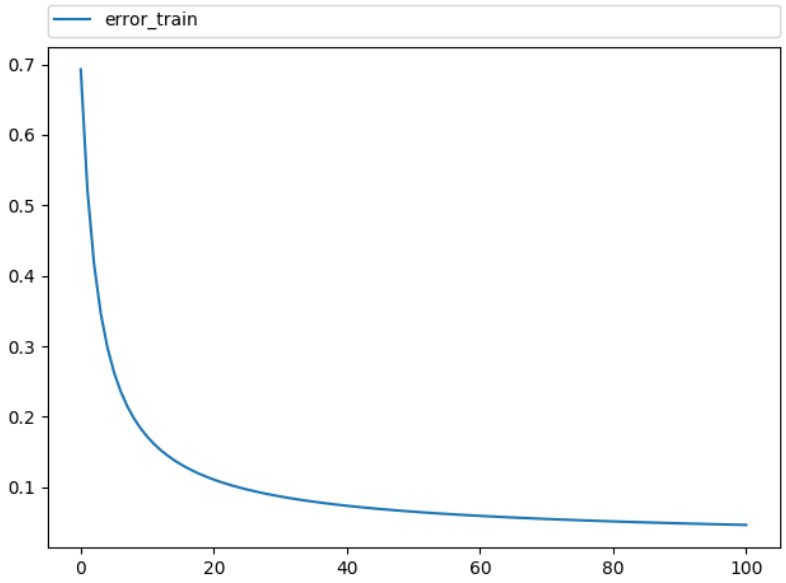
# یادگیری ماشین - تمرین سوم- بخش عملی
# دانیال ملک محمد ۹۴۱۰۰۰۹۲

## سوال ۶)

## بخش۱)




**etah= 0.000000001**

1000 000 بار گرادیان دیسنت شده

محور عمودی، میزان هزینه ی تابع رگرسیون لاجستیک است
محور افقی، تعداد دفعات اجرای گرادیان دیسنت است. هر واحد محور افقی معادل 10000 بار اجرای گرادیان دیسنت است

Accuracy on Train Data : 0.99125

Confusion Matrix on Train:
[.3 .400]]
[[.393 .4 ]

Accuracy on Test Data : 0.99

Confusion Matrix on Test :
[.0 .97 ]]
[[.101 .2 ]

W :
[0.18145157 0.18133784-]]
[0.08222857- 0.08225882 ]
[0.06148939 0.06146548-]
[0.16006995 0.16001677-]
[0.01592528 0.01583172-]
[0.12579091- 0.12590135 ]
[[0.10841383- 0.10852209 ]

سطر و ستون اول در ماتریس کانفیوژن: دسته صفر /// سطر و ستون دوم در ماتریس کانفیوژن: دسته سوم

## بخش دوم)

**etah=  0.0000000001**
1000 000 بار گرادیان دیسنت شده

$\lambda = 2$ :

Accuracy on Train Data : 0.99
Confusion Matrix on Train :
[[400.  3.]
 [ 5. 392.]]
Accuracy on Test Data : 0.99
Confusion Matrix on Test :
[[ 97.  0.]
 [ 2. 101.]]
 W :
[[-0.07065175  0.07076544]
 [ 0.03217287 -0.03214264]
 [-0.0251162   0.0251401 ]
 [-0.07316228  0.07321544]
 [-0.00860465  0.00869817]
 [ 0.05189197 -0.05178158]
 [ 0.04936238 -0.04925417]]

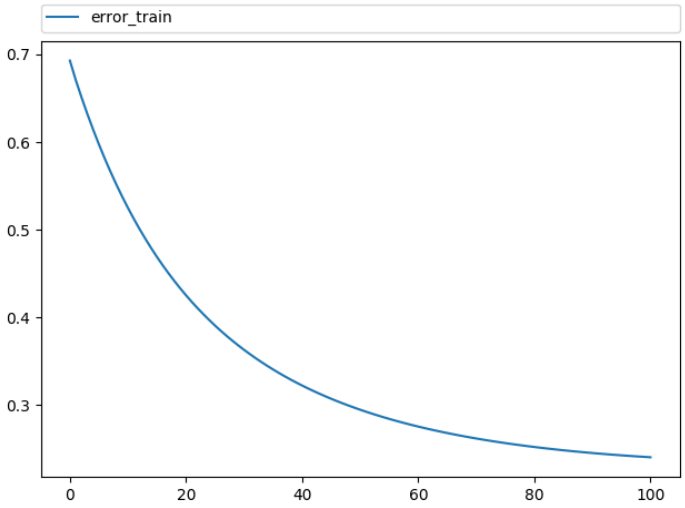
$\lambda = 1$

Accuracy on Train Data : 0.99
Confusion Matrix on Train :
[[400.  3.]
 [ 5. 392.]]
Accuracy on Test Data : 0.99
Confusion Matrix on Test :
[[ 97.  0.]
 [ 2. 101.]]
 W :
[[-0.0706579   0.07077162]
 [ 0.03217569 -0.03214545]
 [-0.02511837  0.02514228]
 [-0.07316861  0.07322178]
 [-0.00860538  0.00869892]
 [ 0.05189651 -0.05178609]
 [ 0.04936668 -0.04925844]]

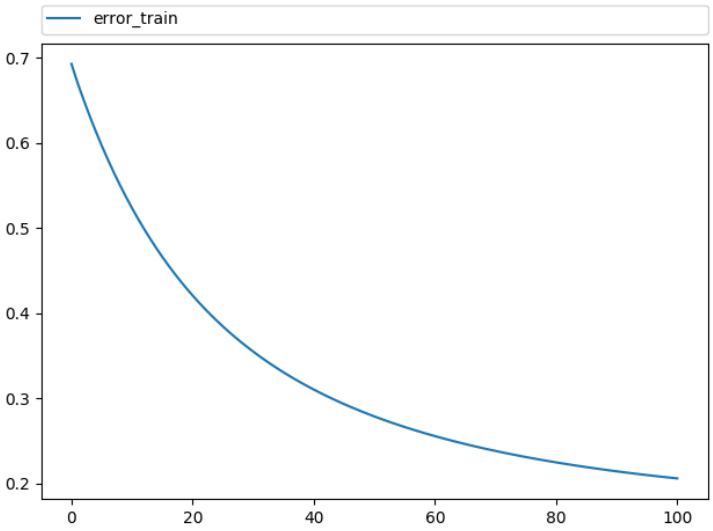
$$\lambda = 0.5$$

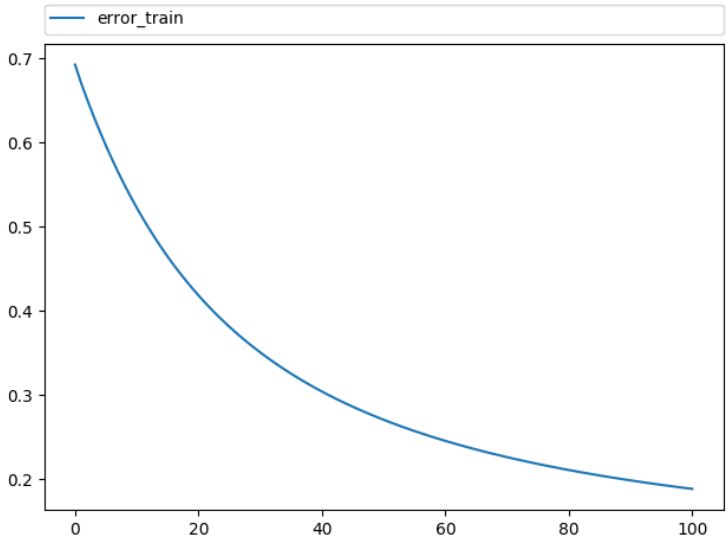
Accuracy on Train Data : 0.99
Confusion Matrix on Train :
[[400.  3.]
 [ 5. 392.]]
Accuracy on Test Data : 0.99
Confusion Matrix on Test :
[[ 97.  0.]
 [ 2. 101.]]
 W :
[[-0.07066098  0.07077471]
 [ 0.0321771  -0.03214686]
 [-0.02511946  0.02514337]
 [-0.07317177  0.07322495]
 [-0.00860575  0.0086993 ]
 [ 0.05189878 -0.05178835]
 [ 0.04936882 -0.04926058]]

**landa=2**




**landa=1**

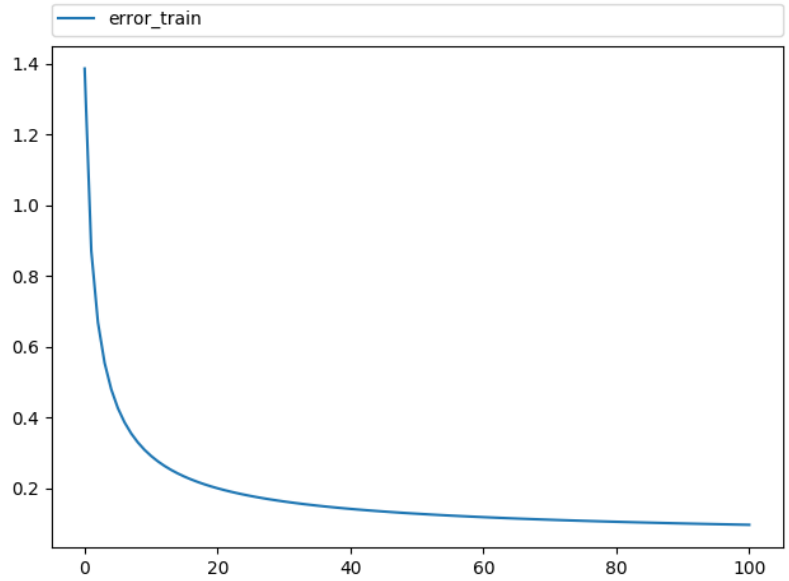



**Landa = 0.5**

همانطور که مشاهده می شود به *etah = 0.0000000001* ، از بین این سه انتخاب برای لاندا، هرچه بزرگتر باشد به سریعتر شدن فرایند یادگیری کمک می کند . اگرچه چون تعداد مراحل زیاد است، هر سه در نهایت به دقت *0.99* رسیده اند.

# بخش سوم)




**etah= 0.000000001**

1000 000 بار گرادیان دیسنت شده

Accuracy on Train Data : 0.97625
Confusion Matrix on Train :
[[396. 0. 3. 1.]
[ 0. 376. 15. 0.]
[ 3. 13. 386. 1.]
[ 0. 0. 2. 404.]]
Accuracy on Test Data : 0.97
Confusion Matrix on Test :
[[100. 0. 0. 0.]
[ 0. 103. 6. 0.]
[ 1. 3. 92. 1.]
[ 0. 0. 1. 93.]]
W :
[[-0.2262129 0.26757141 0.10618185 -0.14739638]
[ 0.12995803 -0.13240606 -0.0116762 0.01420132]
[-0.0793963 -0.16176569 0.11611811 0.12524788]
[-0.1973634 0.24059361 0.07448089 -0.11753305]
[-0.07651193 -0.2481918 -0.03474617 0.35958136]
[ 0.16169181 0.03682503 -0.099842 -0.09839736]
[ 0.13465071 0.04114072 -0.08964867 -0.08595324]]

بخش چهارم)

# Bayesian Classifier :

## MLE_class1 :

**## mio :**
[-62.53598015 -56.1662531 -60.51364764 -64.2382134 -70.22580645
-82.92059553 -84.21836228]

**### covariances :**
[[11.34051684 4.88359635 5.02990598 5.73832731 7.61594493 5.39987932
4.10628721]
[ 4.88359635 10.77881152 5.39847545 4.81895708 6.38677659 4.1422335
3.91903158]
[ 5.02990598 5.39847545 14.01160034 5.16796483 7.56391579 5.20207624
3.07642434]
[ 5.73832731 4.81895708 5.16796483 13.52638093 7.29608581 6.01643382
5.00009236]
[ 7.61594493 6.38677659 7.56391579 7.29608581 21.99615785 6.87897222
4.94324822]
[ 5.39987932 4.1422335 5.20207624 6.01643382 6.87897222 13.91429046
4.49128435]
[ 4.10628721 3.91903158 3.07642434 5.00009236 4.94324822 4.49128435
15.24264049]]

## ###MLE_class3 :

**## mio :**
[-49.82367758 -54.78589421 -52.77078086 -50.71284635 -63.16120907
-81.31486146 -82.53904282]

**### covariances :**
[[ 6.88578698 0.31237429 -1.51396811 2.02493512 0.10651042 1.94720479
1.00688412]
[ 0.31237429 13.31184133 2.44210673 0.19040791 3.42242512 2.95154465
1.03228877]
[-1.51396811 2.44210673 9.92982634 0.12309576 1.06466001 1.29131585
1.53917606]
[ 2.02493512 0.19040791 0.12309576 12.91502389 -0.3869576 1.3977184
2.75428434]

[ 0.10651042  3.42242512  1.06466001 -0.3869576  12.82035924 -0.56461243
  1.78967572]
[ 1.94720479  2.95154465  1.29131585  1.3977184  -0.56461243 13.06710911
  0.36680012]
[ 1.00688412  1.03228877  1.53917606  2.75428434  1.78967572  0.36680012
 17.5986016 ]]

**Confusion Matrix on Test Data  :**
[[ 97.   1.]
 [  0. 102.]]

**Accuracy on Test :0.995**

# Naive  Bayesian Classifier  :

## NMLE_class1  :

**## mio :**
[-62.53598015 -56.1662531  -60.51364764 -64.2382134  -70.22580645
 -82.92059553 -84.21836228]

**### variances  :**
[11.34051684 10.77881152 14.01160034 13.52638093 21.99615785 13.91429046
 15.24264049]

## NMLE_class3  :

**## mio :**
[-49.82367758 -54.78589421 -52.77078086 -50.71284635 -63.16120907
 -81.31486146 -82.53904282]

**### variances  :**
[ 6.88578698 13.31184133  9.92982634 12.91502389 12.82035924 13.06710911
 17.5986016 ]

**Confusion Matrix on Test Data  :**
[[ 95.   0.]
 [  2. 103.]]

**Accuracy on Test :0.99**

بخش پنجم)

# Bayesian Classifier

## MLE_class1 :

**## mio :**
[-62.52 -56.1725 -60.5625 -64.2 -70.2225 -82.95 -84.0075]

**### covariances :**
[[11.1846 4.7678 5.125 5.6485 8.0718 5.361
4.0511 ]
[ 4.7678 10.68774375 4.80046875 4.258 6.13661875 3.986125
3.32120625]
[ 5.125 4.80046875 13.80609375 4.7675 8.30734375 5.275625
2.98328125]
[ 5.6485 4.258 4.7675 13.565 7.073 5.0225
3.776 ]
[ 8.0718 6.13661875 8.30734375 7.073 22.40299375 6.861125
4.61333125]
[ 5.361 3.986125 5.275625 5.0225 6.861125 14.4675
4.587875 ]
[ 4.0511 3.32120625 2.98328125 3.776 4.61333125 4.587875
15.92244375]]

## MLE_class2 :

**## mio :**
[-36.77493606 -56.1943734 -56.11508951 -37.8286445 -67.61892583
-72.81074169 -73.68797954]

**### covariances :**
[[80.107914 -7.68003872 -8.10453228 57.25043661 -3.73026733 5.52262217
4.52824092]
[-7.68003872 10.49930338 4.70141483 -6.93088742 4.41933922 1.87566146
2.74862802]
[-8.10453228 4.70141483 16.83841681 -6.76288747 7.14360189 1.08316272
1.34025811]
[57.25043661 -6.93088742 -6.76288747 69.36449919 -5.31082345 4.15427031
1.33016529]
[-3.73026733 4.41933922 7.14360189 -5.31082345 28.15401521 2.07877369
1.14963926]
[ 5.52262217 1.87566146 1.08316272 4.15427031 2.07877369 21.62147029
9.36038487]
[ 4.52824092 2.74862802 1.34025811 1.33016529 1.14963926 9.36038487
22.76709336]]

## MLE_class3 :

**## mio :**
[-49.64764268 -54.93052109 -52.62282878 -50.75930521 -63.32506203
 -81.36476427 -82.46650124]

**### covariances :**
[[ 7.09172521  0.57601488 -1.13538043  1.67201325  1.31056776  2.18559932
   1.13211706]
 [ 0.57601488 13.49889477  2.53706999  0.12967877  3.47667925  3.01541786
   0.72968247]
 [-1.13538043  2.53706999  8.79074436 -0.42825213  1.49729387  1.10283913
   1.76900295]
 [ 1.67201325  0.12967877 -0.42825213 13.21998165 -0.54706944  0.70814425
   1.69541097]
 [ 1.31056776  3.47667925  1.49729387 -0.54706944 12.92411135 -0.81832288
   2.03942516]
 [ 2.18559932  3.01541786  1.10283913  0.70814425 -0.81832288 12.87190981
   0.86705786]
 [ 1.13211706  0.72968247  1.76900295  1.69541097  2.03942516  0.86705786
  18.21413838]]

## MLE_class4 :

**## mio :**
[-60.2635468  -55.23399015 -50.61576355 -61.37438424 -49.38669951
 -87.03448276 -86.89901478]

**## covariances :**
[[ 9.48965639  2.91616516  1.99042685  5.30281007 -1.77186416  4.78401563
   3.76553059]
 [ 2.91616516 10.34672644  1.30665631  4.04293965 -1.00920309  2.44020724
   2.01870344]
 [ 1.99042685  1.30665631 17.15285496  3.1586304   2.0008008   2.7891116
   2.48829139]
 [ 5.30281007  4.04293965  3.1586304  14.99776748 -1.37630129  4.96245966
   4.37770875]
 [-1.77186416 -1.00920309  2.0008008  -1.37630129 12.86770487 -1.15865466
  -0.57424956]
 [ 4.78401563  2.44020724  2.7891116   4.96245966 -1.15865466 11.58994394
   2.88279259]
 [ 3.76553059  2.01870344  2.48829139  4.37770875 -0.57424956  2.88279259
  13.40605814]]

**Confusion Matrix on Test Data :**
[[100.   0.   0.   0.]
 [  0. 105.   3.   0.]
 [  0.   4.  92.   1.]
 [  0.   0.   2.  93.]]
**Accuracy on Test :0.975**

# Naive  Bayesian Classifier

## NMLE_class1  :

## mio :
[-62.52   -56.1725 -60.5625 -64.2    -70.2225 -82.95   -84.0075]

### variances  :
[11.1846     10.68774375 13.80609375 13.565      22.40299375 14.4675
 15.92244375]

## NMLE_class2  :

## mio :
[-36.77493606 -56.1943734  -56.11508951 -37.8286445  -67.61892583
 -72.81074169 -73.68797954]

### variances  :
[80.107914   10.49930338 16.83841681 69.36449919 28.15401521 21.62147029
 22.76709336]

## NMLE_class3  :

## mio :
[-49.64764268 -54.93052109 -52.62282878 -50.75930521 -63.32506203
 -81.36476427 -82.46650124]

### variances  :
[ 7.09172521 13.49889477  8.79074436 13.21998165 12.92411135 12.87190981
 18.21413838]

## NMLE_class4  :

## mio :
[-60.2635468  -55.23399015 -50.61576355 -61.37438424 -49.38669951
 -87.03448276 -86.89901478]

### variances  :
[ 9.48965639 10.34672644 17.15285496 14.99776748 12.86770487 11.58994394
 13.40605814]

**Confusion Matrix on Test Data  :**
[[ 99.   0.   1.   0.]
 [  0. 100.   0.   0.]
 [  1.   9.  95.   1.]
 [  0.   0.   1.  93.]]

**Accuracy on Test :0.9675**