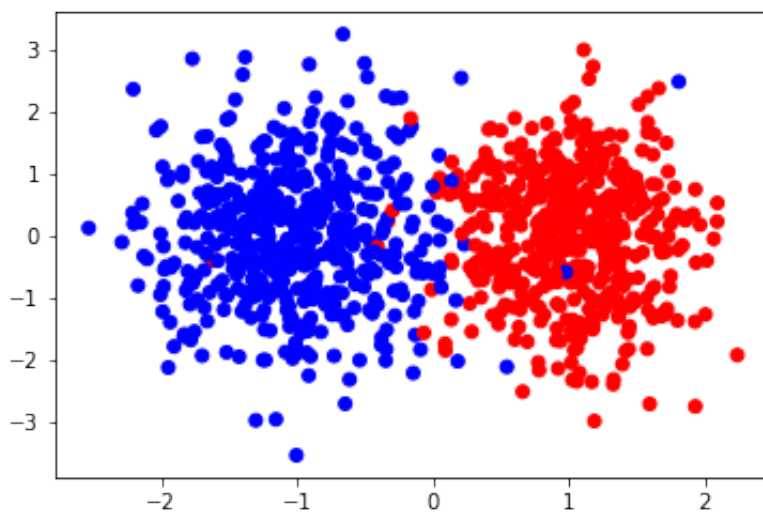


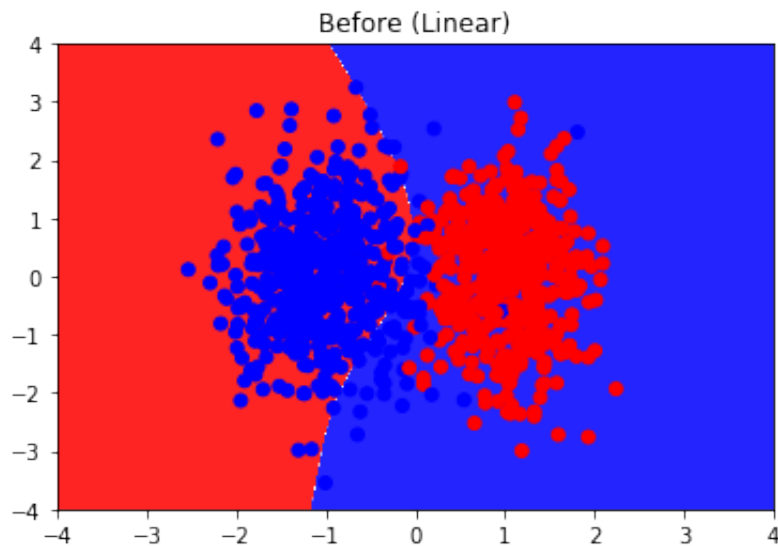
# Programming Assignment - 1

Subdivision 3,4,5,7 Goals: 1) Implement a 3 layer NN (1 hidden layer) 2) Train the model with linear data 3) Visualize the decision boundary learned by this model 4) Train this model on non-linear data 5) Visualize the decision boundary learned by this model 6) Visualize the effect of learning rate on NN 7) Tabularize the effect of number of nodes in the hidden layer 8) L2 Regularization

## 1) Implement a 3 layer NN (1 hidden layer)

Load Data (Linear)

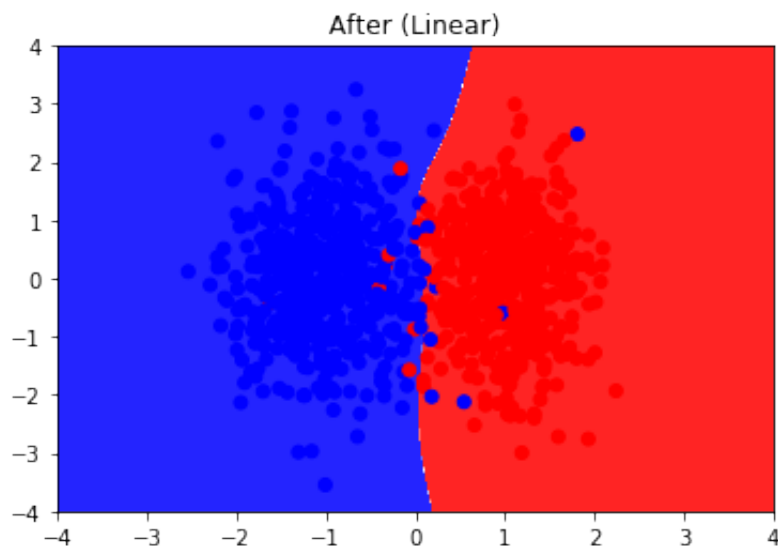




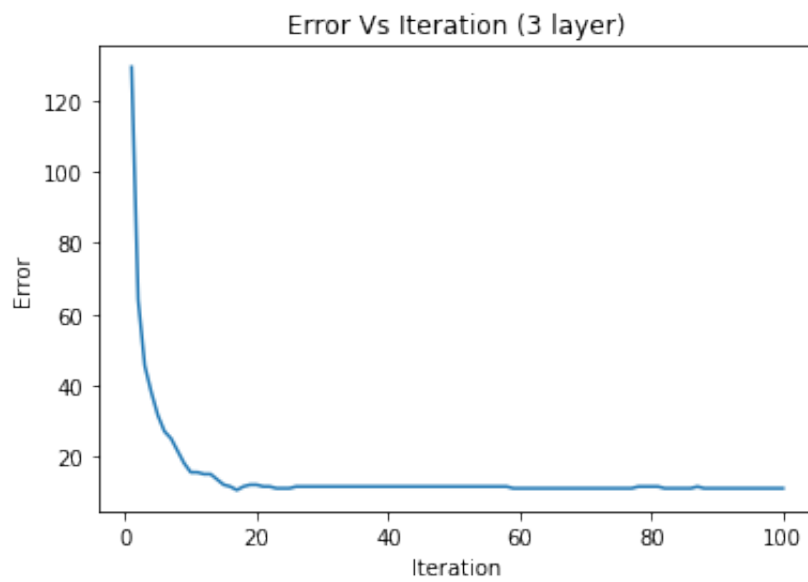
## 2) Training the Model with Linear data

Out[114]: 52

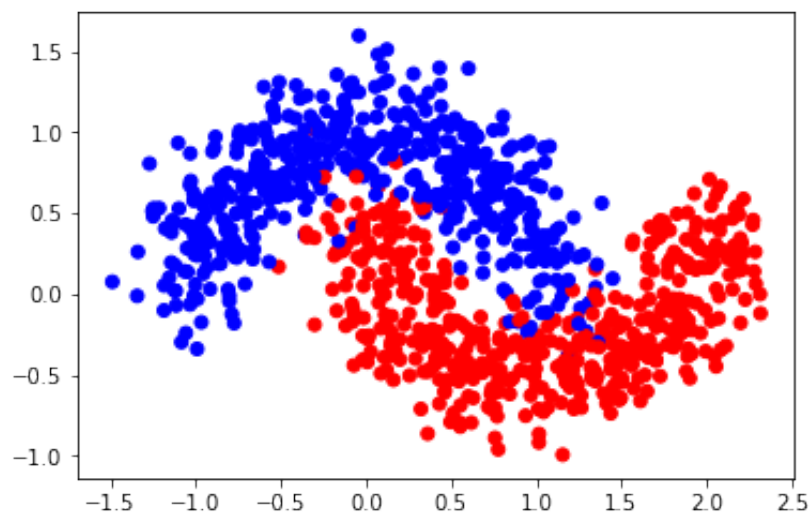
## 3) Visualize & evaluate the decision boundary learned by this model

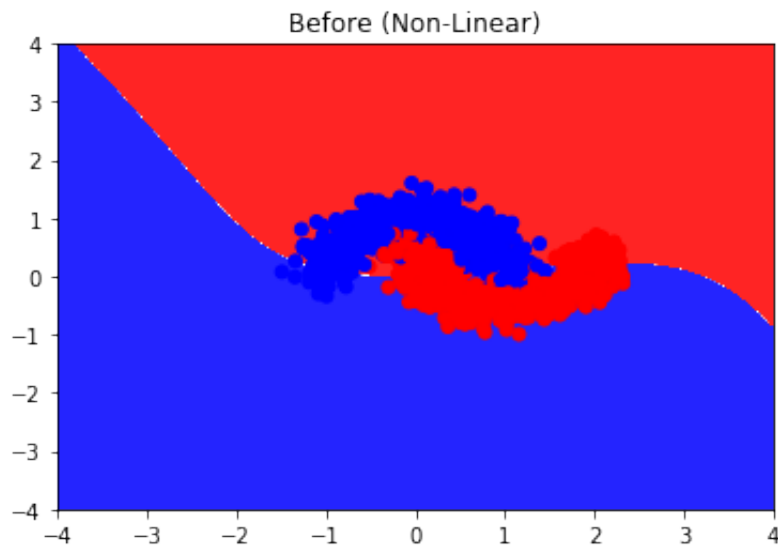


```
('ACCURACY: ', 0.983)
('CONFUSION MATRIX: \n', array([[492., 8.],
[ 9., 491.])))
```



### Load Data (Non-Linear)

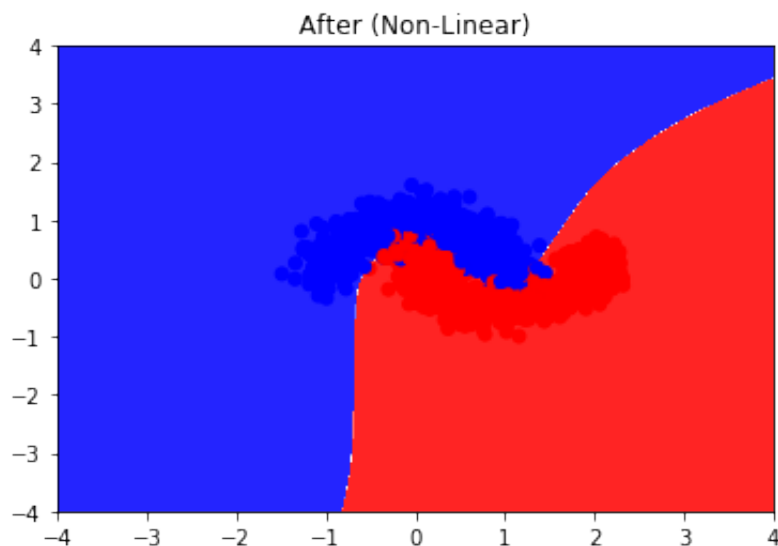




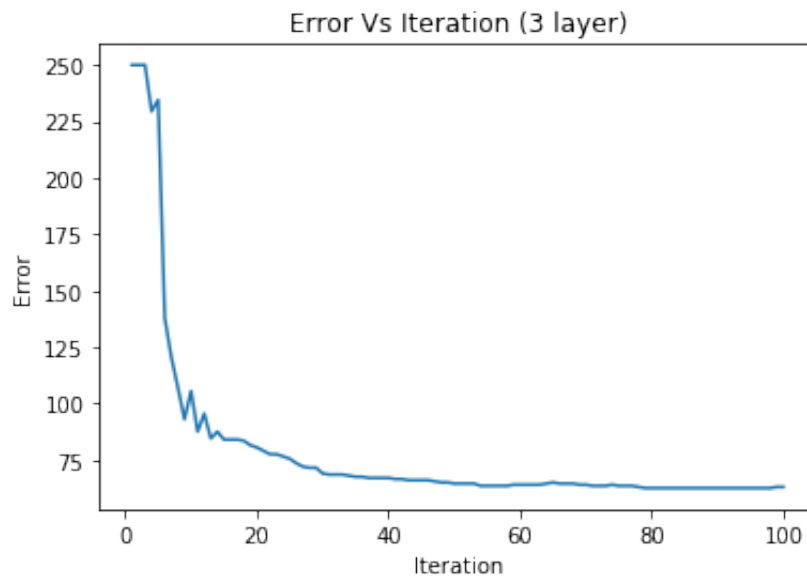
## 4) Training the Model with Non-Linear data

Out[127]: 52

## 5) Visualize and Evaluate decision boundary learned by this Model

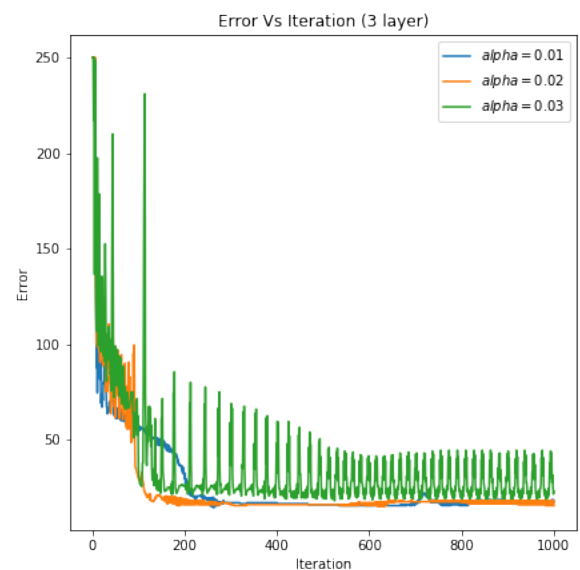
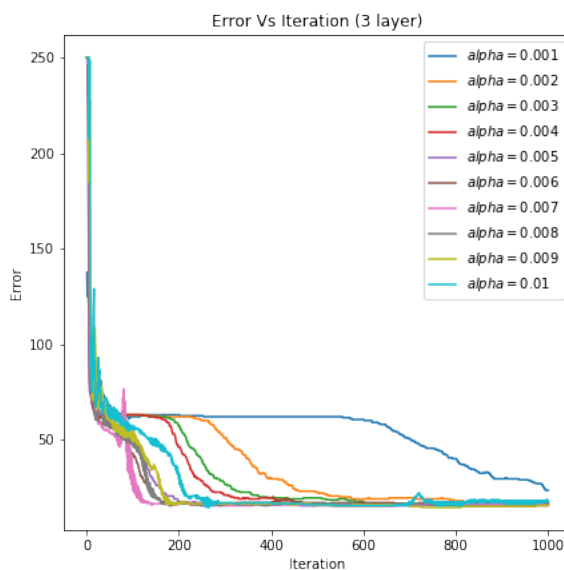


```
969.0
('ACCURACY: ', 0.969)
CONFUSION MATRIX:
[[483.  14.]
 [ 17. 486.]]
```



## 6) Effect of learning rate on NN

NN has 10 hidden layers



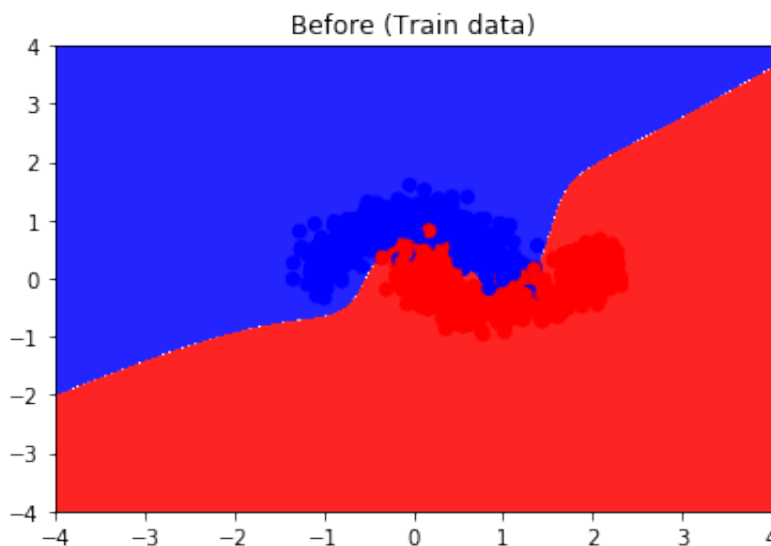
## 7) Effect of number of Hidden Layer nodes

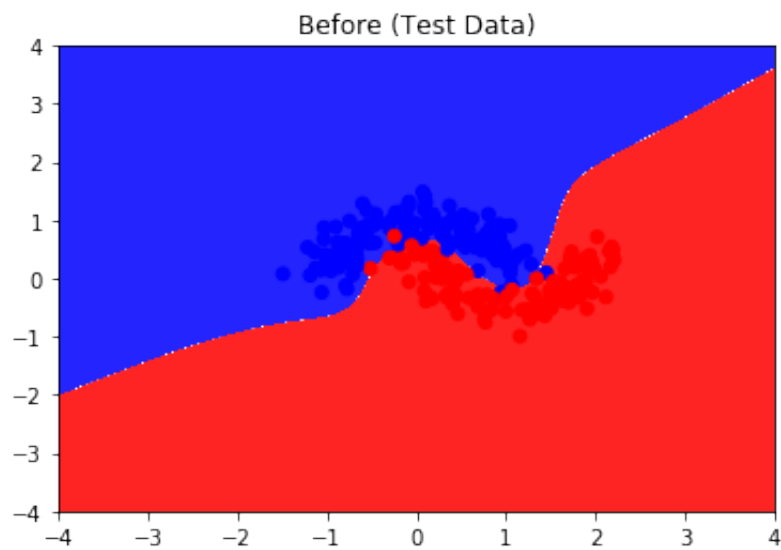
Evaluation through Accuracy, Cost function, time elapsed and number of updates

	#Nodes	Accuracy	CostFunction	TimeElapsed	#Updates
0	1.0	0.871	0.32527	0.61274	7.0
1	2.0	0.887	0.32277	1.04259	12.0
2	3.0	0.881	0.31302	0.89794	17.0
3	4.0	0.965	0.08812	0.85636	22.0
4	5.0	0.949	0.13034	0.59349	27.0
5	6.0	0.967	0.08321	0.61423	32.0
6	7.0	0.970	0.08226	0.89329	37.0
7	8.0	0.965	0.08770	0.79272	42.0
8	9.0	0.966	0.08741	0.65206	47.0
9	10.0	0.969	0.07930	0.70333	52.0
10	11.0	0.969	0.07901	0.69074	57.0
11	12.0	0.966	0.08566	0.85673	62.0
12	13.0	0.967	0.07928	0.99102	67.0
13	14.0	0.967	0.07828	0.77222	72.0
14	15.0	0.968	0.07905	0.75163	77.0
15	16.0	0.965	0.08733	0.76503	82.0
16	17.0	0.968	0.07993	0.89266	87.0
17	18.0	0.969	0.07796	0.90861	92.0
18	19.0	0.966	0.08168	0.93453	97.0
19	20.0	0.967	0.07899	0.96632	102.0

## 8) L2 Regularization

Out[131]: 102

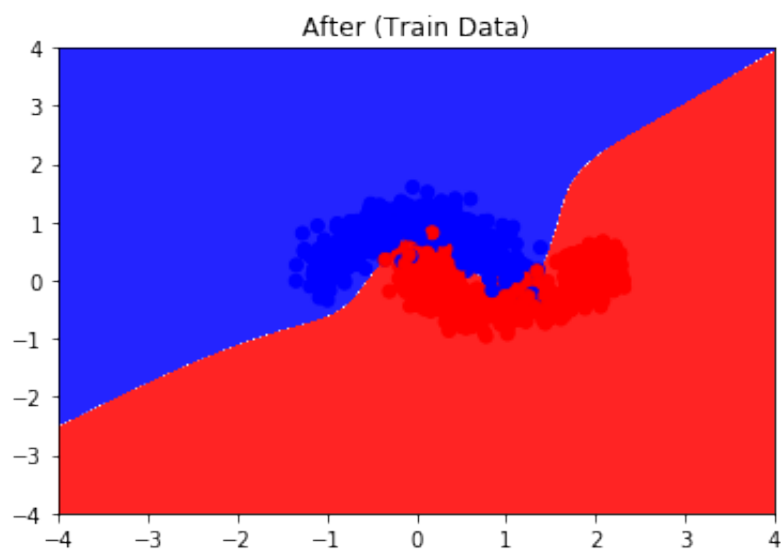


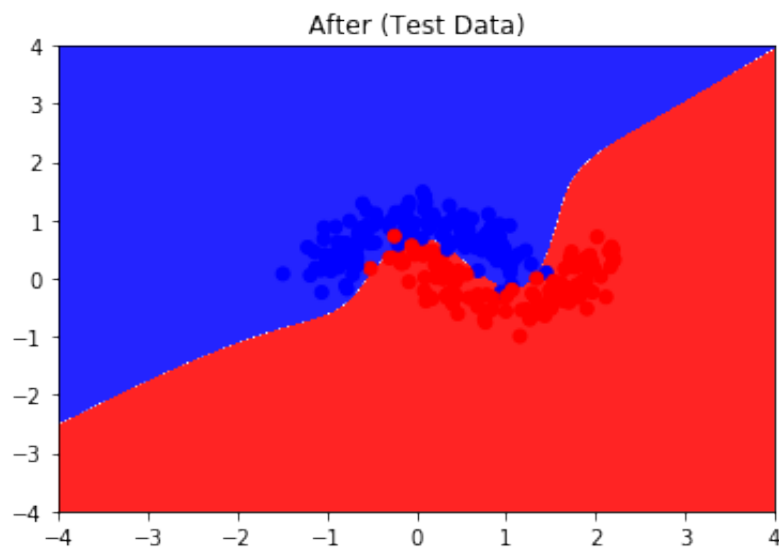


Training accuracy: 0.9627

Testing accuracy: 0.9800

Out[135]: 102





Training accuracy: 0.9733

Testing accuracy: 0.9520