

Implementation Design:

For this problem specifically a 2 hidden layer fully connected NN was chosen as it had a suitable degree of non-linearity. To avoid overfitting and to determine when to stop the training, I started with learning rate = 1 and regularization = $2e-3$ and ran a fine search in the search space to find the most suitable values for both while monitoring the training loss, validation loss, training accuracy, and validation accuracy. Gradient Descent was used, and the weights were adjusted after each epoch. In addition to keeping a close eye on the learning rate, the ReLU activation function was applied.

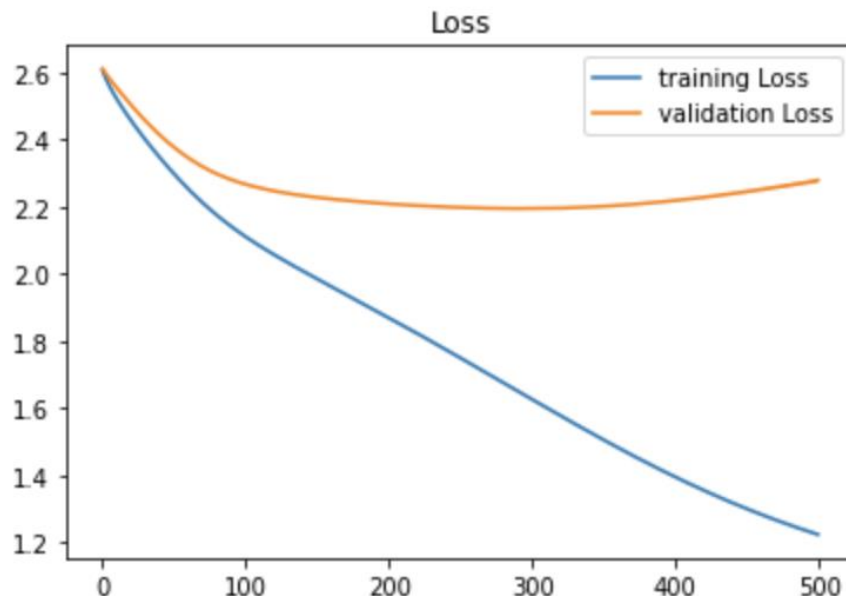
Numerical Examples:

Highest training accuracy

```
Epoch 492:Tr_loss: 1.232572, val_loss: 2.272711,Tr_acc: 0.975830 , val_acc: 0.493000 , lr: 0.050000 , Reg:0.001000
Epoch 493:Tr_loss: 1.231159, val_loss: 2.275660 ,Tr_acc: 0.975281 , val_acc: 0.494000 , lr: 0.050000 , Reg:0.001000
Epoch 494:Tr_loss: 1.229754, val_loss: 2.273741 ,Tr_acc: 0.976404 , val_acc: 0.494000 , lr: 0.050000 , Reg:0.001000
Epoch 495:Tr_loss: 1.228357, val_loss: 2.277088 ,Tr_acc: 0.976030 , val_acc: 0.494000 , lr: 0.050000 , Reg:0.001000
Epoch 496:Tr_loss: 1.226965, val_loss: 2.275111 ,Tr_acc: 0.976779 , val_acc: 0.494000 , lr: 0.050000 , Reg:0.001000
Epoch 497:Tr_loss: 1.225579, val_loss: 2.278514 ,Tr_acc: 0.976030 , val_acc: 0.492000 , lr: 0.050000 , Reg:0.001000

Epoch 498:Tr_loss: 1.224204, val_loss: 2.276471 ,Tr_acc: 0.977154 , val_acc: 0.494000 , lr: 0.050000 , Reg:0.001000
Epoch 499:Tr_loss: 1.222831, val_loss: 2.279991 ,Tr_acc: 0.977154 , val_acc: 0.492000 , lr: 0.050000 , Reg:0.001000
```

Training vs validation loss:



Testing accuracy:

testing accuracy is : 54.40 %

Accuracy of all flowers in our fully connected neural network:

**Daisy accuracy: 36.00 %
dandelion accuracy: 73.00 %
roses accuracy: 42.00 %
sunflowers accuracy: 68.00 %
tulips accuracy: 53.00 %**

Accuracy of all flowers in KNN:

```
Total correct answers for daisy: 13 and the accuracy is 2.6  
Total correct answers for dandelion: 34 and the accuracy is 6.8000000000000001  
Total correct answers for roses: 21 and the accuracy is 4.2  
Total correct answers for sunflowers: 20 and the accuracy is 4.0  
Total correct answers for tulips: 32 and the accuracy is 6.4  
Total correct answers: 120  
Accuracy: 24.0
```

Accuracy of all flowers in the Linear classifier:

```
Acc: 21.6  
Total correct answers for daisy: 23 and the accuracy is 23.0  
Total correct answers for dandelion: 25 and the accuracy is 25.0  
Total correct answers for roses: 17 and the accuracy is 17.0  
Total correct answers for sunflowers: 13 and the accuracy is 13.0  
Total correct answers for tulips: 30 and the accuracy is 30
```