Homework 2, Question 5, part 2

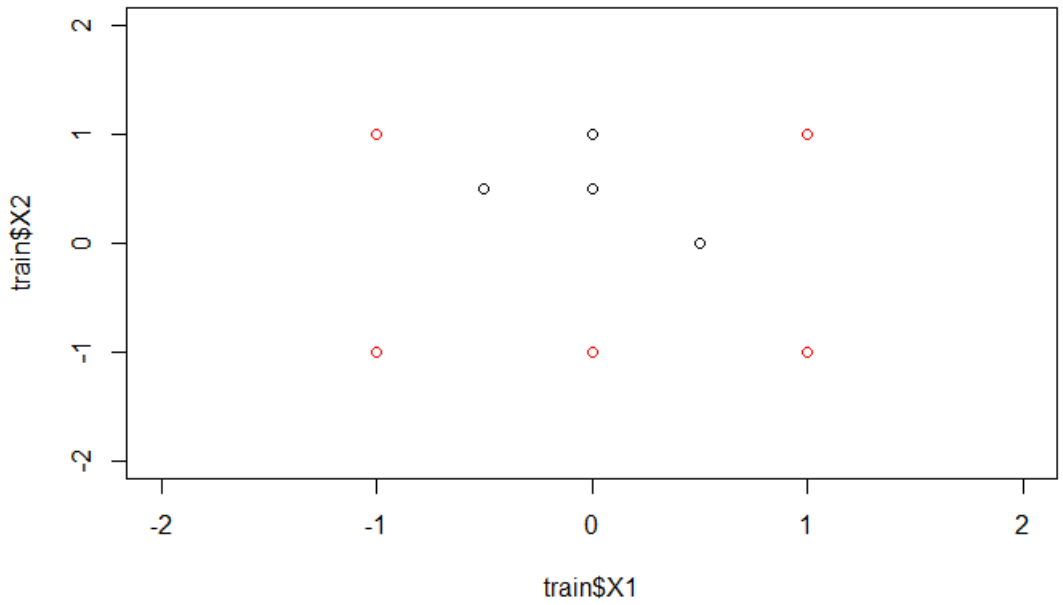
Code

Hide

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

Hide

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



Hide

```
net<-neuralnet(Label~X1+X2,train,hidden=3,rep=5)
net
```

```
$`call`
neuralnet(formula = Label ~ X1 + X2, data = train, hidden = 3,
    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: 0x00000000037cc928>
attr(,"type")
[1] "sse"

$act.fct
function (x)
{
    1/(1 + exp(-x))
}
<bytecode: 0x00000000036b22c8>
<environment: 0x00000000037cc928>
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  0.98802356644
2  0.01011383020
3  0.99989983817
4  1.00206234147
5  0.98391567702
6  0.98308867632
7  0.01444943712
8 -0.01179601381
9  0.02361711888

$net.result[[2]]
             [,1]
1  0.662713729567
2  0.659487140728
3  0.998774177083
4  1.000773241131
5  0.999789293508
6  0.656237405681
7 -0.003998060037
8  0.014256249479
9  0.011617964777

$net.result[[3]]
            [,1]
1  0.99548436795
2  0.03407232002
3  1.02645962101
4  0.98355103045
```

```
5  0.97908315579
6  0.95284771726
7  0.06695532086
8 -0.11953865831
9  0.07469535114

$net.result[[4]]
            [,1]
1  0.99225356709
2  0.05692883094
3  1.00390013742
4  0.99767343254
5  0.98870388195
6  0.97827844552
7  0.01320428715
8 -0.07138916458
9  0.04464358356

$net.result[[5]]
            [,1]
1  0.99604019164
2  0.09500422111
3  1.02603889480
4  1.00096049495
5  0.97142793288
6  0.93898529116
7  0.04817061711
8 -0.17806896734
9  0.10815341949


$weights
$weights[[1]]
$weights[[1]][[1]]
             [,1]         [,2]         [,3]
[1,]  7.316678222  9.982867478  5.060924133
[2,] -7.525611577  9.625715161  2.196722946
[3,] -3.583260266 -3.910092590 11.267717518

$weights[[1]][[2]]
             [,1]
[1,]  3.040733461
[2,] -1.026896015
[3,] -1.027925731
[4,] -1.002142328


$weights[[2]]
$weights[[2]][[1]]
               [,1]         [,2]           [,3]
[1,]  2.82976887613  1.371169377 1.406946783004
[2,] -0.01483511775 -0.392236765 0.001414877116
[3,] -4.24526407719 10.461024385 0.476719983693

$weights[[2]][[2]]
               [,1]
[1,] -0.09574805885
[2,] -1.16712085657
[3,] -1.75461423842
[4,]  3.15409627261


$weights[[3]]
$weights[[3]][[1]]
             [,1]         [,2]          [,3]
[1,] -3.211684282 0.1962824421  5.4433815730
[2,] -8.701083689 1.4635587383 -6.1983361427
[3,] -4.644165528 1.0157602552  0.7371750468

$weights[[3]][[2]]
             [,1]
[1,]  0.189755911
[2,]  2.079689416
```

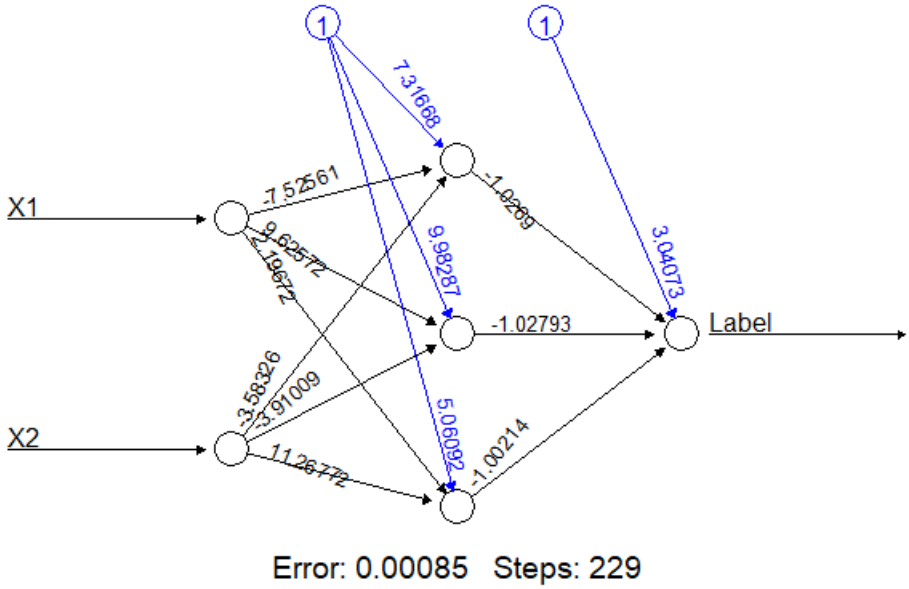
```
[3,]  1.597893427
[4,] -1.390793946


$weights[[4]]
$weights[[4]][[1]]
              [,1]         [,2]         [,3]
[1,] -2.4541158236 -2.612588100  2.363265475
[2,]  3.1111817241 -6.959616415 -2.378612952
[3,] -0.8370305625 -3.990865266 -7.077275420

$weights[[4]][[2]]
              [,1]
[1,] -0.0180474832
[2,]  2.2212736822
[3,]  1.8087618530
[4,] -0.8058553597


$weights[[5]]
$weights[[5]][[1]]
             [,1]          [,2]          [,3]
[1,] -2.595049982 -2.6100227443 -2.1162555196
[2,] -7.000525472  3.1476802156  0.1643510308
[3,] -4.037245395 -0.7020982183  2.7398883657

$weights[[5]][[2]]
              [,1]
[1,] -0.6028066126
[2,]  1.6099348850
[3,]  2.0487886111
[4,]  0.9579415574



$startweights
$startweights[[1]]
$startweights[[1]][[1]]
               [,1]          [,2]         [,3]
[1,] -0.48600522488  1.4990904521  1.198528822
[2,]  0.07256387881  0.7736686402 -0.476061586
[3,] -0.84257365684 -0.9848752707  1.309673924

$startweights[[1]][[2]]
               [,1]
[1,]  1.44906698355
[2,] -1.45386770609
[3,] -0.14652686085
[4,]  0.03055513878


$startweights[[2]]
$startweights[[2]][[1]]
               [,1]           [,2]          [,3]
[1,]  0.01923166420  0.49258013387  1.1186034129
[2,]  0.05358543054  0.08857966749 -0.5612319972
[3,] -0.53061518090 -0.08285589266  0.7993727302

$startweights[[2]][[2]]
              [,1]
[1,] -0.3347820339
[2,] -1.3326310598
[3,] -1.8734397642
[4,]  3.0245091267


$startweights[[3]]
$startweights[[3]][[1]]
              [,1]          [,2]          [,3]
[1,] -1.7424951641 -0.3379050755 -0.4814107201
[2,] -2.2785158598 -0.6739386984 -0.3266046648
[3,] -0.2556276111 -0.8695001647 -0.1963511725
```

```
$startweights[[3]][[2]]
             [,1]
[1,] -1.4960426411
[2,]  1.8314338110
[3,] -0.3843764805
[4,] -1.3386576406


$startweights[[4]]
$startweights[[4]][[1]]
              [,1]          [,2]          [,3]
[1,]  0.37796119441 -1.8473032989  1.6911795605
[2,]  0.18571131093 -0.6322725852  0.1312545414
[3,] -0.03747726068 -0.3846215809 -1.3189798652

$startweights[[4]][[2]]
             [,1]
[1,]  0.2585398578
[2,]  0.9740049325
[3,]  0.3422708240
[4,] -0.4061857583


$startweights[[5]]
$startweights[[5]][[1]]
             [,1]          [,2]          [,3]
[1,] -0.7194989117 -0.4345646490 -0.1477968960
[2,] -1.0008320121  0.6950564547  0.6576136826
[3,] -0.1225280950 -0.5430795210  0.4851573671

$startweights[[5]][[2]]
             [,1]
[1,] -0.4313111095
[2,]  0.5943869288
[3,]  0.2570614722
[4,]  0.9839215082



$generalized.weights
$generalized.weights[[1]]
              [,1]          [,2]
1    14.0823434098   6.705300578
2    15.3377830951   9.303503145
3 -1352.0283700505 521.959671101
4  -101.0732130398  38.579014800
5    -0.2708313292  -1.427923289
6   -16.1033435007   6.546143415
7    14.3503207114   5.318945464
8    -2.2857987184  -1.307414721
9   -15.9015675132   6.450871127

$generalized.weights[[2]]
             [,1]           [,2]
1   0.01438462952    4.221983827
2   0.01441918176    4.234848764
3   0.84547696204  250.153759439
4  -1.25608758172 -397.605809746
5   4.73520097808 1457.957551622
6   0.01445789288    4.247802490
7 -31.31283127800  699.780704946
8   0.38189434489   90.719916669
9   0.45212505931  111.176020859

$generalized.weights[[3]]
             [,1]          [,2]
1  510.750394324 -35.250625397
2   12.885866519   8.538538114
3   -7.210054240  -5.003527138
4  111.725801783  12.735019220
5 -109.483478313 -56.989188228
6  -71.839251348 -36.291245310
```

```
7   18.471386260   3.884383717
8   -3.530442791  -2.379483487
9  -38.520234592 -19.215357556

$generalized.weights[[4]]
            [,1]            [,2]
1  223.167093005  -59.3711186589
2    4.449888853   -0.4437558629
3  -14.568503446    4.5556104184
4  426.147760832 -129.4427011269
5  -95.690634315 -126.8732058897
6 -135.706146050  -60.8404672341
7  133.422212651   48.3642636228
8   -7.485405327  -11.2860719795
9  -41.394945097    1.6577330162

$generalized.weights[[5]]
             [,1]           [,2]
1   414.590970272  52.4298379749
2     2.788147390   6.2684367563
3    -1.466552752  -0.2488102376
4 -1124.362726212 261.7481760901
5   -36.608502246 -41.3211538519
6   -46.721893627 -16.5916471031
7    26.988213404  -0.5268843499
8    -1.079968490  -2.1077363083
9   -20.698533274  -6.9406380057


$result.matrix
                                    1                2                3                4
error                   0.0008501933002   0.333607192721   0.014582373755   0.005592383393
reached.threshold       0.0088851487225   0.008677585332   0.009566526979   0.007589623621
steps                 229.0000000000000 118.000000000000 285.000000000000 267.000000000000
Intercept.to.1layhid1   7.3166782220220   2.829768876133  -3.211684282200  -2.454115823640
X1.to.1layhid1         -7.5256115766374  -0.014835117755  -8.701083688745   3.111181724100
X2.to.1layhid1         -3.5832602663905  -4.245264077194  -4.644165527928  -0.837030562543
Intercept.to.1layhid2   9.9828674779752   1.371169376777   0.196282442148  -2.612588099606
X1.to.1layhid2          9.6257151612989  -0.392236765001   1.463558738346  -6.959616414661
X2.to.1layhid2         -3.9100925904654  10.461024385361   1.015760255187  -3.990865265932
Intercept.to.1layhid3   5.0609241328250   1.406946783004   5.443381572991   2.363265474568
X1.to.1layhid3          2.1967229457584   0.001414877116  -6.198336142692  -2.378612951614
X2.to.1layhid3         11.2677175182531   0.476719983693   0.737175046781  -7.077275419803
Intercept.to.Label      3.0407334613746  -0.095748058848   0.189755910958  -0.018047483201
1layhid.1.to.Label     -1.0268960147400  -1.167120856565   2.079689415962   2.221273682201
1layhid.2.to.Label     -1.0279257310294  -1.754614238416   1.597893427284   1.808761852970
1layhid.3.to.Label     -1.0021423279596   3.154096272608  -1.390793945535  -0.805855359735
                                    5
error                   0.029992857023
reached.threshold       0.007909174926
steps                 151.000000000000
Intercept.to.1layhid1  -2.595049982271
X1.to.1layhid1         -7.000525472417
X2.to.1layhid1         -4.037245395469
Intercept.to.1layhid2  -2.610022744279
X1.to.1layhid2          3.147680215631
X2.to.1layhid2         -0.702098218288
Intercept.to.1layhid3  -2.116255519597
X1.to.1layhid3          0.164351030763
X2.to.1layhid3          2.739888365685
Intercept.to.Label     -0.602806612596
1layhid.1.to.Label      1.609934884958
1layhid.2.to.Label      2.048788611097
1layhid.3.to.Label      0.957941557411

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

Hide

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



Hide

```
findinterceptslope<-function(w)
{
slope<-w[2]/w[3]*(-1)
intercept<-w[1]/w[3]*(-1)
rvector<-c(intercept,slope)
return(rvector)
}
w1<-c(7.31668,-7.52561,-3.58326)
line1<-findinterceptslope(w1)
line1
```

```
[1]  2.041905974 -2.100213214
```

Hide

```
w2<-c(9.98287,9.962572,-3.91009)
line2<-findinterceptslope(w2)
line2
```

```
[1] 2.553104916 2.547913731
```

Hide

```
w3<-c(5.06092,2.19672,11.26772)
line3<-findinterceptslope(w3)
line3
```

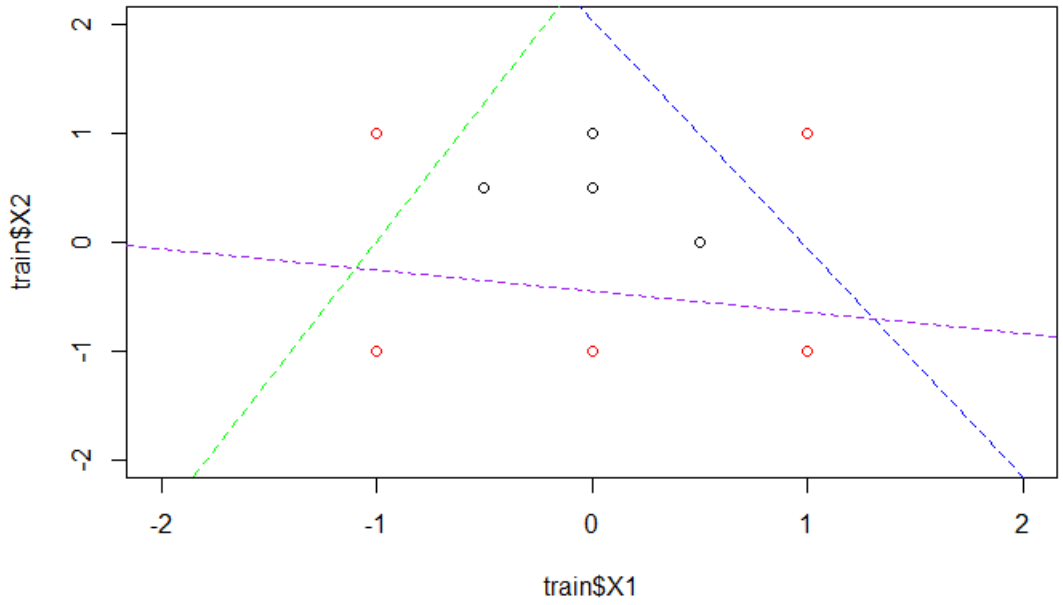
```
[1] -0.4491520911 -0.1949569212
```

Hide

```
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="blue",lty=2)
```

Hide

```
abline(line2[1],line2[2],col="green",lty=2)
abline(line3[1],line3[2],col="purple",lty=2)
```


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