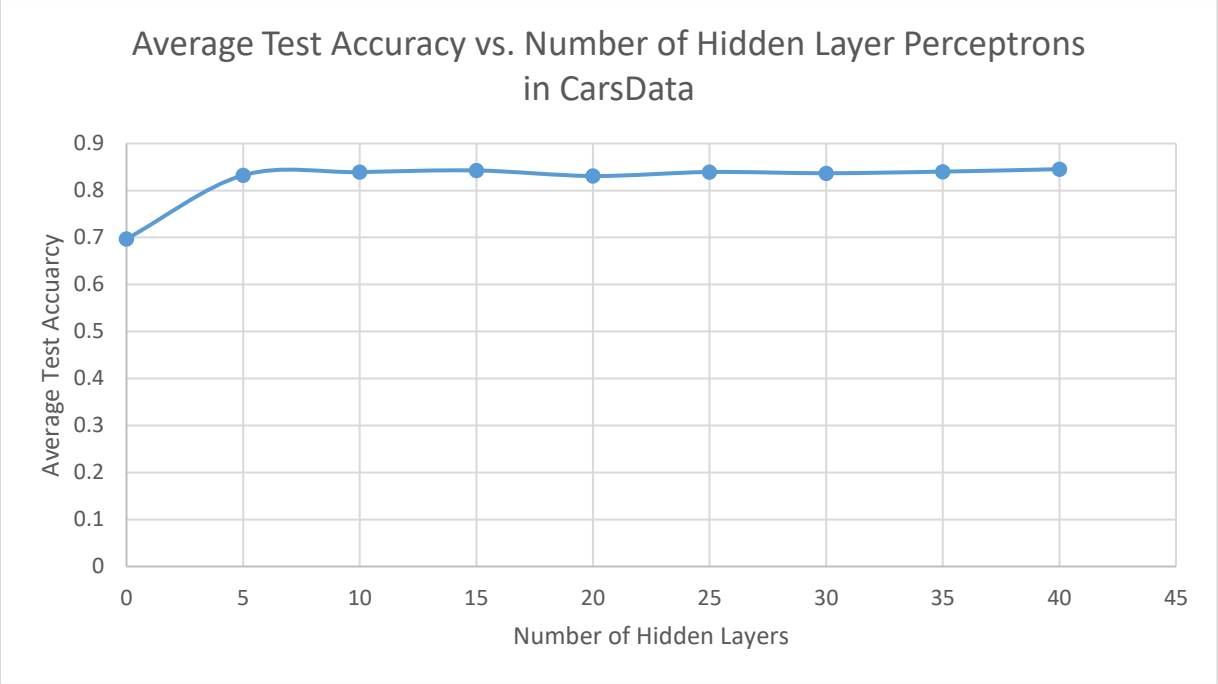
Question 6: (Varying the Hidden Layer)

Number of Hidden Layer Perceptrons in PenData	Run 1	Run 2	Run 3	Run 4	Run 5	Mean	Max	Standard Deviation
0	0	0	0	0	0	0	0	0
5	0.821326	0.819897	0.849914	0.824185	0.843339	0.831732	0.849914	0.013879993
10	0.891081	0.86821	0.885935	0.899657	0.894797	0.887936	0.899657	0.012118841
15	0.897942	0.906804	0.91052	0.899085	0.901944	0.903259	0.91052	0.005308275
20	0.899085	0.884505	0.906518	0.904517	0.902516	0.899428	0.906518	0.008782302
25	0.891081	0.906518	0.89737	0.907662	0.9008	0.900686	0.907662	0.006818022
30	0.907662	0.902802	0.904231	0.903087	0.884791	0.900515	0.907662	0.008999694
35	0.904517	0.900515	0.899943	0.899657	0.893939	0.899714	0.904517	0.00377878
40	0.90566	0.904803	0.903087	0.902802	0.907376	0.904746	0.907376	0.001889905



For the PenData, the average test accuracy increased drastically from when ran using zero hidden layer perceptrons to using five hidden layer perceptrons. This just shows the challenges of attempting to classify very non-linear data without the help of hidden layer perceptrons (zero accuracy when zero hidden layer perceptrons are used). From ten hidden layer perceptrons to forty hidden layer perceptrons, the accuracy did not change that much suggesting there is a limit to accuracy improvements (adding more and more hidden layer perceptrons does not equate to drastically increased test accuracy).

Number of Hidden Layer Perceptrons in CarData	Run 1	Run 2	Run 3	Run 4	Run 5		Mean	Max	Standard Deviation
0	0.69699	0.69699	0.69699	0.69699	0.69699		0.69699	0.69699	0
5	0.834424	0.812173	0.840969	0.842932	0.831152		0.83233	0.842932	0.012238381
10	0.850785	0.85733	0.818063	0.849476	0.820026		0.839136	0.85733	0.018593681
15	0.834424	0.857984	0.837696	0.846859	0.836387		0.84267	0.857984	0.009801525
20	0.832461	0.821335	0.828534	0.82199	0.850131		0.83089	0.850131	0.011712631
25	0.844895	0.852094	0.823298	0.849476	0.827225		0.839398	0.852094	0.01323219
30	0.82788	0.82199	0.872382	0.834424	0.827225		0.83678	0.872382	0.020385689
35	0.827225	0.854058	0.844895	0.85733	0.817408		0.840183	0.85733	0.017286907
40	0.829843	0.848822	0.848168	0.848168	0.852094		0.845419	0.852094	0.008858073



For the CarData, the average test accuracy increased a decent amount (from roughly 0.69 to roughly 0.84) from when ran using zero hidden layer perceptrons to using five hidden layer perceptrons. Unlike the PenData, the CarData can still be reasonably separated and the positive examples can be teased apart from the negative ones without the use of any hidden layer perceptrons (suggesting the data is not as non-linear as the PenData). Still from ten hidden layer perceptrons to forty hidden layer perceptrons, the accuracy did not change that much suggesting there is a limit to accuracy improvements (similar to the PenData but with a decreased overall average accuracy).