

# HW07

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```
rm(list=ls())
file <- file.choose()
bc_temp <- read.csv(file)
summary(bc_temp)
```

```
##           id           diagnosis           radius_mean           texture_mean
## Min.      :    8670   Length:569           Min.      : 6.981   Min.      : 9.71
## 1st Qu.:   869218   Class :character   1st Qu.:11.700   1st Qu.:16.17
## Median :   906024   Mode  :character   Median :13.370   Median :18.84
## Mean      : 30371831           Mean      :14.127   Mean      :19.29
## 3rd Qu.:   8813129           3rd Qu.:15.780   3rd Qu.:21.80
## Max.      :911320502           Max.      :28.110   Max.      :39.28
## perimeter_mean   area_mean   smoothness_mean   compactness_mean
## Min.      : 43.79   Min.      : 143.5   Min.      :0.05263   Min.      :0.01938
## 1st Qu.: 75.17   1st Qu.: 420.3   1st Qu.:0.08637   1st Qu.:0.06492
## Median : 86.24   Median : 551.1   Median :0.09587   Median :0.09263
## Mean      : 91.97   Mean      : 654.9   Mean      :0.09636   Mean      :0.10434
## 3rd Qu.:104.10   3rd Qu.: 782.7   3rd Qu.:0.10530   3rd Qu.:0.13040
## Max.      :188.50   Max.      :2501.0   Max.      :0.16340   Max.      :0.34540
## concavity_mean   concave.points_mean symmetry_mean   fractal_dimension_mean
## Min.      :0.00000   Min.      :0.00000   Min.      :0.1060   Min.      :0.04996
## 1st Qu.:0.02956   1st Qu.:0.02031   1st Qu.:0.1619   1st Qu.:0.05770
## Median :0.06154   Median :0.03350   Median :0.1792   Median :0.06154
## Mean      :0.08880   Mean      :0.04892   Mean      :0.1812   Mean      :0.06280
## 3rd Qu.:0.13070   3rd Qu.:0.07400   3rd Qu.:0.1957   3rd Qu.:0.06612
## Max.      :0.42680   Max.      :0.20120   Max.      :0.3040   Max.      :0.09744
## radius_se        texture_se        perimeter_se        area_se
## Min.      :0.1115   Min.      :0.3602   Min.      : 0.757   Min.      : 6.802
## 1st Qu.:0.2324   1st Qu.:0.8339   1st Qu.: 1.606   1st Qu.: 17.850
## Median :0.3242   Median :1.1080   Median : 2.287   Median : 24.530
## Mean      :0.4052   Mean      :1.2169   Mean      : 2.866   Mean      : 40.337
## 3rd Qu.:0.4789   3rd Qu.:1.4740   3rd Qu.: 3.357   3rd Qu.: 45.190
## Max.      :2.8730   Max.      :4.8850   Max.      :21.980   Max.      :542.200
## smoothness_se    compactness_se    concavity_se    concave.points_se
## Min.      :0.001713   Min.      :0.002252   Min.      :0.00000   Min.      :0.000000
## 1st Qu.:0.005169   1st Qu.:0.013080   1st Qu.:0.01509   1st Qu.:0.007638
## Median :0.006380   Median :0.020450   Median :0.02589   Median :0.010930
## Mean      :0.007041   Mean      :0.025478   Mean      :0.03189   Mean      :0.011796
## 3rd Qu.:0.008146   3rd Qu.:0.032450   3rd Qu.:0.04205   3rd Qu.:0.014710
## Max.      :0.031130   Max.      :0.135400   Max.      :0.39600   Max.      :0.052790
## symmetry_se      fractal_dimension_se radius_worst    texture_worst
```

```
## Min. :0.007882 Min. :0.0008948 Min. : 7.93 Min. :12.02
## 1st Qu.:0.015160 1st Qu.:0.0022480 1st Qu.:13.01 1st Qu.:21.08
## Median :0.018730 Median :0.0031870 Median :14.97 Median :25.41
## Mean :0.020542 Mean :0.0037949 Mean :16.27 Mean :25.68
## 3rd Qu.:0.023480 3rd Qu.:0.0045580 3rd Qu.:18.79 3rd Qu.:29.72
## Max. :0.078950 Max. :0.0298400 Max. :36.04 Max. :49.54
## perimeter_worst area_worst smoothness_worst compactness_worst
## Min. : 50.41 Min. : 185.2 Min. :0.07117 Min. :0.02729
## 1st Qu.: 84.11 1st Qu.: 515.3 1st Qu.:0.11660 1st Qu.:0.14720
## Median : 97.66 Median : 686.5 Median :0.13130 Median :0.21190
## Mean :107.26 Mean : 880.6 Mean :0.13237 Mean :0.25427
## 3rd Qu.:125.40 3rd Qu.:1084.0 3rd Qu.:0.14600 3rd Qu.:0.33910
## Max. :251.20 Max. :4254.0 Max. :0.22260 Max. :1.05800
## concavity_worst concave.points_worst symmetry_worst fractal_dimension_worst
## Min. :0.0000 Min. :0.00000 Min. :0.1565 Min. :0.05504
## 1st Qu.:0.1145 1st Qu.:0.06493 1st Qu.:0.2504 1st Qu.:0.07146
## Median :0.2267 Median :0.09993 Median :0.2822 Median :0.08004
## Mean :0.2722 Mean :0.11461 Mean :0.2901 Mean :0.08395
## 3rd Qu.:0.3829 3rd Qu.:0.16140 3rd Qu.:0.3179 3rd Qu.:0.09208
## Max. :1.2520 Max. :0.29100 Max. :0.6638 Max. :0.20750
```

```
summary(bc_temp$diagnosis)
```

```
## Length Class Mode
##      569 character character
```

```
table(bc_temp$diagnosis)
```

```
##
## B M
## 357 212
```

```
mmnorm2 <- function(x)
{ z <- ((x-min(x))/(max(x)-min(x)))
  return(z)
}
```

```
myvector <- 1:20
mmnorm2(myvector)
```

```
## [1] 0.00000000 0.05263158 0.10526316 0.15789474 0.21052632 0.26315789
## [7] 0.31578947 0.36842105 0.42105263 0.47368421 0.52631579 0.57894737
## [13] 0.63157895 0.68421053 0.73684211 0.78947368 0.84210526 0.89473684
## [19] 0.94736842 1.00000000
```

```
bc <- data.frame(id=as.character(bc_temp$id)
,diagnosis=as.integer(ifelse((bc_temp$diagnosis=="M"),1,0))
,radius_mean=mmnorm2( bc_temp$radius_mean)
,texture_mean=mmnorm2(bc_temp$texture_mean)
,perimeter_mean=mmnorm2(bc_temp$perimeter_mean)
,area_mean=mmnorm2(bc_temp$area_mean)
```

```

,smoothness_mean=mmnorm2(bc_temp$smoothness_mean)
,compactness_mean=mmnorm2(bc_temp$compactness_mean)
,concavity_mean=mmnorm2(bc_temp$concavity_mean)
,concave.points_mean=mmnorm2(bc_temp$concave.points_mean)
,symmetry_mean=mmnorm2(bc_temp$symmetry_mean)
,fractal_dimension_mean=mmnorm2(bc_temp$fractal_dimension_mean)
,radius_se=mmnorm2(bc_temp$radius_se)
,perimeter_se=mmnorm2(bc_temp$perimeter_se)
,texture_se=mmnorm2(bc_temp$texture_se)
,area_se=mmnorm2(bc_temp$area_se)
,smoothness_se=mmnorm2(bc_temp$smoothness_se)
,compactness_se=mmnorm2(bc_temp$compactness_se)
,concavity_se=mmnorm2(bc_temp$concavity_se)
,concave.points_se =mmnorm2(bc_temp$concave.points_se)
,symmetry_se=mmnorm2(bc_temp$symmetry_se)
,fractal_dimension_se=mmnorm2(bc_temp$fractal_dimension_se)
,radius_worst=mmnorm2(bc_temp$radius_worst)
,texture_worst=mmnorm2(bc_temp$texture_worst)
,perimeter_worst=mmnorm2(bc_temp$perimeter_worst)
,area_worst=mmnorm2(bc_temp$area_worst)
,smoothness_worst=mmnorm2(bc_temp$smoothness_worst)
,compactness_worst=mmnorm2(bc_temp$compactness_worst)
,concavity_worst=mmnorm2(bc_temp$concavity_worst)
,concave.points_worst=mmnorm2(bc_temp$concave.points_worst)
,symmetry_worst=mmnorm2(bc_temp$symmetry_worst)
,fractal_dimension_worst=mmnorm2(bc_temp$fractal_dimension_worst)
)

index <- sort(sample(nrow(bc),round(.30*nrow(bc ))))
training <- bc[-index,]
test <- bc[index,]

library("neuralnet")

```

## Warning: package 'neuralnet' was built under R version 4.0.5

```

net_bc <- neuralnet( diagnosis~ radius_mean+texture_mean+perimeter_mean+
                        area_mean+smoothness_mean+compactness_mean+
                        concavity_mean+concave.points_mean+
                        symmetry_mean+fractal_dimension_mean+
                        radius_se+texture_se+perimeter_se+
                        area_se+smoothness_se+compactness_se+
                        concavity_se+concave.points_se+
                        symmetry_se+fractal_dimension_se+
                        radius_worst+texture_worst+perimeter_worst+
                        area_worst+smoothness_worst+
                        compactness_worst+concavity_worst+
                        concave.points_worst+symmetry_worst+
                        fractal_dimension_worst
                        ,training, hidden=15, threshold=0.01)

```

```

plot(net_bc)

net_bc_results <- compute(net_bc, test[,c(-1,-2)])
ANN=as.numeric(net_bc_results$net.result)

ANN_cat <- ifelse(ANN<.3,0,1)

table(Actual=test$diagnosis,ANN_cat)

```

```

##      ANN_cat
## Actual    0    1
##      0 106    2
##      1   4   59

```

```

wrong <- ( test$diagnosis!=ANN_cat)
rate <- sum(wrong)/length(wrong)
rate

```

```

## [1] 0.03508772

```