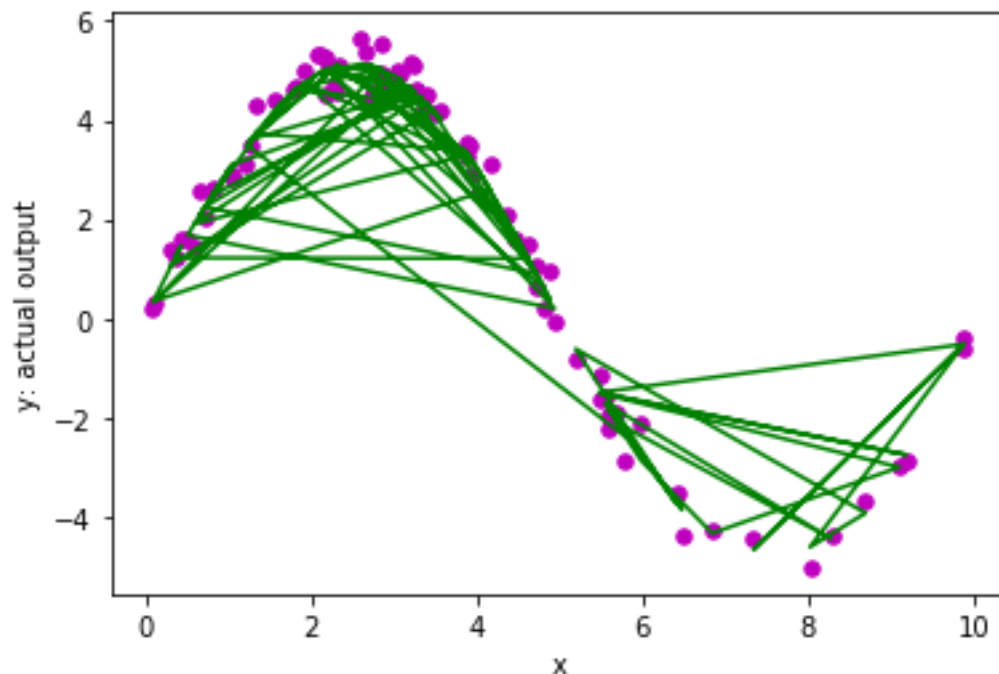1. Kumari Rashmi EE20S051   PRML Assignment1
2. Rohan Padhy   ED21S001

Question1.   Regression:
   Part(a).
   (i)Plot of the best fit curve:

(ii) Equation of the best fit curve:
   Parameter value b and curve is of degree 11
b = [[-7.06086438e-02]
   [4.50997251e+00]
   [-3.43208131e+00]
   [3.59226403e+00]
   [-2.29197362e+00]
   [8.41087759e-01]
   [-1.93200845e-01]
   [2.82322629e-02]
   [-2.53324510e-03]
   [1.26643899e-04]
   [-2.69246465e-06]]

So equation will be y_hat = X.b where X = [1,x,x^2,x^3,x^4,....,x^11]

(iii) Value of least square error over the test data is [16.79096222] and training data is 8.0298
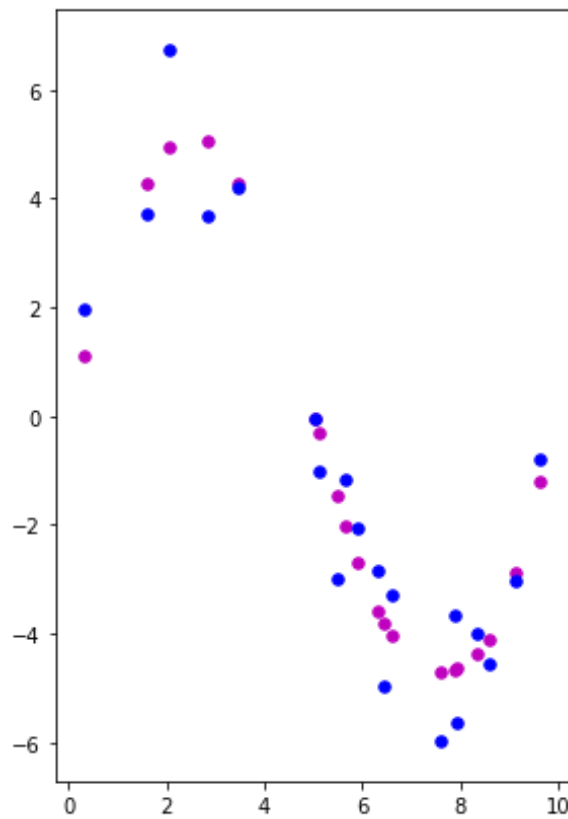8841
Solution got converges here
   This one is the best result among all the degree upto 11

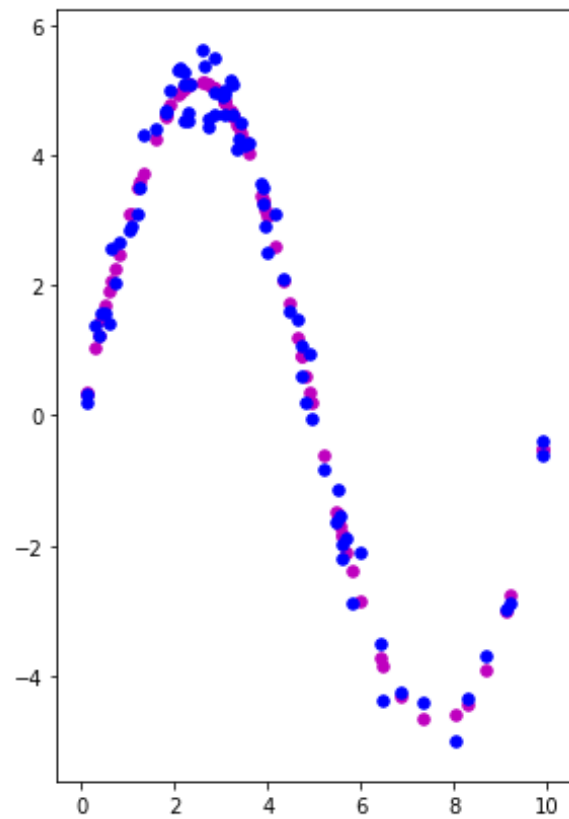(iv) Scatter plot of test data and train data:

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Note: blue color represents actual output pink color represent predicted output
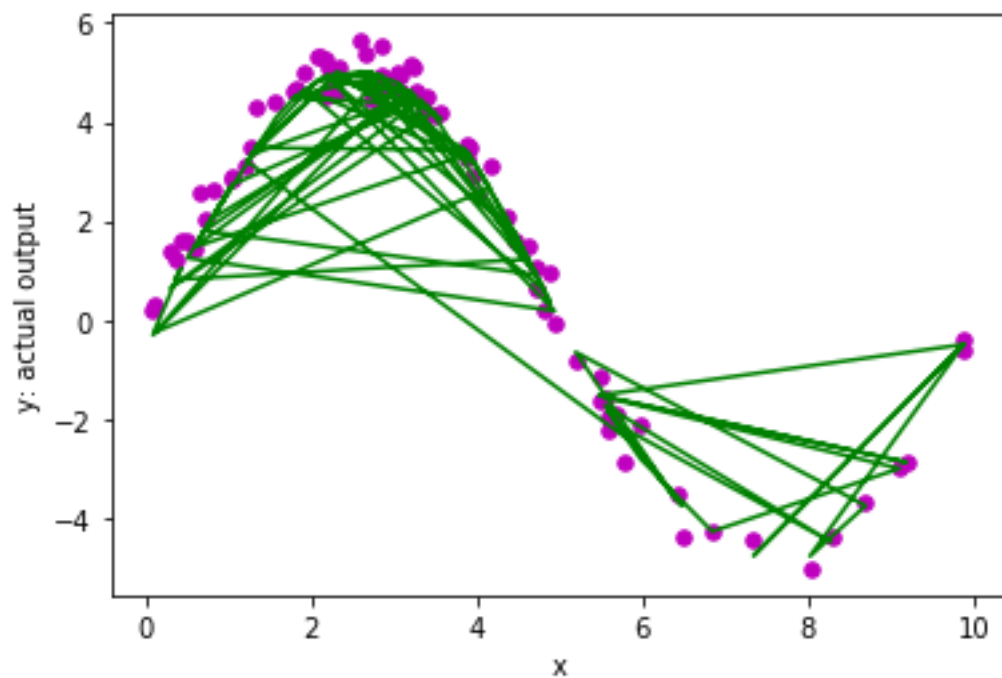
Test data scatter plot.   Train data scatter plot

Part(b).
(i)   Plot of the best fit curve

(ii)   Equation of the curve: y_hat = X.b

```
b = [[-9.86341380e-01]
     [ 8.62727666e+00]
```

```
        [-1.58645284e+01]
       [ 2.14705453e+01]
       [-1.62775025e+01]
       [ 7.41249454e+00]
        [-2.15076584e+00]
        [ 4.06530529e-01]
        [-4.97815441e-02]
         [ 3.80389323e-03]
         [-1.64728903e-04]
         [ 3.08568099e-06]]
```
And X = [1,x,x^2,x^3,......x^12]

(iii).

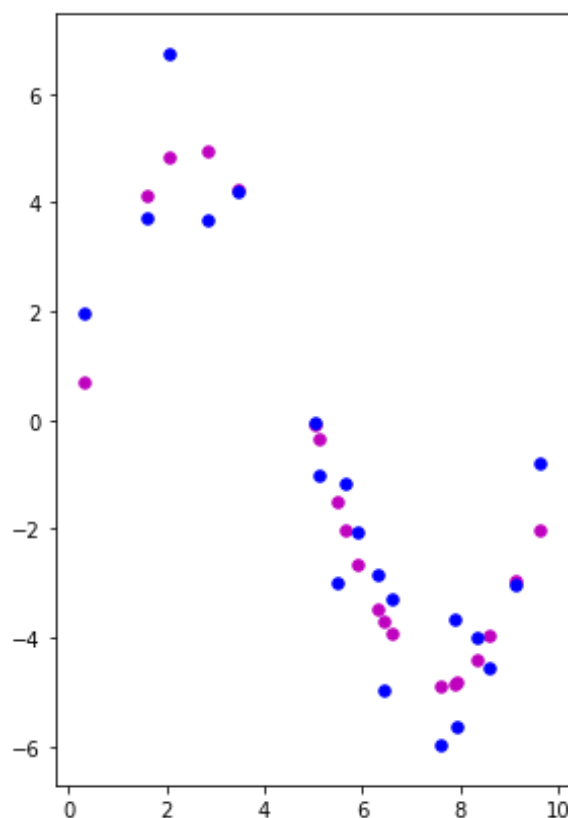   Least square error in test prediction: [18.58795113]
    Least square error in training data prediction: [10.75647872]
After solution got converges, the prediction error increased
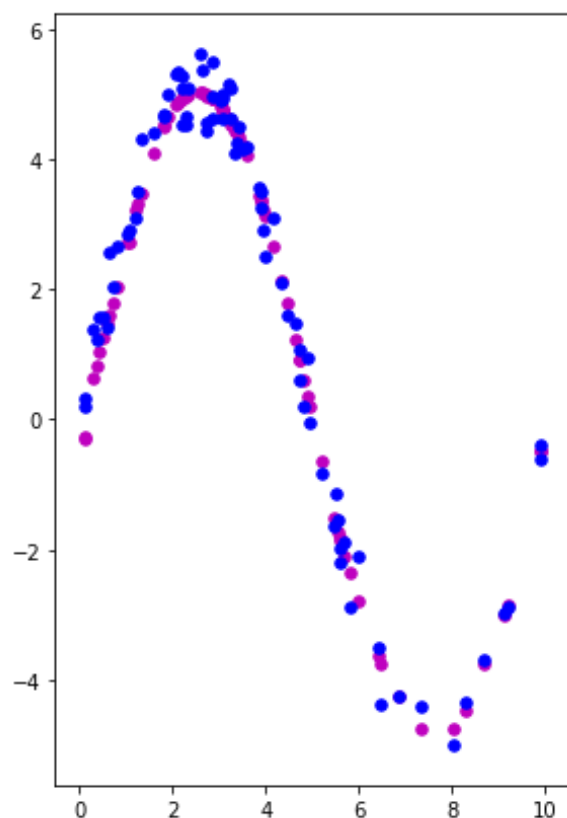
(iv). Scatter plot of test data and train data:
    Note: blue color represents actual output pink color represent predicted output
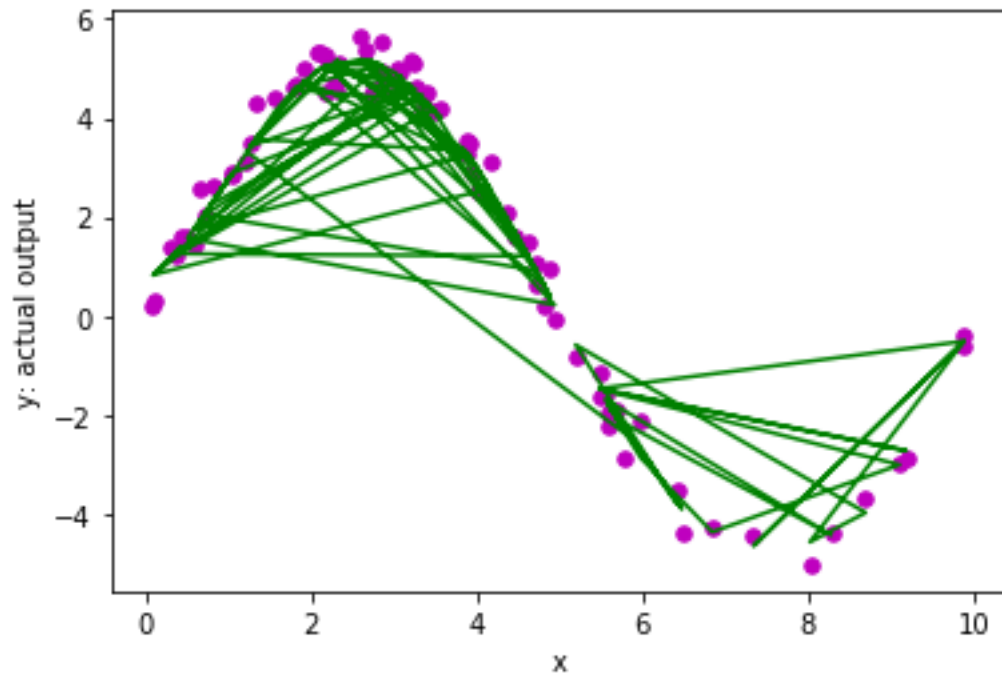
Test data scatter plot.   Train data scatter plot

Part(c). Ridge regression :
(i)

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(ii) y_hat = X.b where

b = [[7.01342732e-01]
　 [1.26154591e+00]
　 [8.33887070e-01]
　 [2.19590423e-01]
　 [-2.23279339e-01]
　 [-1.20253603e-01]
　 [1.15198520e-01]
　 [-3.68562571e-02]
　 [6.26853894e-03]
　 [-6.05255877e-04]
　 [3.13380154e-05]
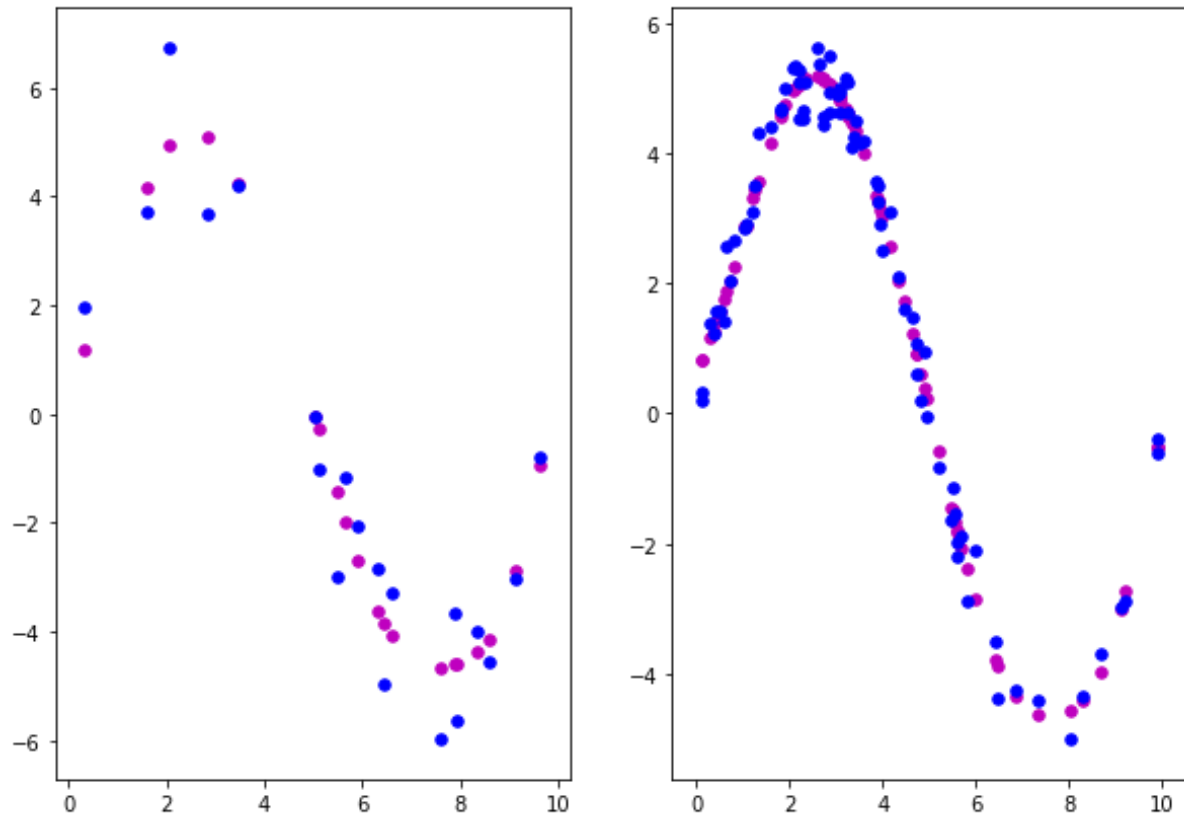　 [-6.76730023e-07]]

And X = [1,x,x^2,x^3......x^12]
(iii) loss in test prediction: [16.68446488]
　　 loss in training data prediction: [9.04192877]

　 Have taken lambda = 0.9 for optimized solution
(iv) Scatter plot of test data and train data:
　 Note: blue color represents actual output pink color represent predicted output

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Q2. Classification
Part (a) Perceptron learning Algorithm
Predicted weight = [-17.491825264096352, 16.76442185975007]

Confusion matrix of train data:
confusion matrix for training data is as below:
[[90.   0.]
 [0. 110.]]
training accuracy in percentage:
100.0

Confusion matrix of test data:
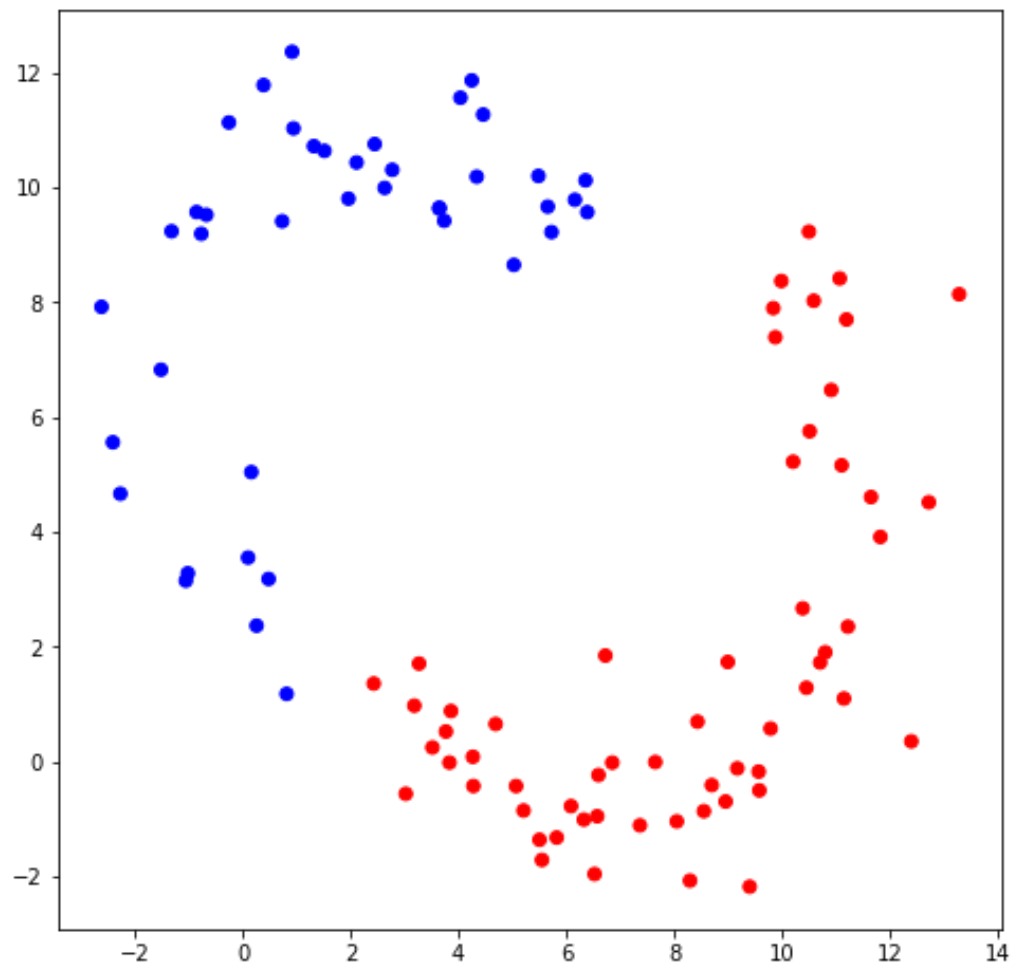confusion matrix for test data is:
[[59. 0.]
 [0. 41.]]
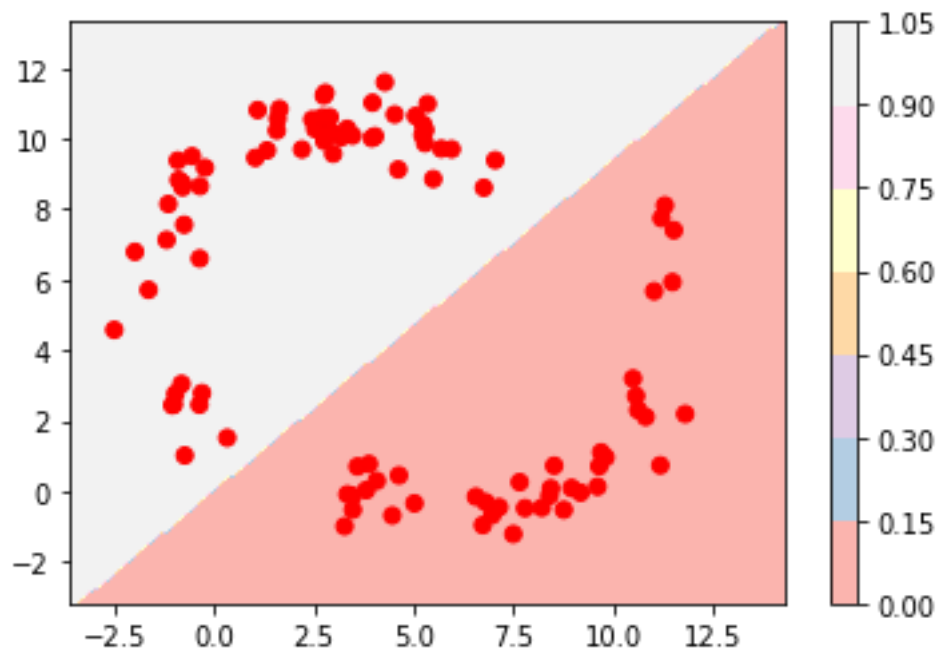test accuracy in percentage:
100.0

Scatter plot of test data:

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Decision Boundary:

Part(b).
Covariance matrix for both classes are equal

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Taking the covariance matrix as below:
[[16.28349919561478, 0], [0, 16.28349919561478]]

confusion matrix for test data is as below:
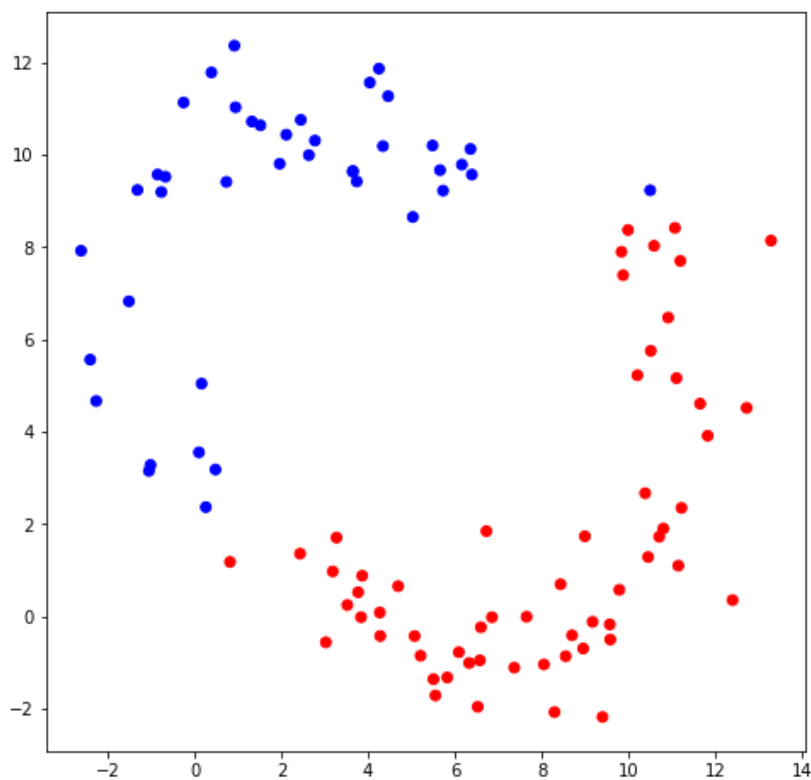
[[58. 1.]
 [1. 40.]]

test accuracy in percentage:
98.0

confusion matrix for train data is as below:
[[90.   0.]
 [0. 110.]]
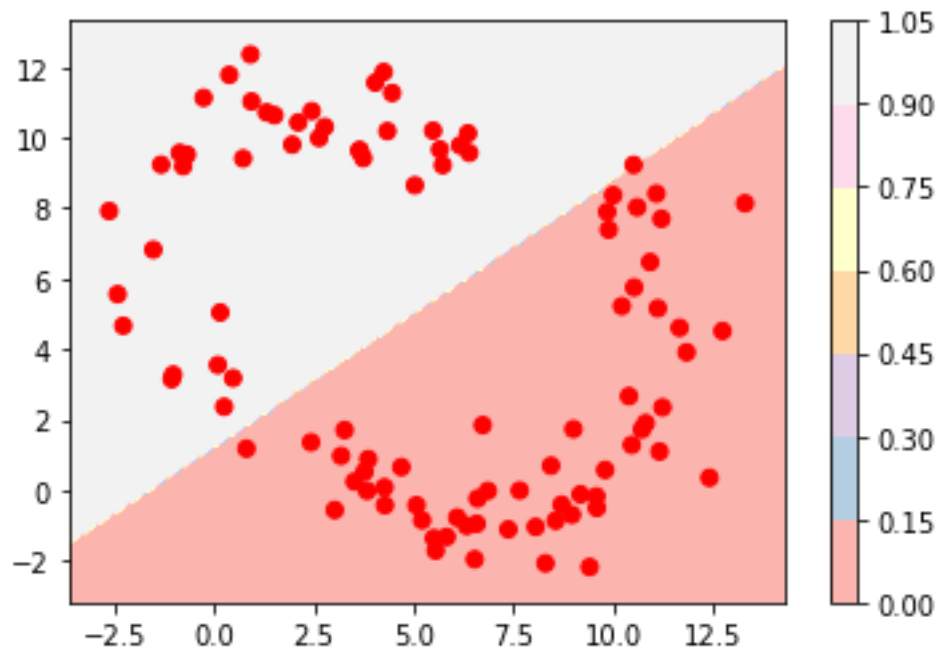training accuracy in percentage:
100.0

Scatter plot of test data after classification:

Decision boundary of test data:

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2. Rohan Padhy   ED21S001

Part(c). Training accuracy is 100%
Covariance from training data: C1 = C2 = [[14.485080379789565, 0], [0, 19.955533021400562]]
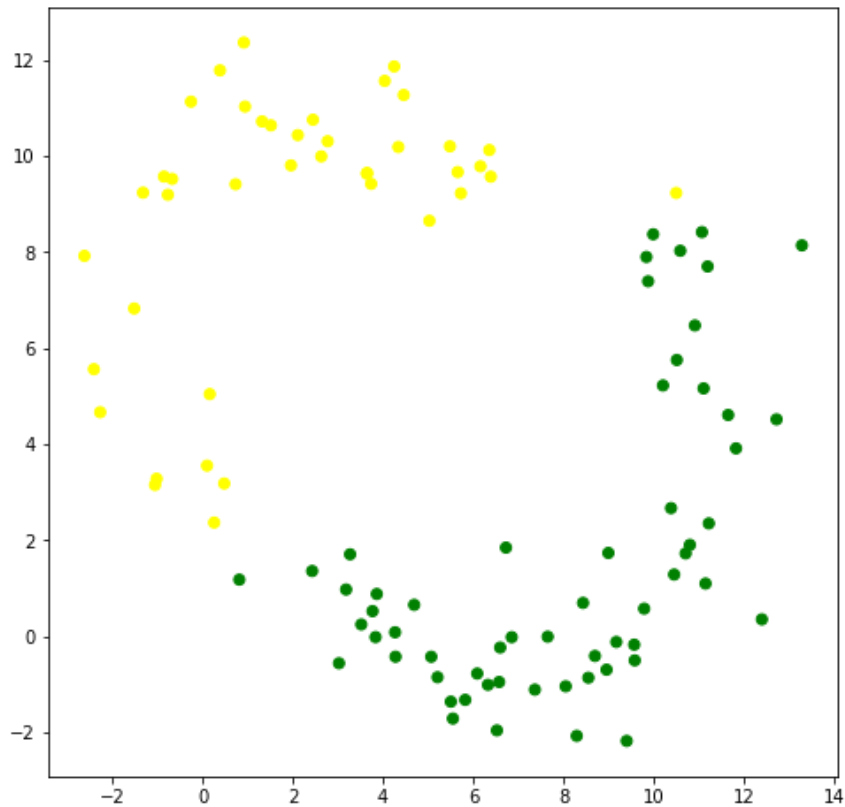
Confusion matrix:
confusion matrix for test data is as below:
[[58. 1.]
 [1. 40.]]
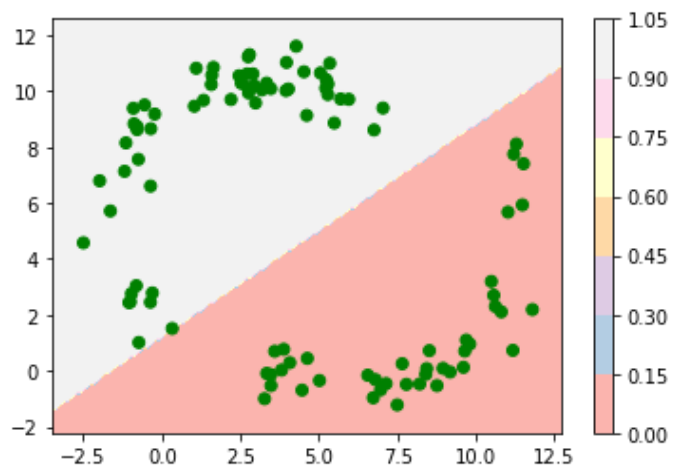test accuracy in percentage:
98.0

Scatter plot of test data with class label:

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Decision Boundary of test data:

Part(d). Note : training accuracy is 100%
Covariance matrix C1 and C2 are:
C1 = [[7.19652856 4.46811773]
 [4.46811773 7.31573156]]

C2 = [[6.882969   4.12203567]
 [4.12203567 6.66585842]]

Confusion matrix:
confusion matrix for test data is as below:
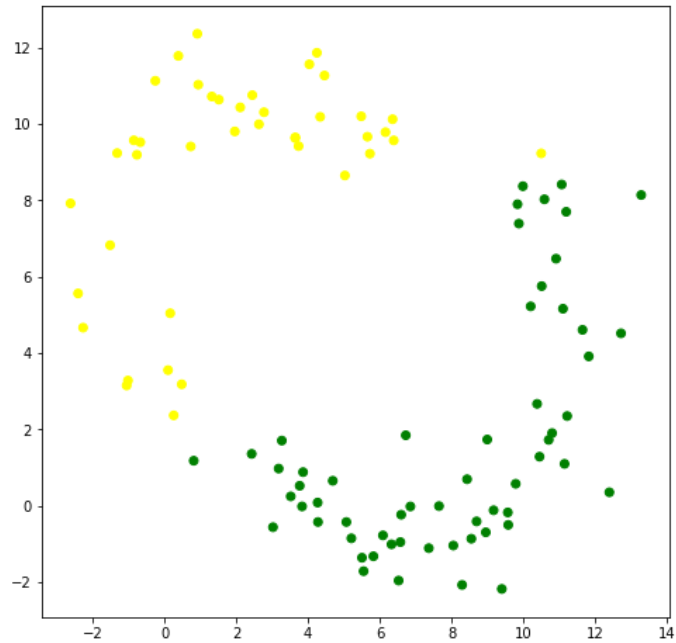[[58. 1.]

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 [1. 40.]]
test accuracy in percentage:
98.0

Scatter plot of test data with class label:

Decision boundary: