Homework 2, Question 5

Code

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```
library(neuralnet)
train<-read.table("nine.instances.txt",sep=",",header=T)
train
```

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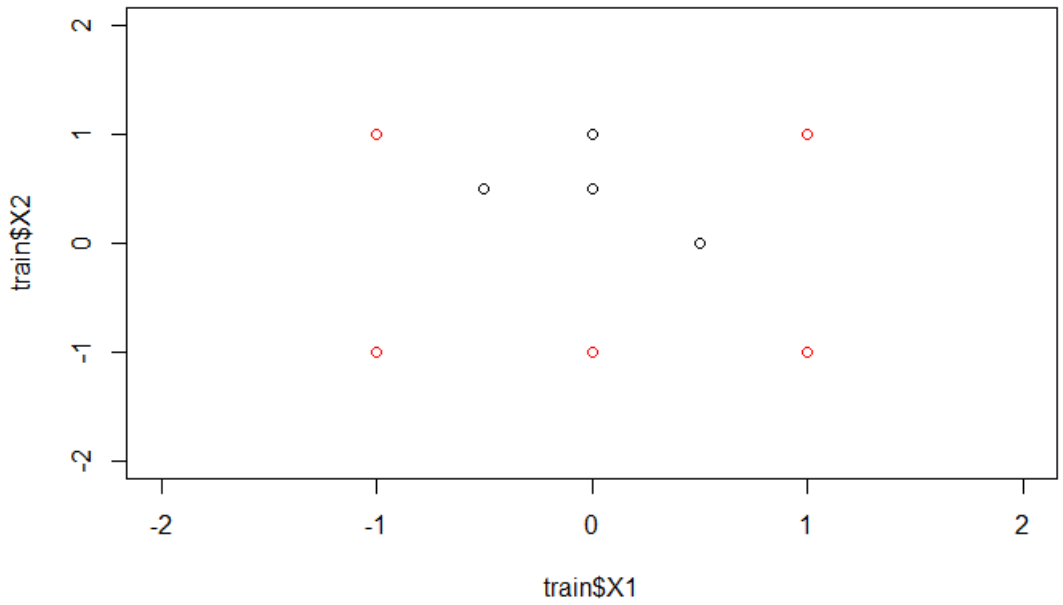
```
plot(train$X1,train$X2,col=c("black","red")[train$Label+1],xlim=c(-2,2),ylim=c(-2,2))
```



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```
net<-neuralnet(Label~X1+X2,train,hidden=2,rep=5)
net
```

```
$`call`
neuralnet(formula = Label ~ X1 + X2, data = train, hidden = 2,
    rep = 5)

$response
  Label
1     1
2     0
3     1
4     1
5     1
6     1
7     0
8     0
9     0

$covariate
      [,1] [,2]
 [1,]  1.0  1.0
 [2,]  0.0  1.0
 [3,] -1.0 -1.0
 [4,]  1.0 -1.0
 [5,]  0.0 -1.0
 [6,] -1.0  1.0
 [7,]  0.5  0.0
 [8,]  0.0  0.5
 [9,] -0.5  0.5

$model.list
```

```
$model.list$response
[1] "Label"

$model.list$variables
[1] "X1" "X2"


$err.fct
function (x, y)
{
    1/2 * (y - x)^2
}
<bytecode: 0x00000000036b4798>
<environment: 0x0000000008eefea0>
attr(,"type")
[1] "sse"

$act.fct
function (x)
{
    1/(1 + exp(-x))
}
<bytecode: 0x00000000036b22c8>
<environment: 0x0000000008eefea0>
attr(,"type")
[1] "logistic"

$linear.output
[1] TRUE

$data
    X1   X2 Label
1  1.0  1.0     1
2  0.0  1.0     0
3 -1.0 -1.0     1
4  1.0 -1.0     1
5  0.0 -1.0     1
6 -1.0  1.0     1
7  0.5  0.0     0
8  0.0  0.5     0
9 -0.5  0.5     0

$net.result
$net.result[[1]]
             [,1]
1  0.651368580151
2  0.644903857292
3  0.990747166657
4  0.999832295904
5  0.995278190389
6  0.638416897451
7 -0.001417433235
8  0.038010587250
9  0.034063517207

$net.result[[2]]
             [,1]
1  0.658142762083
2  0.652082150424
3  0.999370630699
4  0.999858240151
5  0.999614568237
6  0.646000578432
7 -0.001586213024
8  0.029552652856
9  0.026700946190

$net.result[[3]]
            [,1]
1  0.98872569872
2 -0.09963086472
3  1.09830103803
4  0.98012465372
```

```
5  0.95284820409
6  0.90811009126
7  0.14483283929
8 -0.09889574482
9  0.13093579416

$net.result[[4]]
            [,1]
1  0.99441607157
2 -0.05905915587
3  1.09968226092
4  0.99420637872
5  0.96001443627
6  0.89216640956
7  0.02112394342
8 -0.05860149662
9  0.15075680680

$net.result[[5]]
             [,1]
1  0.661750448883
2  0.658317056997
3  0.993363508566
4  1.003293234831
5  1.000114273750
6  0.654981323922
7 -0.001553103107
8  0.017003312529
9  0.013902855930


$weights
$weights[[1]]
$weights[[1]][[1]]
             [,1]            [,2]
[1,]  2.466839362 -0.315669730798
[2,] -2.544655281  0.007666761765
[3,] 53.073633646  1.279781044231

$weights[[1]][[2]]
              [,1]
[1,]  0.2826088793
[2,] -2.6974709750
[3,]  4.2265217959


$weights[[2]]
$weights[[2]][[1]]
              [,1]           [,2]
[1,]  -2.178423857 -2.06195204279
[2,]   2.022222760  0.01313330785
[3,] -16.974586261  2.60152925289

$weights[[2]][[2]]
              [,1]
[1,] -0.6031107153
[2,]  1.5841569005
[3,]  1.9869636224


$weights[[3]]
$weights[[3]][[1]]
             [,1]            [,2]
[1,]  -4.22549064 -3.844189671604
[2,] -11.82437689  3.466100603669
[3,]  -5.87613290  0.006373649005

$weights[[3]][[2]]
              [,1]
[1,] -0.1589800332
[2,]  1.2554157665
[3,]  2.8121317869
```

```
$weights[[4]]
$weights[[4]][[1]]
                [,1]         [,2]
[1,]   7.751758491292  4.536494904
[2,] -10.371093815925 12.579992005
[3,]  -0.001667719037  6.520425462

$weights[[4]][[2]]
             [,1]
[1,]  2.230318924
[2,] -1.130636130
[3,] -1.159246999


$weights[[5]]
$weights[[5]][[1]]
                [,1]          [,2]
[1,] -3.013718813849 -1.7812863693
[2,]  0.008206271291  0.7640499976
[3,]  3.447213624527 -7.2059526111

$weights[[5]][[2]]
              [,1]
[1,] -0.3465966421
[2,]  1.6560605062
[3,]  1.3500489162



$startweights
$startweights[[1]]
$startweights[[1]][[1]]
              [,1]          [,2]
[1,] -0.2345915135  0.8565954740
[2,] -0.6083395063 -0.2260846120
[3,]  0.4582732168  0.5441877067

$startweights[[1]][[2]]
              [,1]
[1,] -0.5374711931
[2,] -0.4735496098
[3,]  0.2234835392


$startweights[[2]]
$startweights[[2]][[1]]
              [,1]          [,2]
[1,] -2.8748456985 -0.8097970621
[2,] -1.5627898055 -0.5359009979
[3,] -0.8693862608 -1.7104317341

$startweights[[2]][[2]]
              [,1]
[1,] -1.2263530691
[2,] -0.5512209061
[3,]  1.9065768865


$startweights[[3]]
$startweights[[3]][[1]]
              [,1]          [,2]
[1,] -0.5330714924 -0.7360644272
[2,]  1.0186877753  1.4541252426
[3,]  0.6314747096  0.5455712948

$startweights[[3]][[2]]
              [,1]
[1,] -1.1969837497
[2,]  0.9428641471
[3,]  0.4436207590
```

```
$startweights[[4]]
$startweights[[4]][[1]]
              [,1]          [,2]
[1,] -1.4074239911  0.1349660925
[2,]  0.5949015266  1.6259592871
[3,]  1.5447973058 -0.7968246928

$startweights[[4]][[2]]
              [,1]
[1,]  1.7655130388
[2,] -0.6592311546
[3,] -0.9211328048


$startweights[[5]]
$startweights[[5]][[1]]
              [,1]          [,2]
[1,] 0.05550504537  0.0120261632
[2,] 0.07806010244  1.2620078635
[3,] 0.57940481714 -2.0156335855

$startweights[[5]][[2]]
              [,1]
[1,] -0.1320845186
[2,]  0.9134991659
[3,]  1.2244556718



$generalized.weights
$generalized.weights[[1]]
              [,1]            [,2]
1    0.02841890352     4.743850812
2    0.02827848367     4.720411103
3    0.49300636816    82.295527627
4   27.22906832418  4545.236510600
5    0.96660153214   161.350822686
6    0.02814950379     4.698881021
7 -868.36655154928 17065.376004529
8    0.21582248879    36.026361385
9    0.23999351125    40.061130868

$generalized.weights[[2]]
              [,1]           [,2]
1    0.02689015206    5.326465769
2    0.02676035075    5.300846671
3    0.39362034101   74.990798782
4    1.72771159998  342.004439260
5    0.63017161936  124.184484404
6    0.02663909594    5.276839923
7 -366.64252898528 2736.335628760
8    0.20007090237   39.093228001
9    0.21843927373   43.053797719

$generalized.weights[[3]]
             [,1]               [,2]
1 211.22002586241   0.38840235041054
2  -1.83090744438  -0.00061562493332
3  -0.05970767981  -0.00001410463699
4 120.54953071646   0.20727680317528
5 -40.21164407657 -22.17349127649474
6 -22.79137562690 -11.36505431725071
7   7.57778583332   0.01158707858929
8  -1.74010923581   0.04908427912200
9 -22.24235270325 -11.21308844711452

$generalized.weights[[4]]
                [,1]               [,2]
1 133.46627312305378   0.02146190965402
2  -0.07699744532189   0.00189367814992
3   0.00006150345655   0.00003262361788
4 128.97083198431298  -0.01207479754863
```

```
5 -40.24666489166907 -20.92842282398286
6 -22.27772692065108 -11.54692852922138
7  37.55779715494053  -0.00122012291696
8   0.01528516651308   0.05003491730227
9 -16.91610383985057  -8.76802084576435

$generalized.weights[[5]]
              [,1]          [,2]
1    0.01569765939   6.063258189
2    0.01498951163   6.050525681
3    1.45585280728 -12.361901677
4   -0.64460058898   3.303613443
5  -39.60866775956 293.964356872
6    0.01464042475   6.035886925
7 -105.66656237123 828.515995235
8    0.41819270170  55.161596952
9    0.40151754917  68.104610876


$result.matrix
                                    1                2                3                4
error                    0.335451133853   0.334491236569   0.039339845800   0.026662091531
reached.threshold        0.009742560659   0.009930500314   0.009827329318   0.008621494771
steps                  558.000000000000 188.000000000000 209.000000000000 198.000000000000
Intercept.to.1layhid1    2.466839361828  -2.178423856779  -4.225490639995   7.751758491292
X1.to.1layhid1          -2.544655280802   2.022222760158 -11.824376892867 -10.371093815925
X2.to.1layhid1          53.073633645811 -16.974586260799  -5.876132900192  -0.001667719037
Intercept.to.1layhid2   -0.315669730798  -2.061952042789  -3.844189671604   4.536494903589
X1.to.1layhid2           0.007666761765   0.013133307848   3.466100603669  12.579992004563
X2.to.1layhid2           1.279781044231   2.601529252890   0.006373649005   6.520425462308
Intercept.to.Label       0.282608879274  -0.603110715271  -0.158980033168   2.230318924353
1layhid.1.to.Label      -2.697470974996   1.584156900523   1.255415766452  -1.130636130172
1layhid.2.to.Label       4.226521795897   1.986963622409   2.812131786915  -1.159246999104
                                    5
error                    0.333685854424
reached.threshold        0.008540590449
steps                  108.000000000000
Intercept.to.1layhid1   -3.013718813849
X1.to.1layhid1           0.008206271291
X2.to.1layhid1           3.447213624527
Intercept.to.1layhid2   -1.781286369333
X1.to.1layhid2           0.764049997589
X2.to.1layhid2          -7.205952611068
Intercept.to.Label      -0.346596642103
1layhid.1.to.Label       1.656060506216
1layhid.2.to.Label       1.350048916155

attr(,"class")
[1] "nn"
```

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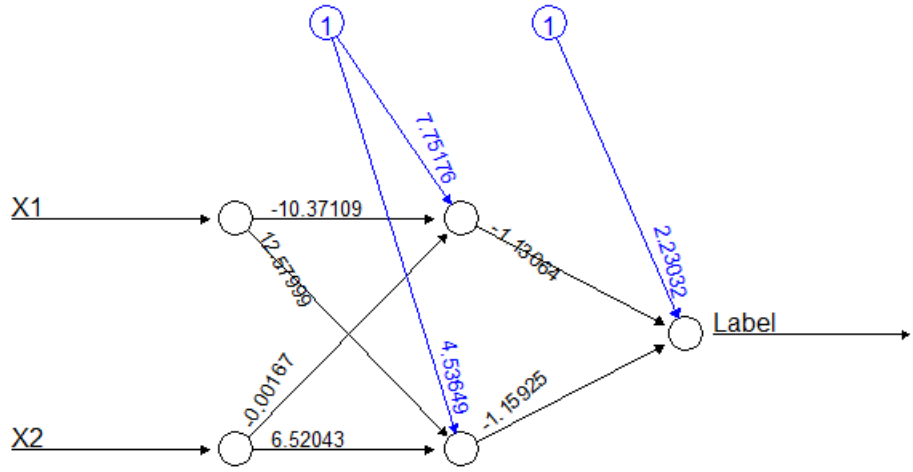
```
plot(net,rep="best")
```



Error: 0.026662 Steps: 198

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```
findinterceptslope<-function(w)
{
slope<-w[2]/w[3]*(-1)
intercept<-w[1]/w[3]*(-1)
rvector<-c(intercept,slope)
return(rvector)
}
w1<-c(7.75176,-10.37109,-0.00167)
line1<-findinterceptslope(w1)
line1
```

```
[1]  4641.772455 -6210.233533
```

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```
w2<-c(4.53649,12.57999,6.52043)
line2<-findinterceptslope(w2)
line2
```

```
[1] -0.6957347905 -1.9293190786
```

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```
plot(train$X1,train$X2,col=c("black","red")[train$Label+1],xlim=c(-2,2),ylim=c(-2,2))
abline(line1[1],line1[2],col="green",lty=2)
```

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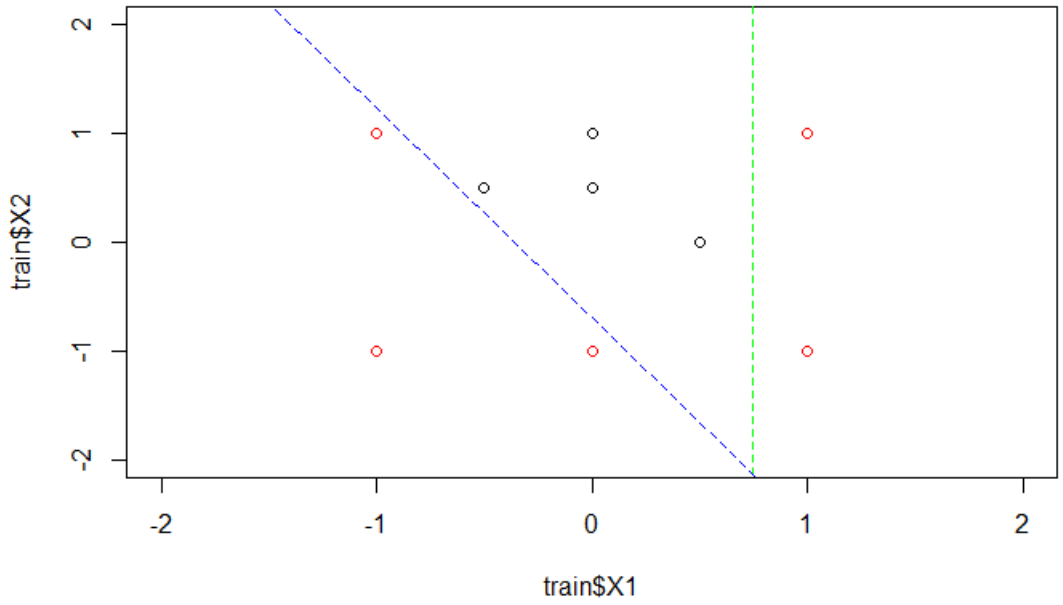
```
abline(line2[1],line2[2],col="blue",lty=2)
```


train$X2
2
1
0
-1
-2
-2
-1
0
1
2
train$X1