Machine Learning: Assignment #2
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1. A Walk Through Linear Models

(a) Perceptron

(i)

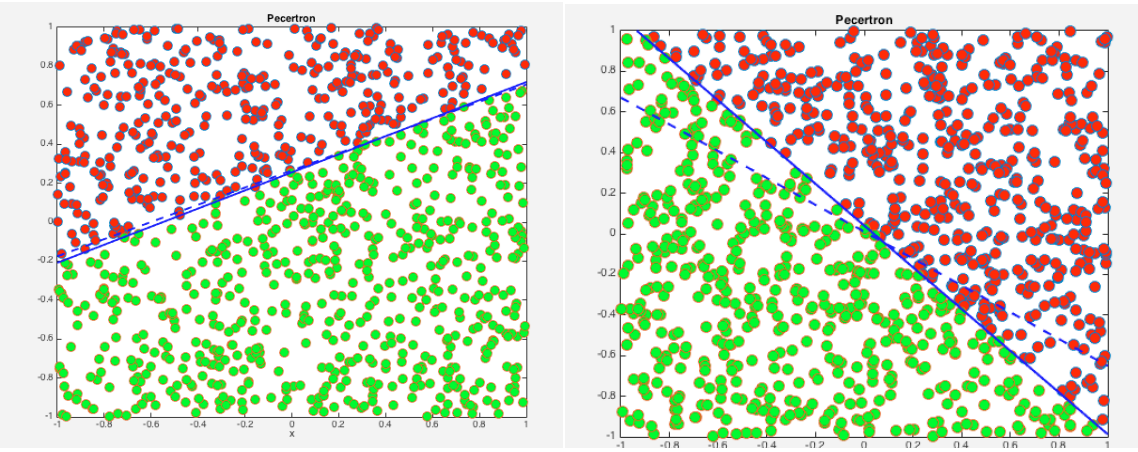
	Train error	Test error
nTrain= 10, nTest = 1000	0	0.111
nTrain = 100 ,nTest =1000	0	0.014

(ii)

	Average Iterations
nTrain = 10	10
nTrain = 100	452

(iii)

The algorithm won't stop.

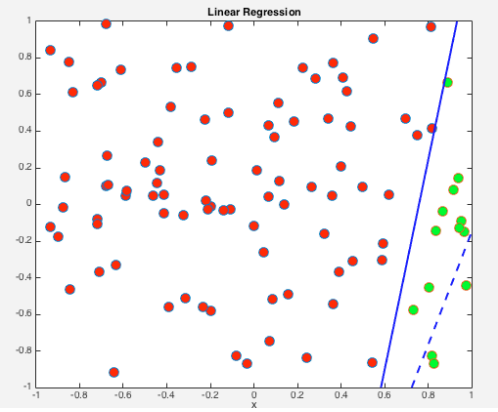


(1)100 train samples and 1000 test sample (2)10 train samples and 1000 test sample

(b) Linear Regreesion

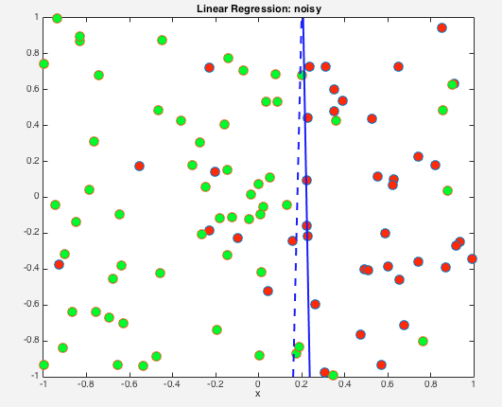
(i)

	Test error
nTrain = 100 nTest = 100	0.048



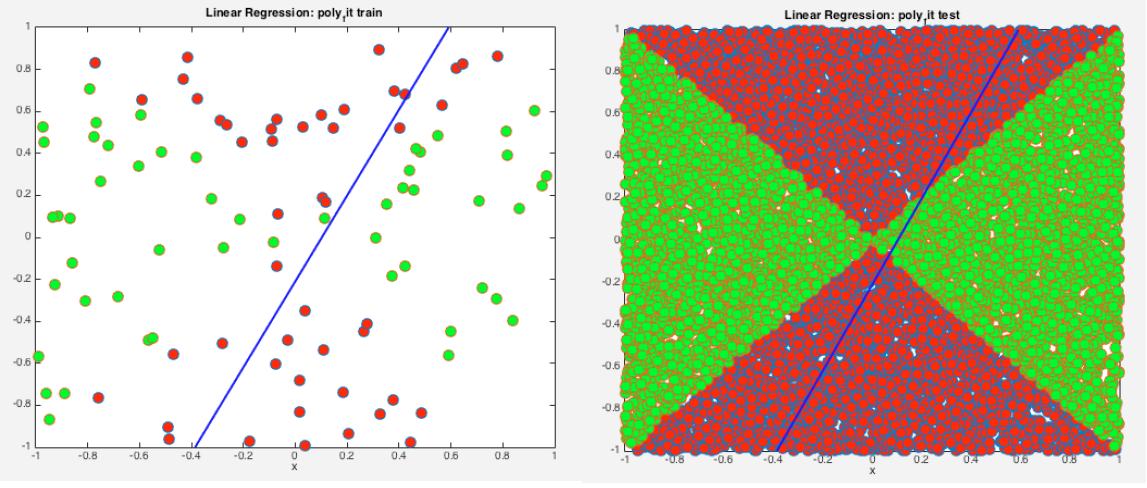
(ii)

	Training error	Test error
nTrain = 100 nTest = 100	0.136	0.149



(iii)

	Training error	Test error
nTrain = poly_train,nTest = poly_tset	0.49	0.5496



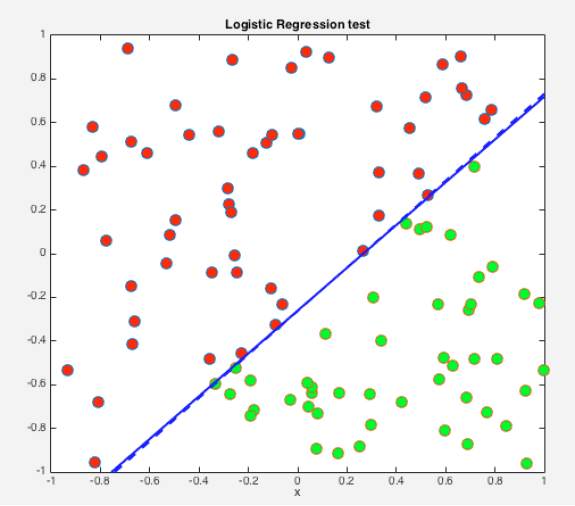
(iv)After trainsformation

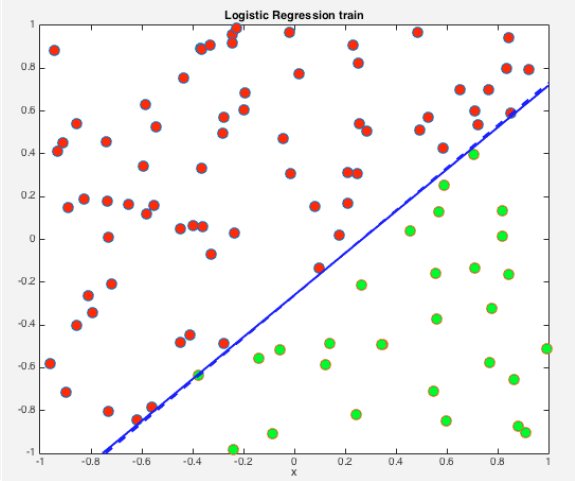
	Training error	Test error
nTrain = poly_train,nTest = poly_tset	0.05	0.066

(C)Logistic Regression

(i)

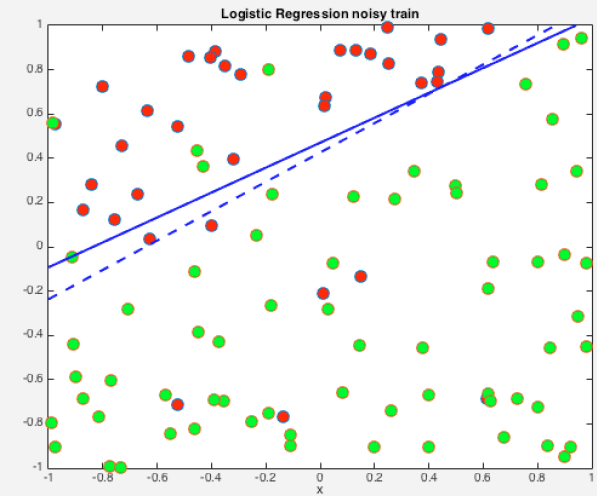
	Training error	Test error
nTrain = 100 nTest = 100	0.0071	0.0164

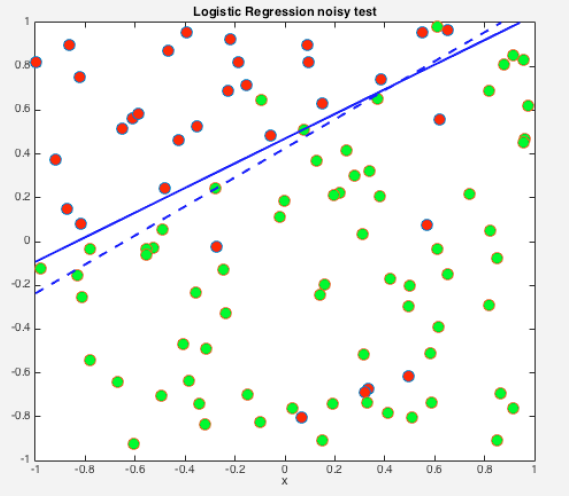




(ii)

	Training error	Test error
nTrain = 100 nTest = 100	0.228	0.2464

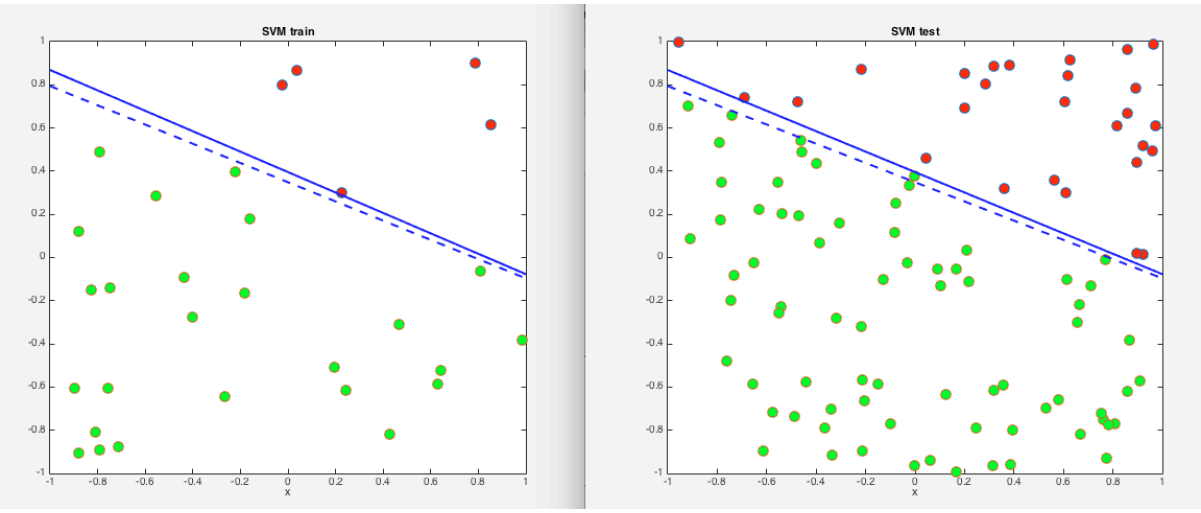




(d)Support Vector Machine

(i)

	Train error	Test error
nTrain = 30 ,nTest = 100	0	0.03187



(ii)

	Train error	Test error
nTrain = 100,nTest = 1000	0	0.010676

(iii)

	Number of average support vectors
nTrain = 100, nTest =1000	2.676

2. Regularization and Cross-Validation

(a)

(i)lambda =100

(ii)||w|| = 1.025064 when lambda = 0

```
In Ridge Regression,when lambda = 0.001000, E_val = 106.723834 wTw = 1.024248.
In Ridge Regression,when lambda = 0.010000, E_val = 106.602073 wTw = 1.022136.
In Ridge Regression,when lambda = 0.100000, E_val = 105.415992 wTw = 1.001634.
In Ridge Regression,when lambda = 0.000000, E_val = 106.737399 wTw = 1.024483.
In Ridge Regression,when lambda = 1.000000, E_val = 96.007857 wTw = 0.843664.
In Ridge Regression,when lambda = 10.000000, E_val = 66.866969 wTw = 0.407475.
In Ridge Regression,when lambda = 100.000000, E_val = 46.491760 wTw = 0.133258.
In Ridge Regression,when lambda = 1000.000000, E_val = 63.829109 wTw = 0.033679.
Ridge Regression lambda chosed by LOOCV is 100.000000
when lambda = 0,wTw = 1.025604
```

(iii)

	Train error	Test error
Lambda = 100,nTrain = 200,nTest = 1991	0	0.059
Lambda = 0 nTrain = 200,nTest = 1991	0	0.126067

(b)

	Train error	Test error
Lambda=0.01,nTrain=200,nTest=1991	0.025	0.1160
Lambda=0,nTrain=200,nTest=1991	0.51	0.1145

Lambda = 0.01

```
In logistic Regression with Reg,when lambda = 0.001000, E_val = 20.000000
In logistic Regression with Reg,when lambda = 0.010000, E_val = 19.000000
In logistic Regression with Reg,when lambda = 0.100000, E_val = 21.000000
In logistic Regression with Reg,when lambda = 0.000000, E_val = 20.000000
In logistic Regression with Reg,when lambda = 1.000000, E_val = 21.000000
In logistic Regression with Reg,when lambda = 10.000000, E_val = 25.000000
In logistic Regression with Reg,when lambda = 100.000000, E_val = 84.000000
In logistic Regression with Reg,when lambda = 1000.000000, E_val = 107.000000
Logistic:lambda chosed by LOOCV is 0.010000
```

(best lambda floats among 0.01~0.0)

3. Bias Variance Trade-off

(a)

(i)False. If adding more training example, the test error will decrease first and then increase.

(ii)False. Model with high variance is overfitting. It works badly on test samples, which is more important for our task.

(iii)True. Model with more parameters could be a very complicated, and it is more prone to overfitting

(iv)False. Regularization is aim at working well on test dataset, not training dataset.

(v)False. Large λ will lead to underfitting. On the contrary, Small λ will lead to overfitting,

(vi)False. Too Small or too large λ won't benefit our model.