

Report for Deep Learning (CS541)_Homework4:

Report By:

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Section 1:

We have executed grid search on following values of hyperparameters:

```
def findBestHyperparameters(trainX, trainY, testX, testY):  
  
    hidden_layers_list=[3,4,5]  
    hidden_numbers_list = [30,40,50]  
    mini_batch_size_list=[16,32,64]  
    epsilon_list=[0.001,0.05,0.01,0.1]  
    epochs_list=[40,60,80]  
    alpha_list=[0.00001,0.0001,0.00002]
```

Results:-

We found the best sets of hyperparameters as:

```
Best Hyper Parameters:  
Best_Hidden_Layers: 3  
Best_hidden_num: 50  
Best_epochs: 60  
Best_batch_size: 32  
Best_learning_rate: 0.01  
Best_alpha: 1e-05
```

Then we trained a network again with this set of hyperparameters.

The accuracy on test dataset is **87.63%**

```
Best_accuracy on validation data : 88.66666666666667  
  
loss value on best hyperparameters: 0.38623964269013394  
  
Accuracy on Test data: 87.63
```

This accuracy could be improved if we run more permutation & combinations of learning rate and number of epochs.

Check Grad Result is:

```
=====scipy.optimize.check_grad=====
8.525204103949736e-07
=====
```

Training Loss and Accuracy over last 20 epochs:

```
epoch 40
Loss on epoch: 0.36444022581832214 Accuracy: 87.5
epoch 41
Loss on epoch: 0.36680166225958766 Accuracy: 87.49
epoch 42
Loss on epoch: 0.3676567069853738 Accuracy: 87.45
epoch 43
Loss on epoch: 0.36727133423829683 Accuracy: 87.56
epoch 44
Loss on epoch: 0.3673685374454361 Accuracy: 87.66
epoch 45
Loss on epoch: 0.3684902257779519 Accuracy: 87.56
epoch 46
Loss on epoch: 0.36783142470602165 Accuracy: 87.67
epoch 47
Loss on epoch: 0.37094414733555137 Accuracy: 87.58
epoch 48
Loss on epoch: 0.3709786593841844 Accuracy: 87.59
epoch 49
Loss on epoch: 0.3721762897834018 Accuracy: 87.54
epoch 50
Loss on epoch: 0.3750475348478041 Accuracy: 87.53
epoch 51
Loss on epoch: 0.3741490826678035 Accuracy: 87.6
epoch 52
Loss on epoch: 0.37311214677500876 Accuracy: 87.6
epoch 53
Loss on epoch: 0.3767252146494509 Accuracy: 87.6
epoch 54
Loss on epoch: 0.3766752580744547 Accuracy: 87.62
epoch 55
Loss on epoch: 0.3805942601583852 Accuracy: 87.56
epoch 56
Loss on epoch: 0.37898338308882684 Accuracy: 87.54
epoch 57
Loss on epoch: 0.3816350929548209 Accuracy: 87.72
epoch 58
Loss on epoch: 0.383325143106604 Accuracy: 87.57
epoch 59
Loss on epoch: 0.38623964269013394 Accuracy: 87.63
```

Section 2:

Code:

```
plotSGDPath(trainX[:, 0:5000], trainY[:, 0:5000], trajectory, hidden_layers, hidden_num)
```

Visualization of SGD Trajectory:

