Handwritten Digits Classification

CSE574 Introduction to Machine Learning

Group No - 22
Vishnoo Srinath
Mouli Bollini
Disha Suyogi

1. Choosing hyper-parameter for Neural Network:

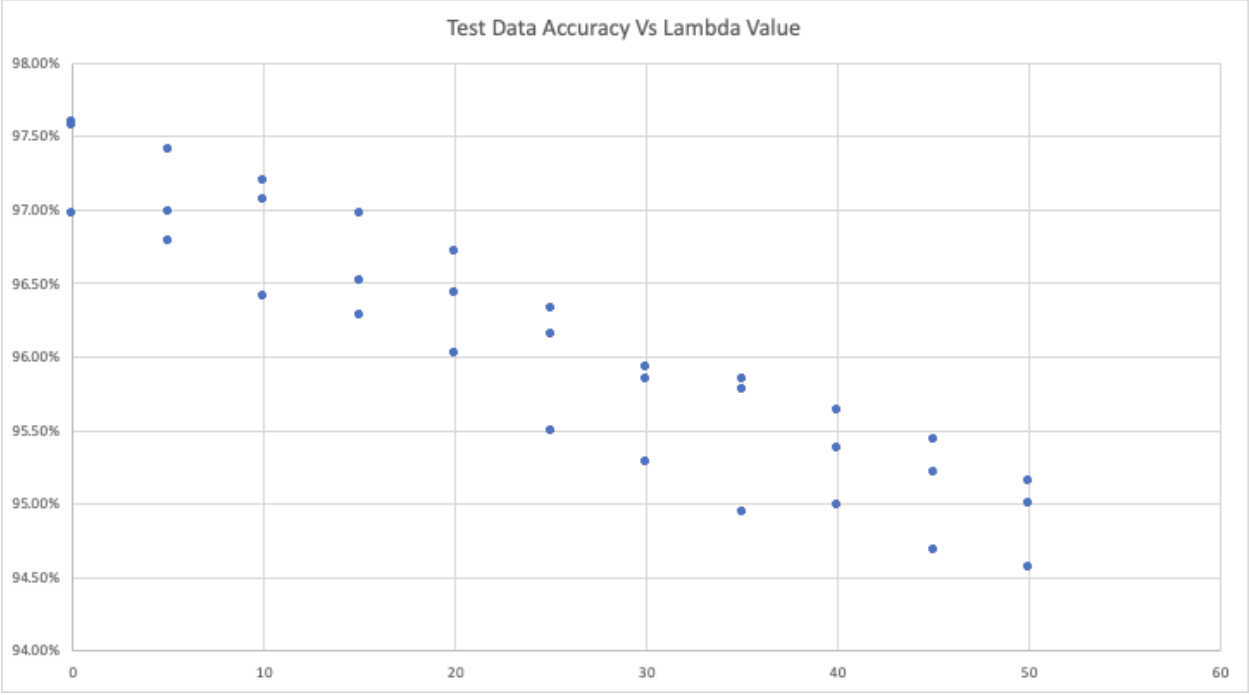
Performance of the neural networks depends upon the following parameters:

- ❖ Number of Hidden Nodes
- ❖ Regularization Term- Lambda

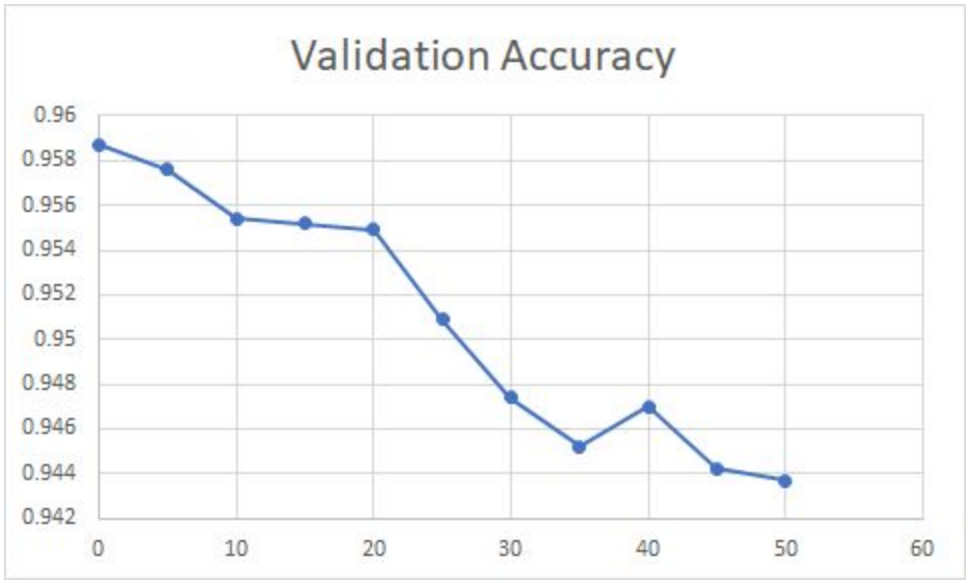
In order to choose the hyper-parameters for optimum performance, We varied the number of Hidden Nodes as follows:
Number of nodes: 30,40,50
We varied regularization term ie Lambda as follows:
Lambda: 0,5,10,15,20,25,30,35,40,45,50

Lambda versus Accuracy with different number of Hidden Nodes:

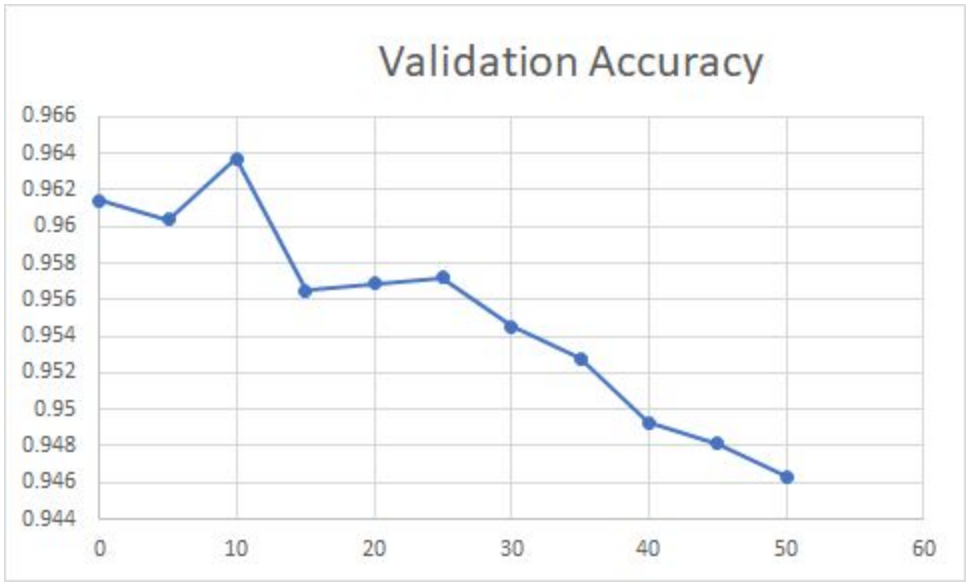
Accuracy of classification method on the MNIST data-set:
Node in hidden unit - 30,40,50 and Lambda: 0,5,10,15,20,25,30,35,40,45,50



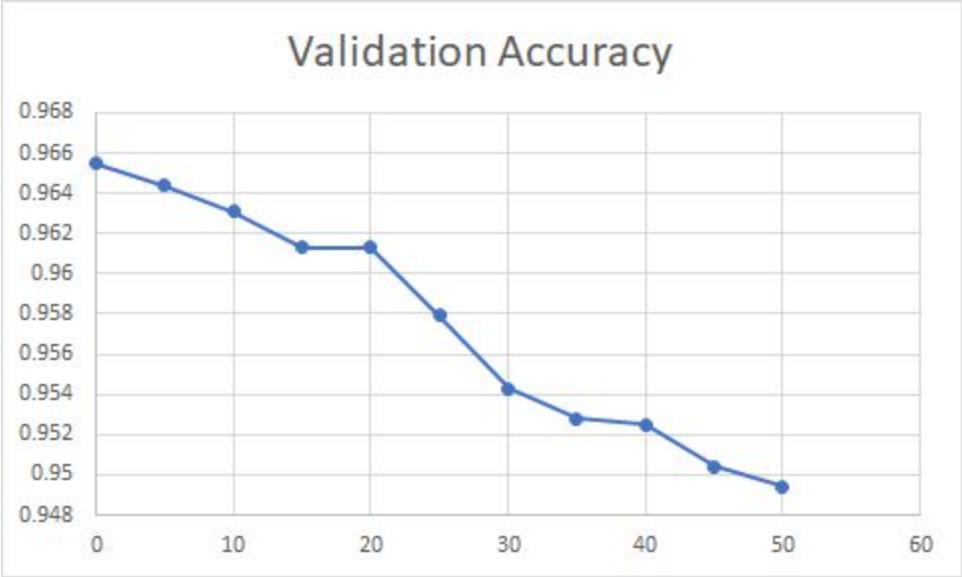
Node in hidden unit - 30



Node in hidden unit - 40

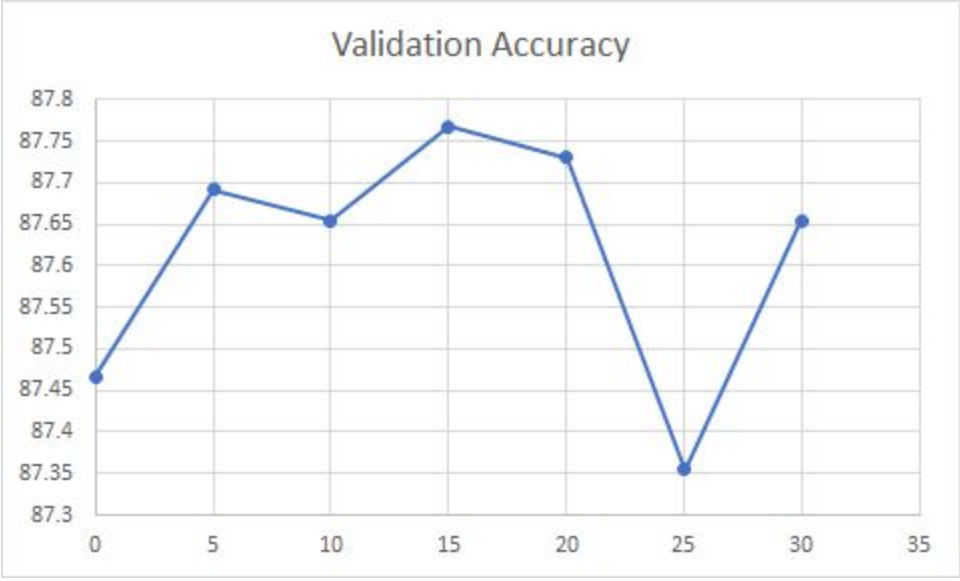


Node in hidden unit - 50

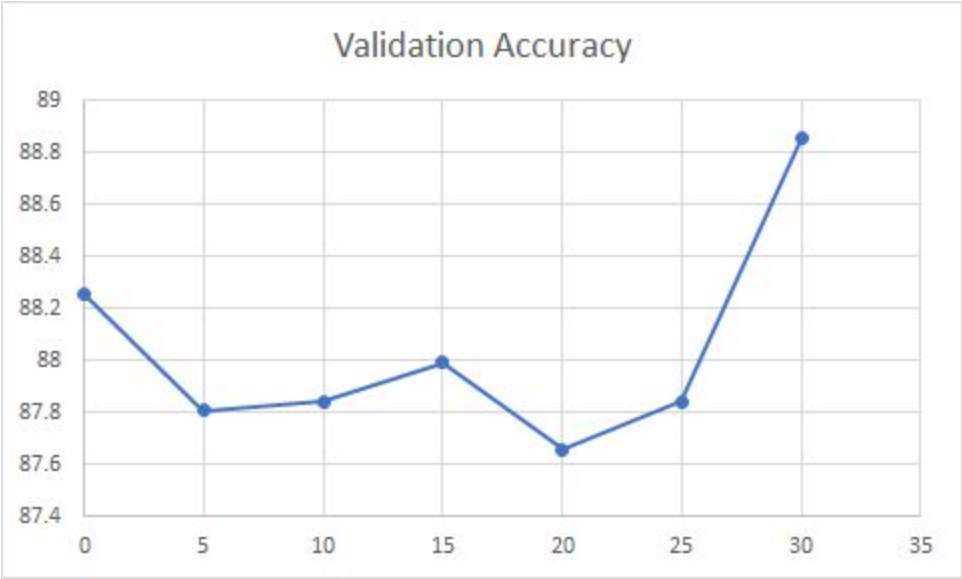


3.Accuracy of classification method on the CelebA data-set:

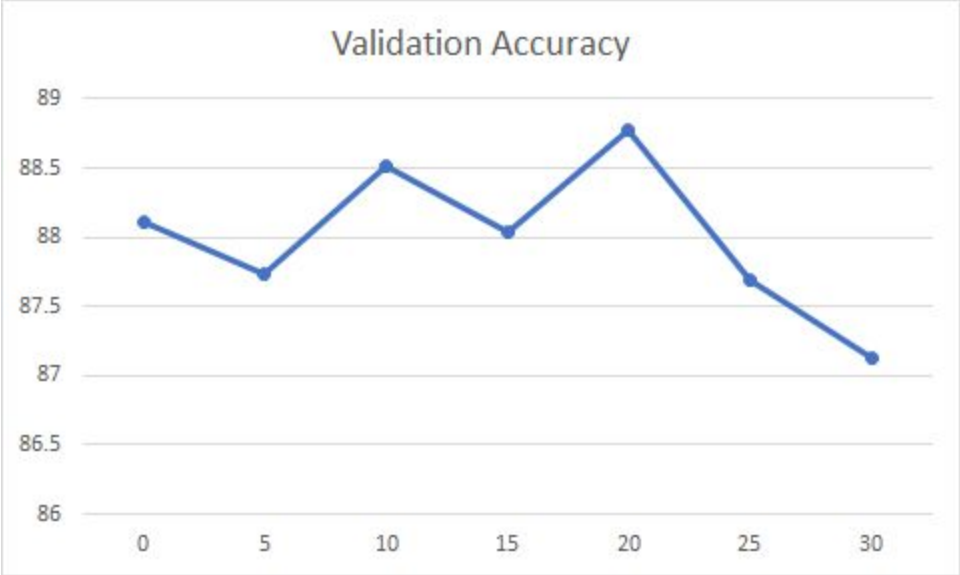
Node in hidden unit - 30



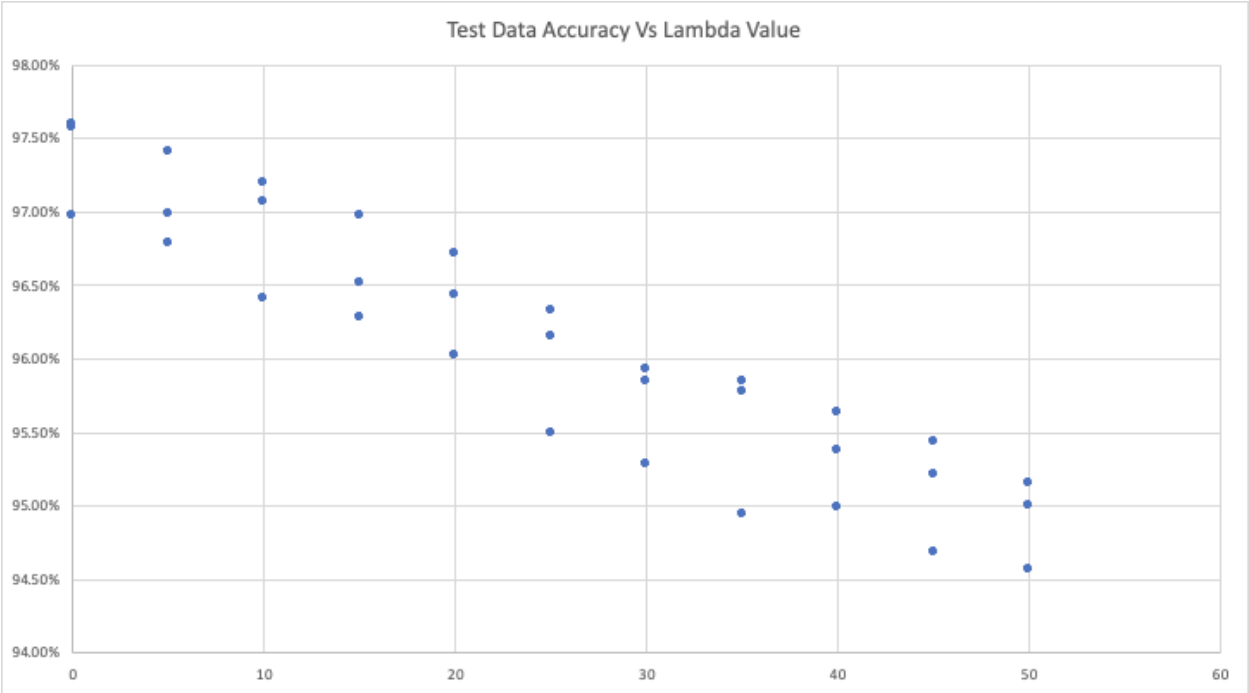
Node in hidden unit - 40



Node in hidden unit - 50

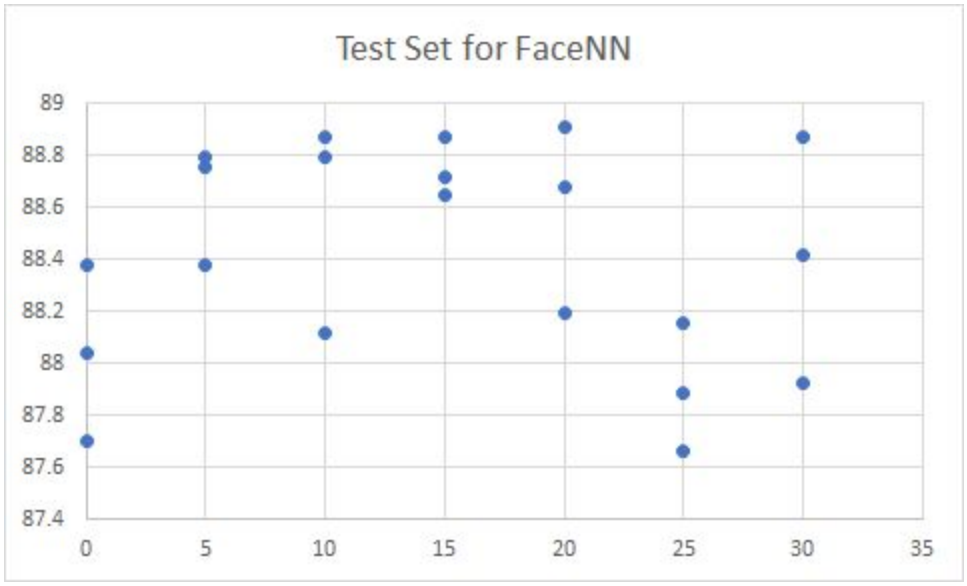


2: **Accuracy of classification method on handwritten digits' test data**



With the output from the nnscript we are able to find that with lambda value 0 the accuracy is high compared to other lambda values, 5 is relatively close to 0. Still the best accuracy is produced with lambda value 0. For hidden unit value of 50 and Lambda value of 0 we get an accuracy of 97.60%

3)Accuracy of classification method on the CelebA data set



With the output from the facescript we are able to find that with lambda value 15 has the best accuracy is high compared to other lambda values. With the Lambda value 15 we are able to get higher accuracy for all 3 different number of hidden unit 30,40 and 50. Out of which the highest we are able to observe is with 88.87%(Lambda = 15 and hidden unit 50). But the overall highest accuracy is with Lambda value 20 and hidden unit 50, where accuracy = 88.91%

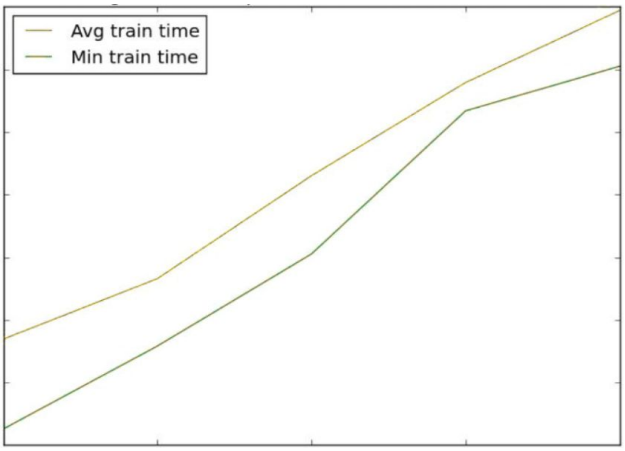
4.Comparison of your neural network with a deep neural network in terms of accuracy and training time

Deep Neural Network Accuracy - 82.9 %

Facenn Accuracy - 88.91%
Time taken - Around 110 seconds on average (Lambda value as a parameter for hidden unit number = 50)

The computations are carried out on the CelebA. Results show that as we increase the hidden layers, the time for computation also increases. However, the accuracy not necessarily increases as we increase the hidden layers.
Occam's Razor comes into play here as more computations may not lead to more accuracy.
We can conclude that single layer neural network is showing a much better accuracy than all the deep neural networks. It is better in terms of time parameter as well.

Relation between Number of Hidden Units and Training Time -
After considering the values obtained from training, we can conclude that there is a direct correlation between number of hidden units and the training time. The reason is the addition of more weights to consider which will further add a computational complexity to the network. Time is essential to get more optimized solution.



5. Report the results from convolutional neural network in terms of accuracy and training time

This took many hours in my personal computer. The convolutional neural network model is provided is applied to handwritten digits data set. The time it takes is much longer than single layer neural network. But, its training accuracy can reach to 99.7%, and the test accuracy can reach to 98.6%.

Evidently, Convolutional neural network will have more accurate results. But, it also takes longer time to train. So, if there is no time constraint and computing constraint, they are preferred.