Machine Learning

Project – II Report

Group-5

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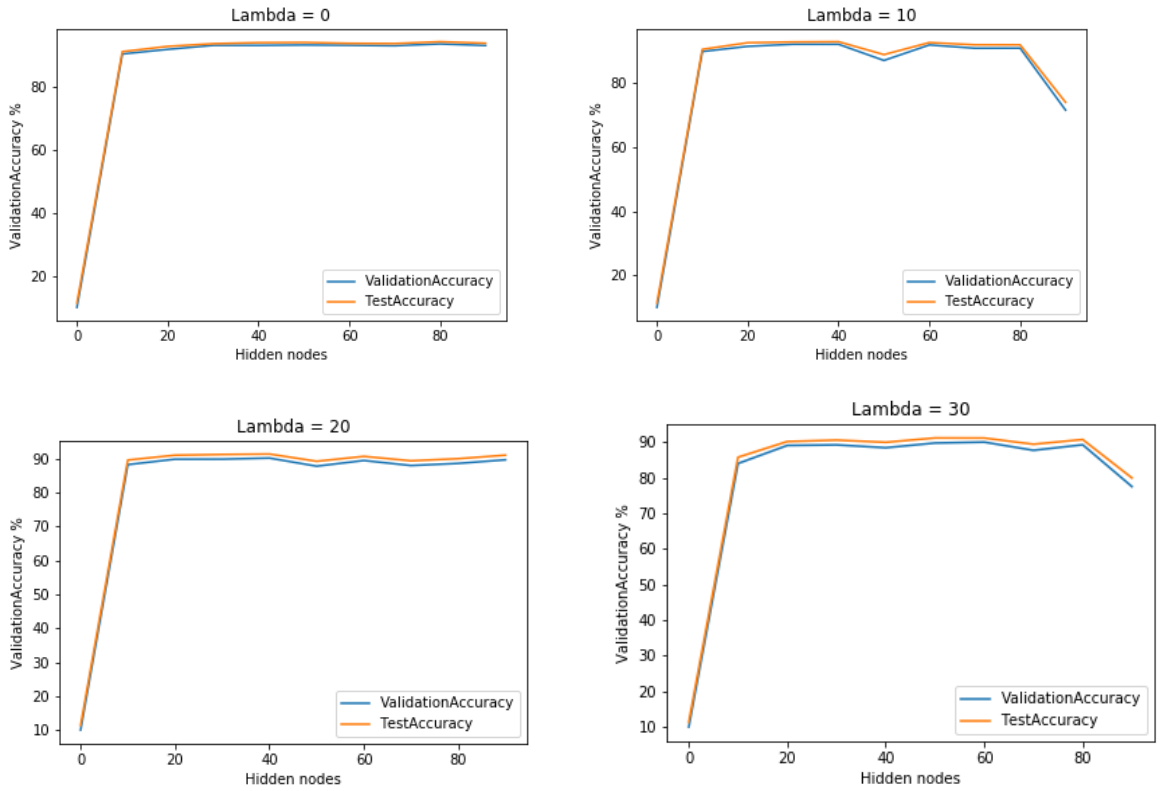
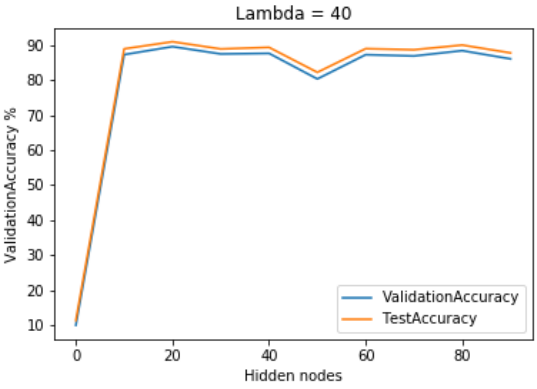
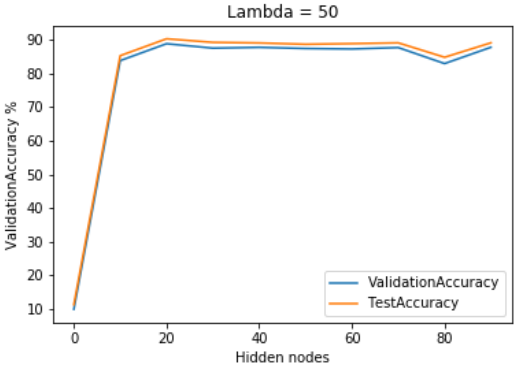
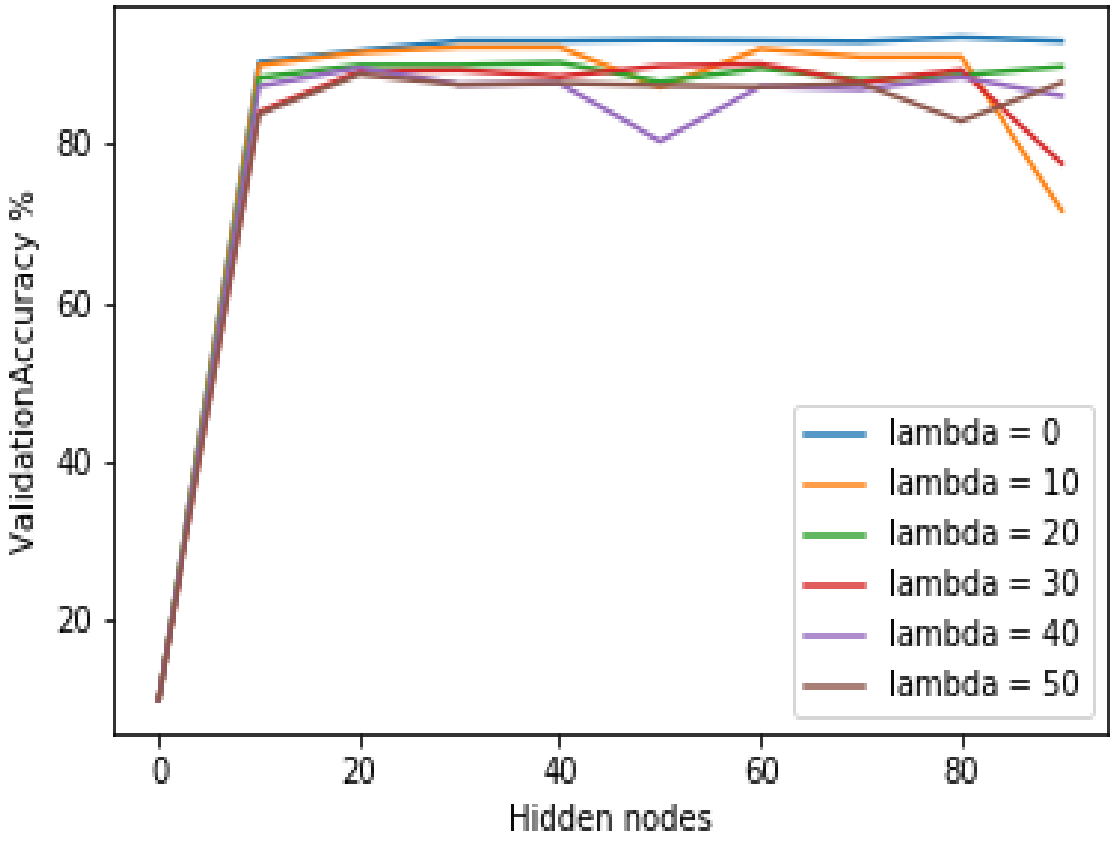
In order to decide the hyper parameters, we should consider validation set to avoid the bias and report the accuracy from the test data set, but in the case of Handwritten digits' classification the variation in Test and validation accuracies are similar:




Lambda = 40
ValidationAccuracy %
Hidden nodes
ValidationAccuracy
TestAccuracy


Lambda = 50
ValidationAccuracy %
Hidden nodes
ValidationAccuracy
TestAccuracy


ValidationAccuracy %
Hidden nodes
lambda = 0
lambda = 10
lambda = 20
lambda = 30
lambda = 40
lambda = 50

The hyper parameters based on the best validation accuracy are given below:

Lambda	Hidden	TrainAccuracy	ValidationAccuracy	TestAccuracy	Time
0	80	94.454	93.44	94.14	96.533633

We can see that the **regularization parameter with lower values** and **no of Hidden Nodes with higher values** tend to have higher test accuracies. The case with the highest accuracy of 94.14% (Hidden Layer nodes = 80 & lambda = 0) is falling in above hypothesis region.
Hence, we can conclude with confidence that **Hidden Layer nodes = 60 & lambda = 10** would be the best set of hyper-parameters in our case.

CelebA Dataset:

Neural network (1-Hidden layer) on CelebA Dataset: Classified the images from CelebA dataset using the previous algorithm to run the 1 hidden layer neural network. The No. of Hidden nodes considered in the range of (0,300) and the values of lambda that are considered are {0,5,10,15}. The best accuracy came to about:

- Accuracy: 85.84
- No of hidden nodes: 200
- Lambda: 0
- Time taken: 158.48

Deep Neural Network on CelebA Dataset: We used multiple layers and found the accuracies as follows:

No of layers	No of nodes in layers	Accuracy	Time taken
2	100,100	0.7316427	125.69220209121704
3	66,66,66	0.836866	93.86904454231262
4	50,50,50,50	0.7937169	87.87740015983582
5	40,40,40,40,40	0.8319455	81.88056254386902
6	33,33,33,33,33,33	0.75018924	80.6524925232

We have considered the same no of total nodes in all the cases which is 200, the best accuracy is 83.68% at 3 no of layers. We can see that the accuracy is best for single layered neural network for this data set

CNN on MNIST Dataset:

Convolutional Neural Network was run on MNIST dataset.
Accuracy = 98.7%
Total time = 19 minutes
We can see that CNN performed way better than 1-Hidden layer NN even though CNN took a lot of time to process (15 minutes more than 1-Hidden layer NN).

For the plots and tabulated values, data stored in data frames and screen shots have been shared along with the code.