Question 6 part 1

Code

Hide

```
library(pixmap)
library(gdata)
left1<-read.pnm(file="an2i_left_angry_open_4.pgm")
```

```
'x' is NULL so the result will be NULL
```

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```
plot(left1)
```

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```
left1.matrix<-left1@grey
left1
```

```
Pixmap image
  Type          : pixmapGrey
  Size          : 30x32
  Resolution    : 1x1
  Bounding box  : 0 0 32 30
```

Hide

```
left1.vector<-unmatrix(left1.matrix,byrow=T)
left1.frame<-data.frame(left1.vector)
left1.frame
```

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```
dim(left1.frame)
```

```
[1] 960   1
```

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```
loadImages <- function(pathName,fileNames, clasLabel) {
files<-list.files(path=pathName,pattern=fileNames,all.files=T,full.name=F,no..=T)
list_of_images=lapply(files,read.pnm)
plot(list_of_images[[1]])
n.images<-length(list_of_images)
image.matrix<-list_of_images[[1]]@grey
image.vector<-unmatrix(image.matrix,byrow=T)
for(ii in 2:n.images)
{
 i.matrix<-list_of_images[[ii]]@grey
 i.vector<-unmatrix(i.matrix,byrow=T)
 image.vector<-rbind(image.vector,i.vector)
}
image.frame<-data.frame(image.vector)
n.rows<-nrow(image.frame)
class1.label<-rep(clasLabel,n.rows)
image.frame<-cbind(image.frame,class1.label)
return (image.frame)
}
```

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```
left.frame <- loadImages("C:\\Users\\astro\\Desktop\\left","left*.*",1)
```

```
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will be NULL'x' is NULL so the result will be NULL
```

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```
left.frame
```

Hide

```
right.frame <- loadImages("C:\\Users\\astro\\Desktop\\right","right*.*",-1)
```

```
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NULL'x' is NULL so the result will be NULL'x' is NULL so the result will be NULL'x' is NULL so the result wi
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be NULL'x' is NULL so the result will be NULL'x' is NULL so the result will be NULL'x' is NULL so the result
will be NULL'x' is NULL so the result will be NULL
```

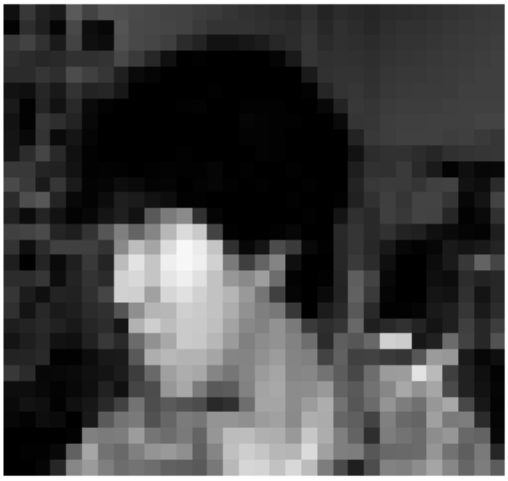

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```
right.frame
```

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```
total.frame<-rbind(left.frame,right.frame)
dim(total.frame)
```

```
[1] 100 961
```

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```
train.index<-sample(nrow(total.frame),nrow(total.frame)*0.4)
training.set<-total.frame[train.index,]
training.set
```

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```
test.set<-total.frame[-train.index,]
test.set
```

Hide

```
library(neuralnet)
myform <- as.formula(paste('class1.label ~ ',paste(names(training.set[!names(training.set) %in% 'class1.label']), collapse = ' + ')))
face.classifier <- neuralnet(myform, training.set, hidden = 3, rep=100, linear.output = FALSE, threshold = 0.1)
summary(face.classifier)
```

```
                   Length Class      Mode
call                    7 -none-     call
response               40 -none-     numeric
covariate           38400 -none-     numeric
model.list              2 -none-     list
err.fct                 1 -none-     function
act.fct                 1 -none-     function
linear.output           1 -none-     logical
data                  961 data.frame list
net.result            100 -none-     list
weights               100 -none-     list
startweights          100 -none-     list
generalized.weights   100 -none-     list
result.matrix      289000 -none-     numeric
```

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```
face.classifier2 <- neuralnet(myform, training.set, hidden = 5, rep=100, linear.output = FALSE, threshold = 0.1)
summary(face.classifier2)
```

```
                   Length Class      Mode
call                    7 -none-     call
response               40 -none-     numeric
covariate           38400 -none-     numeric
model.list              2 -none-     list
err.fct                 1 -none-     function
act.fct                 1 -none-     function
linear.output           1 -none-     logical
data                  961 data.frame list
net.result            100 -none-     list
weights               100 -none-     list
startweights          100 -none-     list
generalized.weights   100 -none-     list
result.matrix      481400 -none-     numeric
```

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```
face.classifier3 <- neuralnet(myform, training.set, hidden = 7, rep=100, linear.output = FALSE, threshold = 0.1)
summary(face.classifier3)
```

```
                   Length Class      Mode
call                    7 -none-     call
response               40 -none-     numeric
covariate           38400 -none-     numeric
model.list              2 -none-     list
err.fct                 1 -none-     function
act.fct                 1 -none-     function
linear.output           1 -none-     logical
data                  961 data.frame list
net.result            100 -none-     list
weights               100 -none-     list
startweights          100 -none-     list
generalized.weights   100 -none-     list
result.matrix      673800 -none-     numeric
```

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```
face.classifier4 <- neuralnet(myform, training.set, hidden = 9, rep=100, linear.output = FALSE, threshold =
0.1)
summary(face.classifier4)
```

```
                   Length Class      Mode
call                    7 -none-     call
response               40 -none-     numeric
covariate           38400 -none-     numeric
model.list              2 -none-     list
err.fct                 1 -none-     function
act.fct                 1 -none-     function
linear.output           1 -none-     logical
data                  961 data.frame list
net.result            100 -none-     list
weights               100 -none-     list
startweights          100 -none-     list
generalized.weights   100 -none-     list
result.matrix      866200 -none-     numeric
```

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```
face.classifier5 <- neuralnet(myform, training.set, hidden = 11, rep=100, linear.output = FALSE, threshold =
0.1)
summary(face.classifier5)
```

```
                   Length  Class      Mode
call                    7 -none-     call
response               40 -none-     numeric
covariate           38400 -none-     numeric
model.list              2 -none-     list
err.fct                 1 -none-     function
act.fct                 1 -none-     function
linear.output           1 -none-     logical
data                  961 data.frame list
net.result            100 -none-     list
weights               100 -none-     list
startweights          100 -none-     list
generalized.weights   100 -none-     list
result.matrix      1058600 -none-     numeric
```

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```
class.index<-length(test.set)
face.prediction<-compute(face.classifier,test.set[,-class.index])
face.prediction2<-compute(face.classifier,test.set[,-class.index])
face.prediction3<-compute(face.classifier,test.set[,-class.index])
face.prediction4<-compute(face.classifier,test.set[,-class.index])
face.prediction5<-compute(face.classifier,test.set[,-class.index])
face.prediction$net.result
```

```
                      [,1]
image.vector 0.931449250669
i.vector     0.931449250668
i.vector.2   0.931449250669
i.vector.3   0.931449250664
i.vector.6   0.931449250669
i.vector.7   0.931449250669
i.vector.8   0.931449250669
i.vector.9   0.931449250669
i.vector.10  0.931449250539
i.vector.13  0.931449250669
i.vector.14  0.931449250529
i.vector.15  0.931449250669
i.vector.16  0.005282529417
i.vector.17  0.931449250669
i.vector.18  0.005282529417
i.vector.19  0.926288962143
i.vector.20  0.005282529417
i.vector.22  0.005282529417
i.vector.26  0.931449250669
i.vector.28  0.931449250669
i.vector.29  0.931449250669
i.vector.32  0.931449250669
i.vector.35  0.931449250669
i.vector.39  0.931449250669
i.vector.40  0.931449250669
i.vector.41  0.931449250669
i.vector.43  0.931449250669
i.vector.44  0.931449250669
i.vector.45  0.931449250669
i.vector.46  0.931449250502
i.vector.47  0.902536998456
i.vector.48  0.931409751756
i.vector1    0.005282529417
i.vector.110 0.005282529417
i.vector.210 0.005282529417
i.vector.310 0.005282529417
i.vector.51  0.005282529417
i.vector.81  0.005282529417
i.vector.91  0.005282529417
i.vector.121 0.005282529417
i.vector.151 0.005282529417
i.vector.161 0.005282529417
i.vector.171 0.005282529417
i.vector.211 0.005282529417
i.vector.231 0.005282529417
i.vector.241 0.005282529417
i.vector.271 0.005282529417
i.vector.281 0.005282529417
i.vector.291 0.005282529417
i.vector.301 0.005282529417
i.vector.321 0.005282529417
i.vector.331 0.005282529417
i.vector.351 0.005282529417
i.vector.371 0.005282529417
i.vector.381 0.005282529417
i.vector.391 0.005282529417
i.vector.421 0.005282529417
i.vector.431 0.005282529417
i.vector.451 0.005282529417
i.vector.481 0.005282529417
```

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```
face.prediction2$net.result
```

```
                      [,1]
image.vector 0.931449250669
i.vector     0.931449250668
i.vector.2   0.931449250669
i.vector.3   0.931449250664
i.vector.6   0.931449250669
i.vector.7   0.931449250669
i.vector.8   0.931449250669
i.vector.9   0.931449250669
i.vector.10  0.931449250539
i.vector.13  0.931449250669
i.vector.14  0.931449250529
i.vector.15  0.931449250669
i.vector.16  0.005282529417
i.vector.17  0.931449250669
i.vector.18  0.005282529417
i.vector.19  0.926288962143
i.vector.20  0.005282529417
i.vector.22  0.005282529417
i.vector.26  0.931449250669
i.vector.28  0.931449250669
i.vector.29  0.931449250669
i.vector.32  0.931449250669
i.vector.35  0.931449250669
i.vector.39  0.931449250669
i.vector.40  0.931449250669
i.vector.41  0.931449250669
i.vector.43  0.931449250669
i.vector.44  0.931449250669
i.vector.45  0.931449250669
i.vector.46  0.931449250502
i.vector.47  0.902536998456
i.vector.48  0.931409751756
i.vector1    0.005282529417
i.vector.110 0.005282529417
i.vector.210 0.005282529417
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i.vector.51  0.005282529417
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i.vector.121 0.005282529417
i.vector.151 0.005282529417
i.vector.161 0.005282529417
i.vector.171 0.005282529417
i.vector.211 0.005282529417
i.vector.231 0.005282529417
i.vector.241 0.005282529417
i.vector.271 0.005282529417
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i.vector.321 0.005282529417
i.vector.331 0.005282529417
i.vector.351 0.005282529417
i.vector.371 0.005282529417
i.vector.381 0.005282529417
i.vector.391 0.005282529417
i.vector.421 0.005282529417
i.vector.431 0.005282529417
i.vector.451 0.005282529417
i.vector.481 0.005282529417
```

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```
face.prediction3$net.result
```

```
                      [,1]
image.vector 0.931449250669
i.vector     0.931449250668
i.vector.2   0.931449250669
i.vector.3   0.931449250664
i.vector.6   0.931449250669
i.vector.7   0.931449250669
i.vector.8   0.931449250669
i.vector.9   0.931449250669
i.vector.10  0.931449250539
i.vector.13  0.931449250669
i.vector.14  0.931449250529
i.vector.15  0.931449250669
i.vector.16  0.005282529417
i.vector.17  0.931449250669
i.vector.18  0.005282529417
i.vector.19  0.926288962143
i.vector.20  0.005282529417
i.vector.22  0.005282529417
i.vector.26  0.931449250669
i.vector.28  0.931449250669
i.vector.29  0.931449250669
i.vector.32  0.931449250669
i.vector.35  0.931449250669
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i.vector.43  0.931449250669
i.vector.44  0.931449250669
i.vector.45  0.931449250669
i.vector.46  0.931449250502
i.vector.47  0.902536998456
i.vector.48  0.931409751756
i.vector1    0.005282529417
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i.vector.371 0.005282529417
i.vector.381 0.005282529417
i.vector.391 0.005282529417
i.vector.421 0.005282529417
i.vector.431 0.005282529417
i.vector.451 0.005282529417
i.vector.481 0.005282529417
```

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```
face.prediction4$net.result
```

```
                     [,1]
image.vector 0.931449250669
i.vector     0.931449250668
i.vector.2   0.931449250669
i.vector.3   0.931449250664
i.vector.6   0.931449250669
i.vector.7   0.931449250669
i.vector.8   0.931449250669
i.vector.9   0.931449250669
i.vector.10  0.931449250539
i.vector.13  0.931449250669
i.vector.14  0.931449250529
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i.vector.18  0.005282529417
i.vector.19  0.926288962143
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i.vector.22  0.005282529417
i.vector.26  0.931449250669
i.vector.28  0.931449250669
i.vector.29  0.931449250669
i.vector.32  0.931449250669
i.vector.35  0.931449250669
i.vector.39  0.931449250669
i.vector.40  0.931449250669
i.vector.41  0.931449250669
i.vector.43  0.931449250669
i.vector.44  0.931449250669
i.vector.45  0.931449250669
i.vector.46  0.931449250502
i.vector.47  0.902536998456
i.vector.48  0.931409751756
i.vector1    0.005282529417
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i.vector.210 0.005282529417
i.vector.310 0.005282529417
i.vector.51  0.005282529417
i.vector.81  0.005282529417
i.vector.91  0.005282529417
i.vector.121 0.005282529417
i.vector.151 0.005282529417
i.vector.161 0.005282529417
i.vector.171 0.005282529417
i.vector.211 0.005282529417
i.vector.231 0.005282529417
i.vector.241 0.005282529417
i.vector.271 0.005282529417
i.vector.281 0.005282529417
i.vector.291 0.005282529417
i.vector.301 0.005282529417
i.vector.321 0.005282529417
i.vector.331 0.005282529417
i.vector.351 0.005282529417
i.vector.371 0.005282529417
i.vector.381 0.005282529417
i.vector.391 0.005282529417
i.vector.421 0.005282529417
i.vector.431 0.005282529417
i.vector.451 0.005282529417
i.vector.481 0.005282529417
```

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```
face.prediction5$net.result
```

```
                      [,1]
image.vector 0.931449250669
i.vector     0.931449250668
i.vector.2   0.931449250669
i.vector.3   0.931449250664
i.vector.6   0.931449250669
i.vector.7   0.931449250669
i.vector.8   0.931449250669
i.vector.9   0.931449250669
i.vector.10  0.931449250539
i.vector.13  0.931449250669
i.vector.14  0.931449250529
i.vector.15  0.931449250669
i.vector.16  0.005282529417
i.vector.17  0.931449250669
i.vector.18  0.005282529417
i.vector.19  0.926288962143
i.vector.20  0.005282529417
i.vector.22  0.005282529417
i.vector.26  0.931449250669
i.vector.28  0.931449250669
i.vector.29  0.931449250669
i.vector.32  0.931449250669
i.vector.35  0.931449250669
i.vector.39  0.931449250669
i.vector.40  0.931449250669
i.vector.41  0.931449250669
i.vector.43  0.931449250669
i.vector.44  0.931449250669
i.vector.45  0.931449250669
i.vector.46  0.931449250502
i.vector.47  0.902536998456
i.vector.48  0.931409751756
i.vector1    0.005282529417
i.vector.110 0.005282529417
i.vector.210 0.005282529417
i.vector.310 0.005282529417
i.vector.51  0.005282529417
i.vector.81  0.005282529417
i.vector.91  0.005282529417
i.vector.121 0.005282529417
i.vector.151 0.005282529417
i.vector.161 0.005282529417
i.vector.171 0.005282529417
i.vector.211 0.005282529417
i.vector.231 0.005282529417
i.vector.241 0.005282529417
i.vector.271 0.005282529417
i.vector.281 0.005282529417
i.vector.291 0.005282529417
i.vector.301 0.005282529417
i.vector.321 0.005282529417
i.vector.331 0.005282529417
i.vector.351 0.005282529417
i.vector.371 0.005282529417
i.vector.381 0.005282529417
i.vector.391 0.005282529417
i.vector.421 0.005282529417
i.vector.431 0.005282529417
i.vector.451 0.005282529417
i.vector.481 0.005282529417
```

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```
classifications<-ifelse(face.prediction$net.result>0.5,1,-1)
classifications2<-ifelse(face.prediction$net.result>0.5,1,-1)
classifications3<-ifelse(face.prediction$net.result>0.5,1,-1)
classifications4<-ifelse(face.prediction$net.result>0.5,1,-1)
classifications5<-ifelse(face.prediction$net.result>0.5,1,-1)
classifications
```

```
             [,1]
image.vector    1
i.vector        1
i.vector.2      1
i.vector.3      1
i.vector.6      1
i.vector.7      1
i.vector.8      1
i.vector.9      1
i.vector.10     1
i.vector.13     1
i.vector.14     1
i.vector.15     1
i.vector.16    -1
i.vector.17     1
i.vector.18    -1
i.vector.19     1
i.vector.20    -1
i.vector.22    -1
i.vector.26     1
i.vector.28     1
i.vector.29     1
i.vector.32     1
i.vector.35     1
i.vector.39     1
i.vector.40     1
i.vector.41     1
i.vector.43     1
i.vector.44     1
i.vector.45     1
i.vector.46     1
i.vector.47     1
i.vector.48     1
i.vector1      -1
i.vector.110   -1
i.vector.210   -1
i.vector.310   -1
i.vector.51    -1
i.vector.81    -1
i.vector.91    -1
i.vector.121   -1
i.vector.151   -1
i.vector.161   -1
i.vector.171   -1
i.vector.211   -1
i.vector.231   -1
i.vector.241   -1
i.vector.271   -1
i.vector.281   -1
i.vector.291   -1
i.vector.301   -1
i.vector.321   -1
i.vector.331   -1
i.vector.351   -1
i.vector.371   -1
i.vector.381   -1
i.vector.391   -1
i.vector.421   -1
i.vector.431   -1
i.vector.451   -1
i.vector.481   -1
```

Hide

```
classifications2
```

```
             [,1]
image.vector    1
i.vector        1
i.vector.2      1
i.vector.3      1
i.vector.6      1
i.vector.7      1
i.vector.8      1
i.vector.9      1
i.vector.10     1
i.vector.13     1
i.vector.14     1
i.vector.15     1
i.vector.16    -1
i.vector.17     1
i.vector.18    -1
i.vector.19     1
i.vector.20    -1
i.vector.22    -1
i.vector.26     1
i.vector.28     1
i.vector.29     1
i.vector.32     1
i.vector.35     1
i.vector.39     1
i.vector.40     1
i.vector.41     1
i.vector.43     1
i.vector.44     1
i.vector.45     1
i.vector.46     1
i.vector.47     1
i.vector.48     1
i.vector1      -1
i.vector.110   -1
i.vector.210   -1
i.vector.310   -1
i.vector.51    -1
i.vector.81    -1
i.vector.91    -1
i.vector.121   -1
i.vector.151   -1
i.vector.161   -1
i.vector.171   -1
i.vector.211   -1
i.vector.231   -1
i.vector.241   -1
i.vector.271   -1
i.vector.281   -1
i.vector.291   -1
i.vector.301   -1
i.vector.321   -1
i.vector.331   -1
i.vector.351   -1
i.vector.371   -1
i.vector.381   -1
i.vector.391   -1
i.vector.421   -1
i.vector.431   -1
i.vector.451   -1
i.vector.481   -1
```

Hide

```
classifications3
```

```
             [,1]
image.vector    1
i.vector        1
i.vector.2      1
i.vector.3      1
i.vector.6      1
i.vector.7      1
i.vector.8      1
i.vector.9      1
i.vector.10     1
i.vector.13     1
i.vector.14     1
i.vector.15     1
i.vector.16    -1
i.vector.17     1
i.vector.18    -1
i.vector.19     1
i.vector.20    -1
i.vector.22    -1
i.vector.26     1
i.vector.28     1
i.vector.29     1
i.vector.32     1
i.vector.35     1
i.vector.39     1
i.vector.40     1
i.vector.41     1
i.vector.43     1
i.vector.44     1
i.vector.45     1
i.vector.46     1
i.vector.47     1
i.vector.48     1
i.vector1      -1
i.vector.110   -1
i.vector.210   -1
i.vector.310   -1
i.vector.51    -1
i.vector.81    -1
i.vector.91    -1
i.vector.121   -1
i.vector.151   -1
i.vector.161   -1
i.vector.171   -1
i.vector.211   -1
i.vector.231   -1
i.vector.241   -1
i.vector.271   -1
i.vector.281   -1
i.vector.291   -1
i.vector.301   -1
i.vector.321   -1
i.vector.331   -1
i.vector.351   -1
i.vector.371   -1
i.vector.381   -1
i.vector.391   -1
i.vector.421   -1
i.vector.431   -1
i.vector.451   -1
i.vector.481   -1
```

Hide

```
classifications4
```

```
             [,1]
image.vector    1
i.vector        1
i.vector.2      1
i.vector.3      1
i.vector.6      1
i.vector.7      1
i.vector.8      1
i.vector.9      1
i.vector.10     1
i.vector.13     1
i.vector.14     1
i.vector.15     1
i.vector.16    -1
i.vector.17     1
i.vector.18    -1
i.vector.19     1
i.vector.20    -1
i.vector.22    -1
i.vector.26     1
i.vector.28     1
i.vector.29     1
i.vector.32     1
i.vector.35     1
i.vector.39     1
i.vector.40     1
i.vector.41     1
i.vector.43     1
i.vector.44     1
i.vector.45     1
i.vector.46     1
i.vector.47     1
i.vector.48     1
i.vector1      -1
i.vector.110   -1
i.vector.210   -1
i.vector.310   -1
i.vector.51    -1
i.vector.81    -1
i.vector.91    -1
i.vector.121   -1
i.vector.151   -1
i.vector.161   -1
i.vector.171   -1
i.vector.211   -1
i.vector.231   -1
i.vector.241   -1
i.vector.271   -1
i.vector.281   -1
i.vector.291   -1
i.vector.301   -1
i.vector.321   -1
i.vector.331   -1
i.vector.351   -1
i.vector.371   -1
i.vector.381   -1
i.vector.391   -1
i.vector.421   -1
i.vector.431   -1
i.vector.451   -1
i.vector.481   -1
```

Hide

```
classifications5
```

```
            [,1]
image.vector    1
i.vector        1
i.vector.2      1
i.vector.3      1
i.vector.6      1
i.vector.7      1
i.vector.8      1
i.vector.9      1
i.vector.10     1
i.vector.13     1
i.vector.14     1
i.vector.15     1
i.vector.16    -1
i.vector.17     1
i.vector.18    -1
i.vector.19     1
i.vector.20    -1
i.vector.22    -1
i.vector.26     1
i.vector.28     1
i.vector.29     1
i.vector.32     1
i.vector.35     1
i.vector.39     1
i.vector.40     1
i.vector.41     1
i.vector.43     1
i.vector.44     1
i.vector.45     1
i.vector.46     1
i.vector.47     1
i.vector.48     1
i.vector1      -1
i.vector.110   -1
i.vector.210   -1
i.vector.310   -1
i.vector.51    -1
i.vector.81    -1
i.vector.91    -1
i.vector.121   -1
i.vector.151   -1
i.vector.161   -1
i.vector.171   -1
i.vector.211   -1
i.vector.231   -1
i.vector.241   -1
i.vector.271   -1
i.vector.281   -1
i.vector.291   -1
i.vector.301   -1
i.vector.321   -1
i.vector.331   -1
i.vector.351   -1
i.vector.371   -1
i.vector.381   -1
i.vector.391   -1
i.vector.421   -1
i.vector.431   -1
i.vector.451   -1
i.vector.481   -1
```

Hide

```
table(test.set[,class.index],classifications)
```

```
   classifications
    -1  1
 -1 28  0
 1   4 28
```

Hide

```
table(test.set[,class.index],classifications2)
```

```
   classifications2
    -1  1
-1 28  0
1   4 28
```

Hide

```
table(test.set[,class.index],classifications3)
```

```
   classifications3
    -1  1
-1 28  0
1   4 28
```

Hide

```
table(test.set[,class.index],classifications4)
```

```
   classifications4
    -1  1
-1 28  0
1   4 28
```

Hide

```
table(test.set[,class.index],classifications5)
```

```
   classifications5
    -1  1
-1 28  0
1   4 28
```

3 nodes

Hide

```
face.3.classifier <- neuralnet(myform, training.set, hidden = 3, rep=100, linear.output = FALSE, threshold =
0.1)
face.prediction<-compute(face.3.classifier,test.set[,-class.index])
face.prediction$net.result
```

```
                      [,1]
image.vector 0.878228050990
i.vector     0.632720516023
i.vector.2   0.874149409456
i.vector.3   0.880786600856
i.vector.6   0.877700536815
i.vector.7   0.985762273271
i.vector.8   0.872907485206
i.vector.9   0.988531755867
i.vector.10  0.070213111730
i.vector.13  0.988535632375
i.vector.14  0.866354320919
i.vector.15  0.988509779786
i.vector.16  0.051053275804
i.vector.17  0.988435368903
i.vector.18  0.050269238560
i.vector.19  0.964680497344
i.vector.20  0.049872214865
i.vector.22  0.049925280806
i.vector.26  0.886926046202
i.vector.28  0.886511677694
i.vector.29  0.986240167255
i.vector.32  0.987587101981
i.vector.35  0.987903128804
i.vector.39  0.988309716183
i.vector.40  0.884217134270
i.vector.41  0.988301204237
i.vector.43  0.988527927444
i.vector.44  0.987476003943
i.vector.45  0.988538976059
i.vector.46  0.890920447277
i.vector.47  0.940161476447
i.vector.48  0.985363466874
i.vector1    0.004388687972
i.vector.110 0.004371825832
i.vector.210 0.004365833582
i.vector.310 0.182689121299
i.vector.51  0.004361364456
i.vector.81  0.024110078652
i.vector.91  0.004360982603
i.vector.121 0.008795162193
i.vector.151 0.004370683668
i.vector.161 0.004361302028
i.vector.171 0.018003329446
i.vector.211 0.005655819234
i.vector.231 0.004361032667
i.vector.241 0.004361009586
i.vector.271 0.004361828805
i.vector.281 0.004361188261
i.vector.291 0.004371437313
i.vector.301 0.004361073833
i.vector.321 0.004365556564
i.vector.331 0.004361050857
i.vector.351 0.004361058273
i.vector.371 0.004361096120
i.vector.381 0.004366002244
i.vector.391 0.004381437809
i.vector.421 0.004360980882
i.vector.431 0.004361973596
i.vector.451 0.004411327600
i.vector.481 0.050776698328
```

Hide

```
classifications<-ifelse(face.prediction$net.result>0.5,1,-1)
classifications
```

```
            [,1]
image.vector    1
i.vector        1
i.vector.2      1
i.vector.3      1
i.vector.6      1
i.vector.7      1
i.vector.8      1
i.vector.9      1
i.vector.10    -1
i.vector.13     1
i.vector.14     1
i.vector.15     1
i.vector.16    -1
i.vector.17     1
i.vector.18    -1
i.vector.19     1
i.vector.20    -1
i.vector.22    -1
i.vector.26     1
i.vector.28     1
i.vector.29     1
i.vector.32     1
i.vector.35     1
i.vector.39     1
i.vector.40     1
i.vector.41     1
i.vector.43     1
i.vector.44     1
i.vector.45     1
i.vector.46     1
i.vector.47     1
i.vector.48     1
i.vector1      -1
i.vector.110   -1
i.vector.210   -1
i.vector.310   -1
i.vector.51    -1
i.vector.81    -1
i.vector.91    -1
i.vector.121   -1
i.vector.151   -1
i.vector.161   -1
i.vector.171   -1
i.vector.211   -1
i.vector.231   -1
i.vector.241   -1
i.vector.271   -1
i.vector.281   -1
i.vector.291   -1
i.vector.301   -1
i.vector.321   -1
i.vector.331   -1
i.vector.351   -1
i.vector.371   -1
i.vector.381   -1
i.vector.391   -1
i.vector.421   -1
i.vector.431   -1
i.vector.451   -1
i.vector.481   -1
```

Hide

```
table(test.set[,class.index],classifications)
```

```
   classifications
    -1  1
  -1 28  0
  1   5 27
```

5

Hide

```
face.5.classifier <- neuralnet(myform, training.set, hidden = 5, rep=100, linear.output = FALSE, threshold = 0.1)
face.prediction<-compute(face.5.classifier,test.set[,-class.index])
face.prediction$net.result
```

```
                      [,1]
image.vector 0.913919699441
i.vector     0.953690660801
i.vector.2   0.971360036527
i.vector.3   0.769872096711
i.vector.6   0.967686604705
i.vector.7   0.945571961852
i.vector.8   0.664357369319
i.vector.9   0.975899858826
i.vector.10  0.971242502444
i.vector.13  0.948845890394
i.vector.14  0.974866356976
i.vector.15  0.947720558962
i.vector.16  0.009185288413
i.vector.17  0.950040094677
i.vector.18  0.006280880096
i.vector.19  0.646119280999
i.vector.20  0.005601863483
i.vector.22  0.003900801117
i.vector.26  0.974370941398
i.vector.28  0.972570479554
i.vector.29  0.974487332405
i.vector.32  0.948535649033
i.vector.35  0.976795329285
i.vector.39  0.943313885973
i.vector.40  0.806870542065
i.vector.41  0.950892397118
i.vector.43  0.959634449628
i.vector.44  0.961729898840
i.vector.45  0.950579604733
i.vector.46  0.876007249981
i.vector.47  0.016699771434
i.vector.48  0.306376304559
i.vector1    0.006717799061
i.vector.110 0.004622606487
i.vector.210 0.006277843151
i.vector.310 0.014140993287
i.vector.51  0.003523810094
i.vector.81  0.070480280559
i.vector.91  0.003482038568
i.vector.121 0.003482088566
i.vector.151 0.003498581321
i.vector.161 0.003491999249
i.vector.171 0.008898101529
i.vector.211 0.004327704289
i.vector.231 0.003510631023
i.vector.241 0.003511363375
i.vector.271 0.003531429686
i.vector.281 0.003565506327
i.vector.291 0.003560185368
i.vector.301 0.003523468093
i.vector.321 0.003488567255
i.vector.331 0.003488909306
i.vector.351 0.003489434801
i.vector.371 0.003493887372
i.vector.381 0.003491271665
i.vector.391 0.003481479335
i.vector.421 0.003483636540
i.vector.431 0.003491757821
i.vector.451 0.003482433096
i.vector.481 0.007080034830
```

Hide

```
classifications<-ifelse(face.prediction$net.result>0.5,1,-1)
classifications
```

```
             [,1]
image.vector    1
i.vector        1
i.vector.2      1
i.vector.3      1
i.vector.6      1
i.vector.7      1
i.vector.8      1
i.vector.9      1
i.vector.10     1
i.vector.13     1
i.vector.14     1
i.vector.15     1
i.vector.16    -1
i.vector.17     1
i.vector.18    -1
i.vector.19     1
i.vector.20    -1
i.vector.22    -1
i.vector.26     1
i.vector.28     1
i.vector.29     1
i.vector.32     1
i.vector.35     1
i.vector.39     1
i.vector.40     1
i.vector.41     1
i.vector.43     1
i.vector.44     1
i.vector.45     1
i.vector.46     1
i.vector.47    -1
i.vector.48    -1
i.vector1      -1
i.vector.110   -1
i.vector.210   -1
i.vector.310   -1
i.vector.51    -1
i.vector.81    -1
i.vector.91    -1
i.vector.121   -1
i.vector.151   -1
i.vector.161   -1
i.vector.171   -1
i.vector.211   -1
i.vector.231   -1
i.vector.241   -1
i.vector.271   -1
i.vector.281   -1
i.vector.291   -1
i.vector.301   -1
i.vector.321   -1
i.vector.331   -1
i.vector.351   -1
i.vector.371   -1
i.vector.381   -1
i.vector.391   -1
i.vector.421   -1
i.vector.431   -1
i.vector.451   -1
i.vector.481   -1
```

Hide

```
table(test.set[,class.index],classifications)
```

```
   classifications
    -1  1
-1 28  0
1   6 26
```

7

Hide

```
face.7.classifier <- neuralnet(myform, training.set, hidden = 7, rep=100, linear.output = FALSE, threshold =
0.1)
face.prediction<-compute(face.7.classifier,test.set[,-class.index])
face.prediction$net.result
```

```
                      [,1]
image.vector 0.919220628715
i.vector     0.750119625351
i.vector.2   0.880183760066
i.vector.3   0.965216377302
i.vector.6   0.891727724664
i.vector.7   0.981158540920
i.vector.8   0.929214580870
i.vector.9   0.981688226471
i.vector.10  0.931572197636
i.vector.13  0.955242786792
i.vector.14  0.977461225141
i.vector.15  0.907329274646
i.vector.16  0.014657042954
i.vector.17  0.900330267845
i.vector.18  0.014855785720
i.vector.19  0.349564106975
i.vector.20  0.014440077307
i.vector.22  0.015051831234
i.vector.26  0.970882218283
i.vector.28  0.949272519641
i.vector.29  0.981255659292
i.vector.32  0.973409740658
i.vector.35  0.965960010405
i.vector.39  0.174540342233
i.vector.40  0.639204589121
i.vector.41  0.198670662217
i.vector.43  0.312075848072
i.vector.44  0.600318400665
i.vector.45  0.338075546519
i.vector.46  0.679788695057
i.vector.47  0.046396510542
i.vector.48  0.037222338234
i.vector1    0.003277904196
i.vector.110 0.014164451439
i.vector.210 0.002621935514
i.vector.310 0.034191051326
i.vector.51  0.003328324384
i.vector.81  0.008054261721
i.vector.91  0.002580892447
i.vector.121 0.002660517608
i.vector.151 0.006126930243
i.vector.161 0.002811670313
i.vector.171 0.006365176326
i.vector.211 0.006003355036
i.vector.231 0.002588620210
i.vector.241 0.002588600501
i.vector.271 0.002854113986
i.vector.281 0.002818994529
i.vector.291 0.002824474282
i.vector.301 0.002808421723
i.vector.321 0.002619191603
i.vector.331 0.002729946703
i.vector.351 0.002840158275
i.vector.371 0.002755374646
i.vector.381 0.002616891901
i.vector.391 0.002579450263
i.vector.421 0.002580264265
i.vector.431 0.002579484456
i.vector.451 0.002579429613
i.vector.481 0.004063679765
```

Hide

```
classifications<-ifelse(face.prediction$net.result>0.5,1,-1)
classifications
```

```
             [,1]
image.vector    1
i.vector        1
i.vector.2      1
i.vector.3      1
i.vector.6      1
i.vector.7      1
i.vector.8      1
i.vector.9      1
i.vector.10     1
i.vector.13     1
i.vector.14     1
i.vector.15     1
i.vector.16    -1
i.vector.17     1
i.vector.18    -1
i.vector.19    -1
i.vector.20    -1
i.vector.22    -1
i.vector.26     1
i.vector.28     1
i.vector.29     1
i.vector.32     1
i.vector.35     1
i.vector.39    -1
i.vector.40     1
i.vector.41    -1
i.vector.43    -1
i.vector.44     1
i.vector.45    -1
i.vector.46     1
i.vector.47    -1
i.vector.48    -1
i.vector1      -1
i.vector.110   -1
i.vector.210   -1
i.vector.310   -1
i.vector.51    -1
i.vector.81    -1
i.vector.91    -1
i.vector.121   -1
i.vector.151   -1
i.vector.161   -1
i.vector.171   -1
i.vector.211   -1
i.vector.231   -1
i.vector.241   -1
i.vector.271   -1
i.vector.281   -1
i.vector.291   -1
i.vector.301   -1
i.vector.321   -1
i.vector.331   -1
i.vector.351   -1
i.vector.371   -1
i.vector.381   -1
i.vector.391   -1
i.vector.421   -1
i.vector.431   -1
i.vector.451   -1
i.vector.481   -1
```

Hide

```
table(test.set[,class.index],classifications)
```

```
    classifications
     -1  1
  -1 28  0
  1  11 21
```

9

Hide

```
face.9.classifier <- neuralnet(myform, training.set, hidden = 9, rep=100, linear.output = FALSE, threshold =
0.1)
face.prediction<-compute(face.9.classifier,test.set[,-class.index])
face.prediction$net.result
```

```
                     [,1]
image.vector 0.01503714231
i.vector     0.01504085795
i.vector.2   0.01503713877
i.vector.3   0.01503713852
i.vector.6   0.01503716823
i.vector.7   0.01503713516
i.vector.8   0.01503713977
i.vector.9   0.01503713424
i.vector.10  0.01503713425
i.vector.13  0.01503713531
i.vector.14  0.01503713438
i.vector.15  0.01503713486
i.vector.16  0.01503721132
i.vector.17  0.01503713509
i.vector.18  0.01503722472
i.vector.19  0.01503713481
i.vector.20  0.01503722103
i.vector.22  0.01503727654
i.vector.26  0.01503713943
i.vector.28  0.01503715704
i.vector.29  0.01503713430
i.vector.32  0.01503713436
i.vector.35  0.01503713426
i.vector.39  0.01503731825
i.vector.40  0.01503811872
i.vector.41  0.01503717091
i.vector.43  0.01505156069
i.vector.44  0.01503974155
i.vector.45  0.01526764016
i.vector.46  0.01503719689
i.vector.47  0.01503713609
i.vector.48  0.01503713469
i.vector1    0.01503713510
i.vector.110 0.01503715198
i.vector.210 0.01503713440
i.vector.310 0.01503716852
i.vector.51  0.01503715892
i.vector.81  0.01503713611
i.vector.91  0.01503723311
i.vector.121 0.01503720675
i.vector.151 0.01503713627
i.vector.161 0.01503713922
i.vector.171 0.01503713447
i.vector.211 0.01503713522
i.vector.231 0.01503713770
i.vector.241 0.01503713450
i.vector.271 0.01503714109
i.vector.281 0.01503714596
i.vector.291 0.01503713940
i.vector.301 0.01503716656
i.vector.321 0.01503714560
i.vector.331 0.01503713466
i.vector.351 0.01503713482
i.vector.371 0.01503713497
i.vector.381 0.01503714465
i.vector.391 0.01503713440
i.vector.421 0.01533286177
i.vector.431 0.01503713446
i.vector.451 0.01503713437
i.vector.481 0.01503713434
```

Hide

```
classifications<-ifelse(face.prediction$net.result>0.5,1,-1)
classifications
```

```
             [,1]
image.vector   -1
i.vector       -1
i.vector.2     -1
i.vector.3     -1
i.vector.6     -1
i.vector.7     -1
i.vector.8     -1
i.vector.9     -1
i.vector.10    -1
i.vector.13    -1
i.vector.14    -1
i.vector.15    -1
i.vector.16    -1
i.vector.17    -1
i.vector.18    -1
i.vector.19    -1
i.vector.20    -1
i.vector.22    -1
i.vector.26    -1
i.vector.28    -1
i.vector.29    -1
i.vector.32    -1
i.vector.35    -1
i.vector.39    -1
i.vector.40    -1
i.vector.41    -1
i.vector.43    -1
i.vector.44    -1
i.vector.45    -1
i.vector.46    -1
i.vector.47    -1
i.vector.48    -1
i.vector1      -1
i.vector.110   -1
i.vector.210   -1
i.vector.310   -1
i.vector.51    -1
i.vector.81    -1
i.vector.91    -1
i.vector.121   -1
i.vector.151   -1
i.vector.161   -1
i.vector.171   -1
i.vector.211   -1
i.vector.231   -1
i.vector.241   -1
i.vector.271   -1
i.vector.281   -1
i.vector.291   -1
i.vector.301   -1
i.vector.321   -1
i.vector.331   -1
i.vector.351   -1
i.vector.371   -1
i.vector.381   -1
i.vector.391   -1
i.vector.421   -1
i.vector.431   -1
i.vector.451   -1
i.vector.481   -1
```

Hide

```
table(test.set[,class.index],classifications)
```

```
   classifications
    -1
-1 28
1  32
```

11

Hide

```
face.11.classifier <- neuralnet(myform, training.set, hidden = 11, rep=100, linear.output = FALSE, threshold
= 0.1)
face.prediction<-compute(face.11.classifier,test.set[,-class.index])
face.prediction$net.result
```

```
                      [,1]
image.vector 0.9014039480954
i.vector     0.9357558805015
i.vector.2   0.8470993961062
i.vector.3   0.8864052027325
i.vector.6   0.9059105639810
i.vector.7   0.9067304629970
i.vector.8   0.4659491645696
i.vector.9   0.9537767248679
i.vector.10  0.7249189982040
i.vector.13  0.9218099783527
i.vector.14  0.9311630369531
i.vector.15  0.7421077292351
i.vector.16  0.0013390923903
i.vector.17  0.7405194725472
i.vector.18  0.0015350981616
i.vector.19  0.1882372988035
i.vector.20  0.0011961560744
i.vector.22  0.0015165079344
i.vector.26  0.9679505786506
i.vector.28  0.9635596012290
i.vector.29  0.9690124685291
i.vector.32  0.9658518833021
i.vector.35  0.9513023932911
i.vector.39  0.5056705232721
i.vector.40  0.7826593134868
i.vector.41  0.5577751974681
i.vector.43  0.6995480637998
i.vector.44  0.9017034006321
i.vector.45  0.4052416375455
i.vector.46  0.7315638907489
i.vector.47  0.1256391459058
i.vector.48  0.1108933688113
i.vector1    0.0016165202440
i.vector.110 0.0022573972669
i.vector.210 0.0019332375464
i.vector.310 0.0060049028018
i.vector.51  0.0009124093925
i.vector.81  0.0072933219031
i.vector.91  0.0008759619856
i.vector.121 0.0008762454636
i.vector.151 0.0022531313184
i.vector.161 0.0009795682585
i.vector.171 0.0061620330309
i.vector.211 0.0031532358125
i.vector.231 0.0008957253607
i.vector.241 0.0009149055605
i.vector.271 0.0010688395038
i.vector.281 0.0012763682692
i.vector.291 0.0014225679806
i.vector.301 0.0013681417193
i.vector.321 0.0009513950861
i.vector.331 0.0009160110547
i.vector.351 0.0009168583140
i.vector.371 0.0009124979604
i.vector.381 0.0009599950876
i.vector.391 0.0008756923935
i.vector.421 0.0008766654900
i.vector.431 0.0008757747521
i.vector.451 0.0008778113328
i.vector.481 0.0041758671967
```

Hide

```
classifications<-ifelse(face.prediction$net.result>0.5,1,-1)
classifications
```

```
            [,1]
image.vector    1
i.vector        1
i.vector.2      1
i.vector.3      1
i.vector.6      1
i.vector.7      1
i.vector.8     -1
i.vector.9      1
i.vector.10     1
i.vector.13     1
i.vector.14     1
i.vector.15     1
i.vector.16    -1
i.vector.17     1
i.vector.18    -1
i.vector.19    -1
i.vector.20    -1
i.vector.22    -1
i.vector.26     1
i.vector.28     1
i.vector.29     1
i.vector.32     1
i.vector.35     1
i.vector.39     1
i.vector.40     1
i.vector.41     1
i.vector.43     1
i.vector.44     1
i.vector.45    -1
i.vector.46     1
i.vector.47    -1
i.vector.48    -1
i.vector1      -1
i.vector.110   -1
i.vector.210   -1
i.vector.310   -1
i.vector.51    -1
i.vector.81    -1
i.vector.91    -1
i.vector.121   -1
i.vector.151   -1
i.vector.161   -1
i.vector.171   -1
i.vector.211   -1
i.vector.231   -1
i.vector.241   -1
i.vector.271   -1
i.vector.281   -1
i.vector.291   -1
i.vector.301   -1
i.vector.321   -1
i.vector.331   -1
i.vector.351   -1
i.vector.371   -1
i.vector.381   -1
i.vector.391   -1
i.vector.421   -1
i.vector.431   -1
i.vector.451   -1
i.vector.481   -1
```

Hide

```
table(test.set[,class.index],classifications)
```

```
   classifications
    -1  1
 -1 28  0
 1   9 23
```