CSE 574 Project 2

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1 How to choose the hyper-parameter for Neural Network

1.1 The data of experiment

The hyper-parameter for Neural Network are the value of lambda and number of hidden units. With implementing the *preprocess*, *nnPredict*, and *nnObject* on classification of hand written digits, we have results as shown in figure 2 and 1. We can see the accuracy is negatively proportional with the λ. Meanwhile, The more hidden units used in the layers, the higher accuracy and the less amount of time takes in training shown in figure 2 and 3.

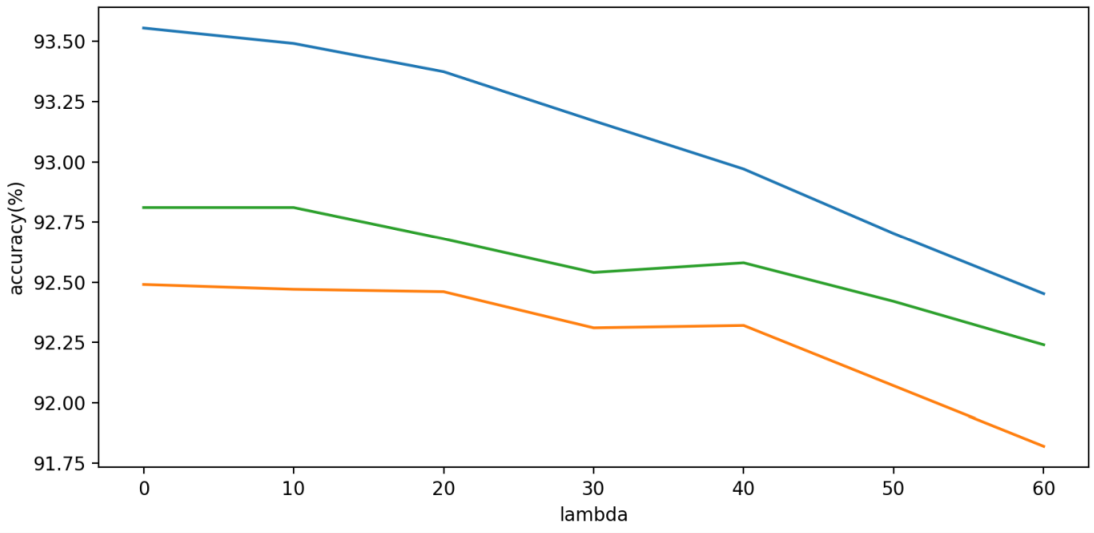

Figure 1: Accuracy vs. λ (Blue:Train, Green:Test, Orange: Validation)

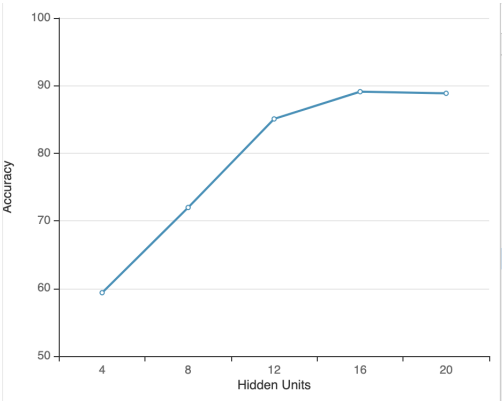

Figure 2: Accuracy vs Hidden Unit

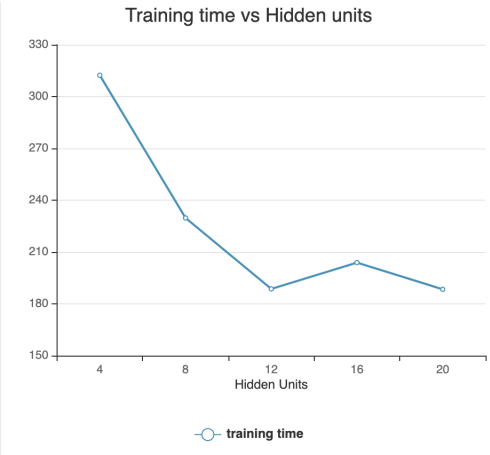

Figure 3: Training Time vs Hidden Unit

1.2 Explanation of choosing hyper-parameter

Therefore, when $\lambda = 0$, the more hidden units we have, the higher the accuracy will be. For the best result, we chose lambda = 0(lowest) and hidden units= 20(highest) as optimal so our hyper-parameter is $\lambda = 0$ and hidden units =20.

1.3 Accuracy of classification method on the handwritten digits test data

Time to train(sec)	188.4079
Training set Accuracy(%)	93.556
Validation set Accuracy(%)	92.81
Test set Accuracy(%)	92.49

Table 1: $\lambda = 0$ Hidden unit=20

2 Accuracy of classification method on the CelebA data set

We ran 3 times and have results as shown in figure 2. The test set accuracy is about from 84 % to 86%. So it is stable.

λ	Training set Accuracy(%)	Validation set Accuracy(%)	Test set Accuracy(%)	Learning Time(sec)
10	85.34	83.82	85.95	237.45
20	85.81	85.47	85.91	219.68
30	84.81	83.52	85.27	217.37

Table 2: λ vs. Training Accuracy vs. Validation Accuracy vs. Test Accuracy vs. Learning Time

3 Comparison of Deep Neural Network and single layer Neural Network

The maximum accuracy that we get from the DeepNN was around 81.11 percent while the maximum accuracy of single layer network is 85.95% (table 4).

Layers	Accuracy(%)	Learning Time(sec)
2	81.11	205.173
3	78.00	233.945
4	77.82	226.753
5	79.94	231.018
6	78.58	227.821
7	80.01	226.193

Table 3: Layers vs. Accuracy vs. Learning Time (Deep Neural Network)

Features	single layer NN(%)	Deep NN(%)
Layers	1	2
Accuracy(%)	85.95	81.11
Time Taken(sec)	237.4532	205.1732

Table 4: deepnn vs single layer nn

The accuracy of single layer Neural Network is better than Deep Neural Network, We can get that a more complicated Network with more layers doesn't mean it is better

4 Convolutional Neural Network

With running the code of *cnn.py*, we obtain the result as shown in figure 4. It takes 13 minutes and result in accurayc of 98.8%.

```
Time usage: 0:13:00
Accuracy on Test-Set: 98.8% (9884 / 10000)
```

Figure 4: The results of *cnn.py*