pproject

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Data Collection

```
data <- read.csv("C:/Users/Saipr/Downloads/diabetes.csv")
head(data)
```

```
##   Pregnancies Glucose BloodPressure SkinThickness Insulin  BMI
## 1           6     148            72            35       0 33.6
## 2           1      85            66            29       0 26.6
## 3           8     183            64             0       0 23.3
## 4           1      89            66            23      94 28.1
## 5           0     137            40            35     168 43.1
## 6           5     116            74             0       0 25.6
##   DiabetesPedigreeFunction Age Outcome
## 1                    0.627  50       1
## 2                    0.351  31       0
## 3                    0.672  32       1
## 4                    0.167  21       0
## 5                    2.288  33       1
## 6                    0.201  30       0
```

Data Summary

```
summary(data)
```

```
##   Pregnancies        Glucose      BloodPressure    SkinThickness
##  Min.   : 0.000   Min.   :  0.0   Min.   :  0.00   Min.   : 0.00
##  1st Qu.: 1.000   1st Qu.: 99.0   1st Qu.: 62.00   1st Qu.: 0.00
##  Median : 3.000   Median :117.0   Median : 72.00   Median :23.00
##  Mean   : 3.845   Mean   :120.9   Mean   : 69.11   Mean   :20.54
##  3rd Qu.: 6.000   3rd Qu.:140.2   3rd Qu.: 80.00   3rd Qu.:32.00
##  Max.   :17.000   Max.   :199.0   Max.   :122.00   Max.   :99.00
##     Insulin           BMI        DiabetesPedigreeFunction      Age
##  Min.   :  0.0   Min.   : 0.00   Min.   :0.0780           Min.   :21.00
##  1st Qu.:  0.0   1st Qu.:27.30   1st Qu.:0.2437           1st Qu.:24.00
##  Median : 30.5   Median :32.00   Median :0.3725           Median :29.00
##  Mean   : 79.8   Mean   :31.99   Mean   :0.4719           Mean   :33.24
##  3rd Qu.:127.2   3rd Qu.:36.60   3rd Qu.:0.6262           3rd Qu.:41.00
##  Max.   :846.0   Max.   :67.10   Max.   :2.4200           Max.   :81.00
##     Outcome
##  Min.   :0.000
```

```
##  1st Qu.:0.000
##  Median :0.000
##  Mean   :0.349
##  3rd Qu.:1.000
##  Max.   :1.000
```

A value of 0 in these columns indicates a missing value since it is illogical.

The 0 value in the following columns or variables is invalid:Glucose,BloodPressure ,SkinThickness ,Insulin and BMI

Since counting them thereafter would be simpler and zeros need to be replaced with appropriate values, it is preferable to replace zeros with nan.

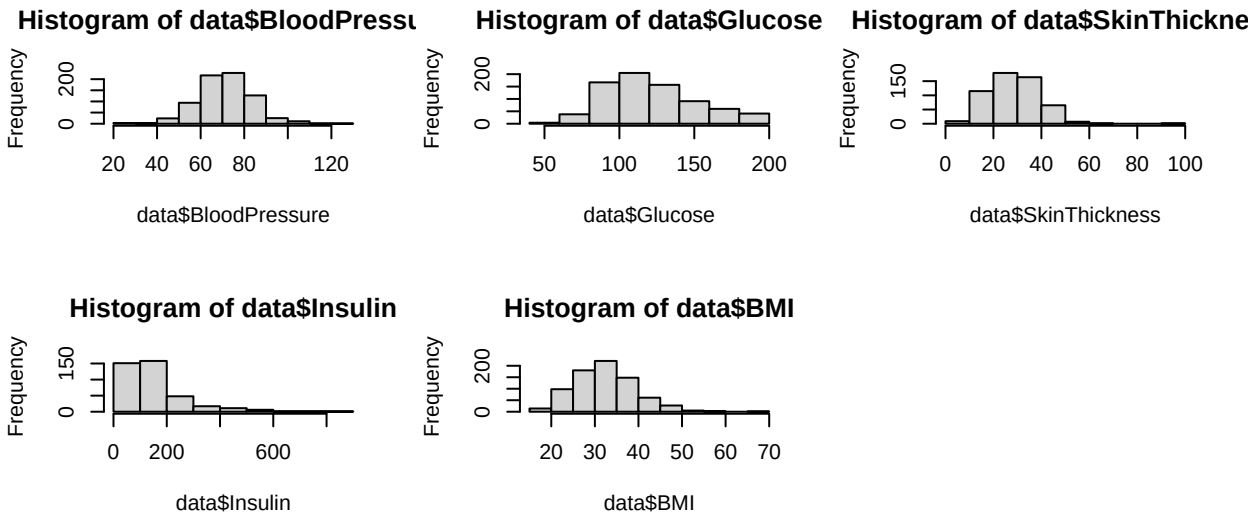
Replacing 0 with Nans

```
data["BloodPressure"][data["BloodPressure"] == 0] <- NA
data["Glucose"][data["Glucose"] == 0] <- NA
data["SkinThickness"][data["SkinThickness"] == 0] <- NA
data["Insulin"][data["Insulin"] == 0] <- NA
data["BMI"][data["BMI"] == 0] <- NA
```

```
summary(data)
```

```
##   Pregnancies        Glucose      BloodPressure    SkinThickness
##  Min.   : 0.000   Min.   : 44.0   Min.   : 24.00   Min.   : 7.00
##  1st Qu.: 1.000   1st Qu.: 99.0   1st Qu.: 64.00   1st Qu.:22.00
##  Median : 3.000   Median :117.0   Median : 72.00   Median :29.00
##  Mean   : 3.845   Mean   :121.7   Mean   : 72.41   Mean   :29.15
##  3rd Qu.: 6.000   3rd Qu.:141.0   3rd Qu.: 80.00   3rd Qu.:36.00
##  Max.   :17.000   Max.   :199.0   Max.   :122.00   Max.   :99.00
##                   NA's   :5       NA's   :35       NA's   :227
##     Insulin            BMI        DiabetesPedigreeFunction      Age
##  Min.   : 14.00   Min.   :18.20   Min.   :0.0780           Min.   :21.00
##  1st Qu.: 76.25   1st Qu.:27.50   1st Qu.:0.2437           1st Qu.:24.00
##  Median :125.00   Median :32.30   Median :0.3725           Median :29.00
##  Mean   :155.55   Mean   :32.46   Mean   :0.4719           Mean   :33.24
##  3rd Qu.:190.00   3rd Qu.:36.60   3rd Qu.:0.6262           3rd Qu.:41.00
##  Max.   :846.00   Max.   :67.10   Max.   :2.4200           Max.   :81.00
##  NA's   :374      NA's   :11
##     Outcome
##  Min.   :0.000
##  1st Qu.:0.000
##  Median :0.000
##  Mean   :0.349
##  3rd Qu.:1.000
##  Max.   :1.000
##
```

```
par(mfrow = c(3, 3))
hist(data$BloodPressure)
hist(data$Glucose)
hist(data$SkinThickness)
hist(data$Insulin)
hist(data$BMI)
```



Replacing Nan values with the appropriate median/mean according to the data histogram

```
data$BloodPressure[is.na(data$BloodPressure)] <- round(mean(data$BloodPressure, na.rm = TRUE))
data$Glucose[is.na(data$Glucose)] <- round(mean(data$Glucose, na.rm = TRUE))
data$SkinThickness[is.na(data$SkinThickness)] <- round(median(data$SkinThickness, na.rm = TRUE))
data$Insulin[is.na(data$Insulin)] <- round(median(data$Insulin, na.rm = TRUE))
data$BMI[is.na(data$BMI)] <- round(mean(data$BMI, na.rm = TRUE))
```

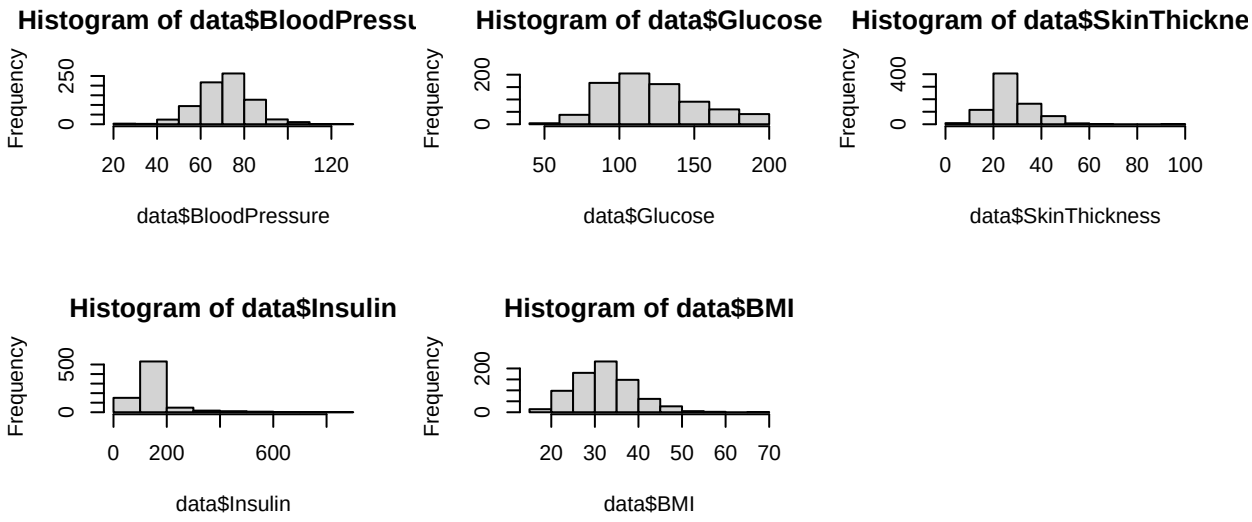
```
summary(data)
```

```
##   Pregnancies        Glucose       BloodPressure    SkinThickness
##  Min.   : 0.000   Min.   : 44.00   Min.   : 24.00   Min.   : 7.00
##  1st Qu.: 1.000   1st Qu.: 99.75   1st Qu.: 64.00   1st Qu.:25.00
##  Median : 3.000   Median :117.00   Median : 72.00   Median :29.00
##  Mean   : 3.845   Mean   :121.69   Mean   : 72.39   Mean   :29.11
##  3rd Qu.: 6.000   3rd Qu.:140.25   3rd Qu.: 80.00   3rd Qu.:32.00
##  Max.   :17.000   Max.   :199.00   Max.   :122.00   Max.   :99.00
##     Insulin           BMI        DiabetesPedigreeFunction      Age
##  Min.   : 14.0   Min.   :18.20   Min.   :0.0780           Min.   :21.00
##  1st Qu.:121.5   1st Qu.:27.50   1st Qu.:0.2437           1st Qu.:24.00
##  Median :125.0   Median :32.00   Median :0.3725           Median :29.00
##  Mean   :140.7   Mean   :32.45   Mean   :0.4719           Mean   :33.24
##  3rd Qu.:127.2   3rd Qu.:36.60   3rd Qu.:0.6262           3rd Qu.:41.00
##  Max.   :846.0   Max.   :67.10   Max.   :2.4200           Max.   :81.00
##     Outcome
##  Min.   :0.000
```

```
##  1st Qu.:0.000
##  Median :0.000
##  Mean   :0.349
##  3rd Qu.:1.000
##  Max.   :1.000
```

plotting the histograms after imputation:

```
par(mfrow = c(3, 3))
hist(data$BloodPressure)
hist(data$Glucose)
hist(data$SkinThickness)
hist(data$Insulin)
hist(data$BMI)
```



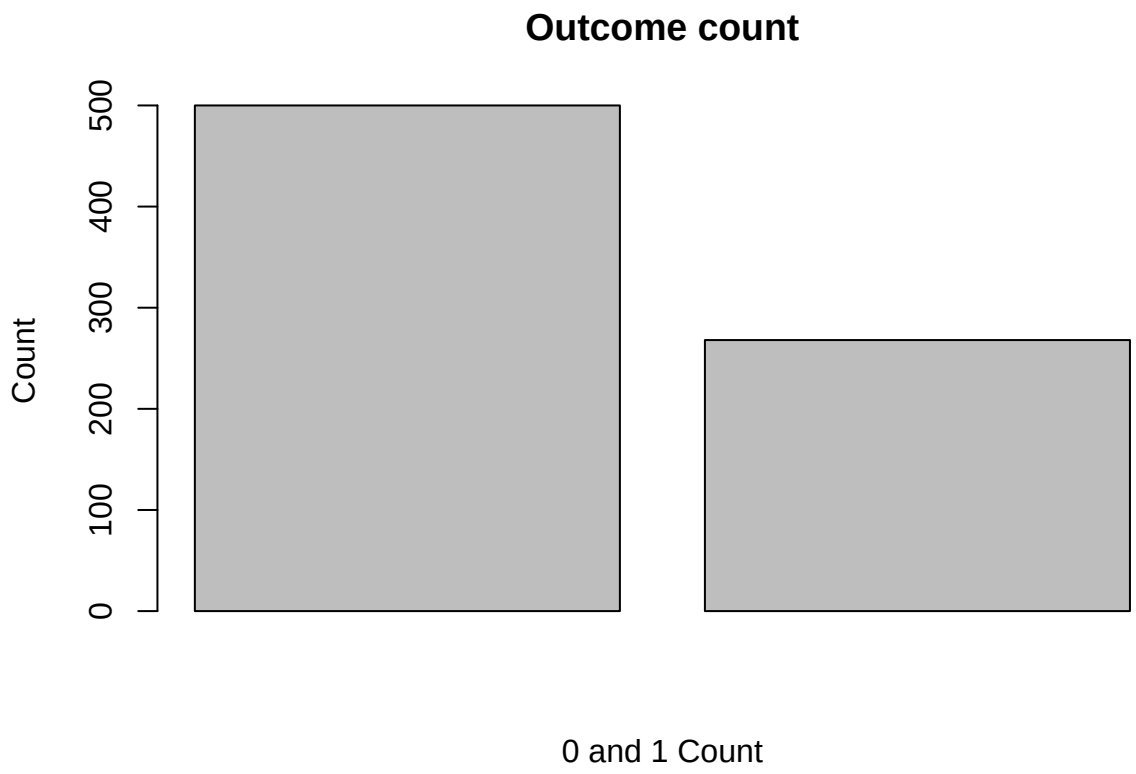

```
count_0 = 0
for (i in data$Outcome) {
  if (i == 0)
    count_0 = count_0 +1
}
count_0
```

```
## [1] 500
```

```
count_1 = length(data$Outcome) - count_0
count_1
```

```
## [1] 268
```

```
A <- c(count_0, count_1)

# Plot the bar chart
barplot(A, xlab = "0 and 1 Count", ylab = "Count", main ="Outcome count")
```




```
length(data)
```

```
## [1] 9
```

```
length(data$Pregnancies)
```

```
## [1] 768
```

Correlation Heatmap for cleaned data

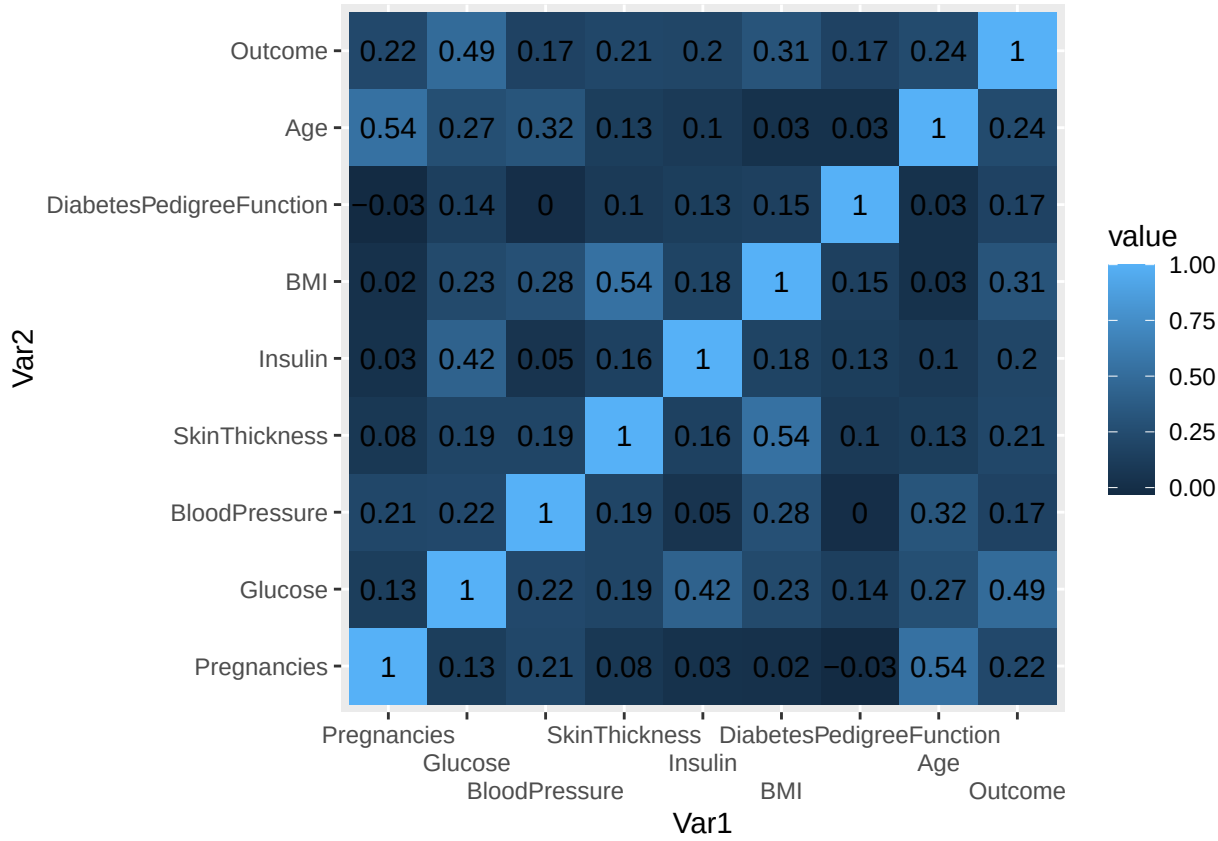
```
cormat <- round(cor(data),2)
cormat
```

```
##                           Pregnancies Glucose BloodPressure SkinThickness
## Pregnancies                      1.00    0.13          0.21          0.08
## Glucose                          0.13    1.00          0.22          0.19
## BloodPressure                    0.21    0.22          1.00          0.19
## SkinThickness                    0.08    0.19          0.19          1.00
## Insulin                          0.03    0.42          0.05          0.16
## BMI                              0.02    0.23          0.28          0.54
## DiabetesPedigreeFunction        -0.03    0.14          0.00          0.10
## Age                              0.54    0.27          0.32          0.13
## Outcome                          0.22    0.49          0.17          0.21
##                           Insulin  BMI DiabetesPedigreeFunction  Age Outcome
## Pregnancies                  0.03 0.02                    -0.03 0.54    0.22
## Glucose                      0.42 0.23                     0.14 0.27    0.49
## BloodPressure                0.05 0.28                     0.00 0.32    0.17
## SkinThickness                0.16 0.54                     0.10 0.13    0.21
## Insulin                      1.00 0.18                     0.13 0.10    0.20
## BMI                          0.18 1.00                     0.15 0.03    0.31
## DiabetesPedigreeFunction     0.13 0.15                     1.00 0.03    0.17
## Age                          0.10 0.03                     0.03 1.00    0.24
## Outcome                      0.20 0.31                     0.17 0.24    1.00
```

```
library(reshape2)



melted_corr_mat <- melt(cormat)
head(melted_corr_mat)
```

```
##            Var1        Var2 value
## 1   Pregnancies Pregnancies  1.00
## 2       Glucose Pregnancies  0.13
## 3 BloodPressure Pregnancies  0.21
## 4 SkinThickness Pregnancies  0.08
## 5       Insulin Pregnancies  0.03
## 6           BMI Pregnancies  0.02
```

```
# plotting the correlation heatmap
library(ggplot2)
ggplot(data = melted_corr_mat, aes(x=Var1, y=Var2,
                                   fill=value)) +
geom_tile() +
 scale_x_discrete(guide = guide_axis(n.dodge=3))+
geom_text(aes(Var2, Var1, label = value),
          color = "black", size = 4)
```



Feature Scaling

```
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(caret)
```

```
## Loading required package: lattice
```

```
row_labels = data[,9]
data[,1:8]<- as.data.frame(scale(data[,1:8]))
row_labels
```

```
##   [1] 1 0 1 0 1 0 1 0 1 1 0 1 0 1 1 1 1 1 0 1 0 0 1 1 1 1 1 0 0 0 0 1 0 0 0 0 0
##  [38] 1 1 1 0 0 0 1 0 1 0 0 1 0 0 0 0 1 0 0 1 0 0 0 0 1 0 0 1 0 1 0 0 0 1 0 1 0
##  [75] 0 0 0 0 1 0 0 0 0 0 1 0 0 0 1 0 0 0 0 1 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 1 1
## [112] 1 0 0 1 1 1 0 0 0 1 0 0 0 1 1 0 0 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0
## [149] 0 0 0 0 1 0 1 1 0 0 0 1 0 0 0 0 1 1 0 0 0 0 1 1 0 0 0 1 0 1 0 1 0 0 0 0 0
## [186] 1 1 1 1 1 0 0 1 1 0 1 0 1 1 1 0 0 0 0 0 0 1 1 0 1 0 0 0 1 1 1 1 0 1 1 1 1
## [223] 0 0 0 0 0 1 0 0 1 1 0 0 0 1 1 1 1 0 0 0 1 1 0 1 0 0 0 0 0 0 0 0 1 1 0 0 0
## [260] 1 0 1 0 0 1 0 1 0 0 1 1 0 0 0 0 0 1 0 0 0 1 0 0 1 1 0 0 1 0 0 0 1 1 1 0 0
## [297] 1 0 1 0 1 1 0 1 0 0 1 0 1 1 0 0 1 0 1 0 0 1 0 1 0 1 1 1 0 0 1 0 1 0 0 0 1
## [334] 0 0 0 0 1 1 1 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 1 1 1 0 1 1 0 0 1 0 0 1 0 0 1
## [371] 1 0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 1 1 1 0 0 1 0 0 1 0 0 1 0 1 1 0 1 0 1 0 1
## [408] 0 1 1 0 0 0 0 1 1 0 1 0 1 0 0 0 0 1 1 0 1 0 1 0 0 0 0 0 1 0 0 0 0 1 0 0 1
## [445] 1 1 0 0 1 0 0 1 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 0 0 0 1
## [482] 0 0 0 1 1 0 0 0 0 0 0 0 1 0 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 0 1 1 0
## [519] 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 1 1 1 0 0 1 1 0 0 0 0 0 0 0 0
## [556] 0 0 0 0 0 1 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 0 1 1 0 0 0 1 0 1 0 1 0 1 0
## [593] 1 0 0 1 0 0 1 0 0 0 0 1 1 0 1 0 0 0 0 1 1 0 1 0 0 0 1 1 0 0 0 0 0 0 0 0 0
## [630] 0 1 0 0 0 0 1 0 0 1 0 0 0 1 0 0 0 1 1 1 0 0 0 0 0 0 1 0 0 0 1 0 1 1 1 1 0
## [667] 1 1 0 0 0 0 0 0 0 0 1 1 0 1 0 0 1 0 1 0 0 0 0 0 1 0 1 0 1 0 1 1 0 0 0 0 1 1
## [704] 0 0 0 1 0 1 1 0 0 1 0 0 1 1 0 0 1 0 0 1 0 0 0 0 0 0 0 1 1 1 0 0 0 0 0 0 1
## [741] 1 0 0 1 0 0 1 0 1 1 1 0 0 1 1 1 0 1 0 1 0 1 0 0 0 0 1 0
```

setting the seed so as to get the same result everytime and splitting the data into train and test

```
set.seed(123)
size <- floor(0.8 *  nrow(data))
train_ind <- sample(seq_len(nrow(data)), size = size)

data_train <- data[train_ind,1:8]
data_test <- data[-train_ind,1:8]

train_labels <- data[train_ind, 9]
test_labels <- row_labels[-train_ind]
length(data$Pregnancies)
```

```
## [1] 768
```

```
data_test
```

```
##     Pregnancies     Glucose BloodPressure SkinThickness      Insulin
## 1    0.63953049  0.86447737    -0.0319691    0.67020577 -0.181423013
## 3    1.23307662  2.01443290    -0.6933097   -0.01229328 -0.181423013
## 9   -0.54756176  2.47441512    -0.1973042    1.80770419  4.657488707
## 17  -1.14110788 -0.12119881     0.9600418    2.03520387  1.034093089
## 22   1.23307662 -0.74546039     0.9600418   -0.01229328 -0.181423013
## 27   0.93630355  0.83162149     0.2987012   -0.01229328 -0.181423013
## 28  -0.84433482 -0.81117213    -0.5279745   -1.60479106 -0.007777856
## 32  -0.25078869  1.19303609     0.2987012    0.78395561  1.207738246
## 42   0.93630355  0.37163928     0.9600418   -0.01229328 -0.181423013
## 43   0.93630355 -0.51546928     1.6213823   -1.26354154 -0.181423013
## 44   1.52984968  1.62016243     3.1093986   -0.58104249  1.149856527
## 58  -1.14110788 -0.71260452     1.2907120    3.51395182 -0.355068171
## 60  -1.14110788 -0.54832515    -0.6933097    1.35270482  0.015374832
```

```
## 62   1.23307662  0.37163928    -0.0319691   -0.01229328 -0.181423013
## 63   0.34275743 -2.55253338    -0.8586448   -0.01229328 -0.181423013
## 70   0.04598437  0.79876562     1.0427093   -0.23979296 -0.470831609
## 77   0.93630355 -1.96112767     0.4640363   -0.01229328 -0.181423013
## 82  -0.54756176 -1.56685720    -0.0319691   -0.01229328 -0.181423013
## 86  -0.54756176 -0.38404579     0.1333660   -0.01229328 -0.181423013
## 92   0.04598437  0.04308055     0.6293715   -1.60479106  0.408970522
## 93   0.93630355 -1.33686610     0.4640363    1.23895498 -1.072801488
## 97  -0.54756176 -0.97545150    -0.8586448   -0.12604312 -0.181423013
## 99   0.63953049 -0.94259562    -1.8506557    0.10145656 -0.887579987
## 102 -0.84433482  0.96304498    -1.0239800   -0.01229328 -0.181423013
## 107 -0.84433482 -0.84402801     4.1014095   -0.01229328 -0.181423013
## 109 -0.25078869 -1.27115435    -1.1893151    0.21520641 -1.420091803
## 123 -0.54756176 -0.48261341     0.1333660    0.10145656 -0.470831609
## 126 -0.84433482 -1.10687499    -3.5040071    1.46645467 -0.482407953
## 140  0.34275743 -0.54832515    -0.0319691   -0.01229328  2.133845752
## 142  0.34275743 -0.51546928     0.7947066    0.10145656 -0.181423013
## 144  1.82662274 -0.44975754    -0.5279745   -0.01229328 -0.181423013
## 145  0.04598437  1.06161260    -0.8586448    0.21520641  1.659215655
## 146 -1.14110788 -0.64689277     0.2160336   -0.69479233 -0.181423013
## 147  1.52984968 -2.12540704     0.6293715    0.89770546 -0.181423013
## 149  0.34275743  0.83162149     0.4640363   -0.01229328 -0.181423013
## 150 -0.54756176 -1.04116324    -0.1973042   -1.37729138 -0.181423013
## 154 -0.84433482  1.02875673     0.7947066    1.46645467  3.986060765
## 157 -0.54756176 -0.74546039    -1.6853205   -1.60479106 -0.540289672
## 182 -1.14110788 -0.08834294    -0.6933097   -1.26354154 -0.563442360
## 183 -0.84433482  0.01022468     0.1333660   -1.03604185 -1.362210084
## 192  1.52984968  0.04308055    -0.1973042    1.69395435 -0.540289672
## 194  2.12339580  0.43735102    -0.0319691   -0.01229328 -0.181423013
## 208  0.34275743  1.32445958     2.6133932   -0.01229328 -0.181423013
## 216  2.42016887  0.96304498    -0.1973042    1.23895498  1.508723186
## 245 -0.54756176  0.79876562     0.2987012    0.67020577  0.617344711
## 249  1.52984968  0.07593642    -0.1973042    0.44270609  3.025224227
## 253 -0.54756176 -1.04116324     0.6293715   -1.71854090 -0.991767081
## 254 -1.14110788 -1.17258673    -0.3626394    0.32895625 -0.181423013
## 256 -0.84433482 -0.28547817    -0.6933097    0.67020577 -0.181423013
## 264 -0.25078869  0.66734213     0.6293715   -1.60479106 -0.181423013
## 271  1.82662274 -0.67974864     1.1253769    0.89770546 -0.181423013
## 274 -0.84433482 -1.66542482     0.4640363    2.37645340 -1.107530520
## 275  2.71694193 -0.51546928    -0.1973042   -0.01229328 -0.181423013
## 293 -0.54756176  0.20735991     0.4640363    0.89770546  0.478428585
## 295 -1.14110788  1.29160371    -1.8506557   -0.01229328 -0.181423013
## 300  1.23307662 -0.31833405    -0.0319691   -0.01229328 -0.181423013
## 312 -1.14110788 -0.51546928    -0.1973042    0.89770546  0.084832895
## 314 -0.25078869 -0.28547817    -1.8506557   -2.17354027 -0.644476767
## 318 -0.25078869  1.98157703     0.1333660   -0.01229328 -0.181423013
## 320  0.63953049  2.37584750     0.4640363   -0.01229328 -0.181423013
## 322 -0.25078869 -0.31833405     0.1333660    0.10145656 -0.181423013
## 324  2.71694193  0.99590086     1.4560472    0.44270609 -1.292752021
## 325 -0.54756176 -0.31833405     0.2160336    0.32895625 -0.181423013
## 327 -0.84433482  0.01022468    -0.6933097    0.32895625  0.177443645
## 328  1.82662274  1.88300941    -0.1973042   -0.01229328 -0.181423013
## 329 -0.54756176 -0.64689277     1.1253769    0.78395561 -0.239304733
## 336 -1.14110788  1.42302720     0.2987012    1.58020451  1.323501684
```

```
## 341 -0.84433482  0.27307166    -0.1973042   -1.83229074 -0.412949890
## 351  0.04598437 -0.97545150     0.6293715   -0.01229328 -0.181423013
## 354 -0.84433482 -1.04116324    -0.8586448   -1.94604059 -1.130683207
## 356  1.52984968  1.42302720     1.2907120   -0.01229328 -0.181423013
## 359  2.42016887 -1.10687499     0.1333660    1.23895498 -1.003343425
## 360 -0.84433482  2.44155925     0.2987012    0.78395561  1.254043621
## 365  0.04598437  0.83162149     0.1333660   -0.46729264  1.763402750
## 368 -1.14110788 -0.67974864    -0.6933097   -1.37729138 -0.181423013
## 369 -0.25078869 -1.33686610     1.1253769   -1.49104122 -0.864427299
## 370 -0.84433482  0.37163928     2.4480581   -0.12604312 -0.007777856
## 383 -0.84433482 -0.41690166    -1.0239800   -2.40103995  0.478428585
## 387  0.34275743 -0.18691056     0.1333660   -0.01229328 -0.181423013
## 388  1.23307662 -0.54832515     2.2827229    0.78395561 -0.181423013
## 394  0.04598437 -0.18691056    -0.0319691   -1.94604059 -0.621324079
## 408 -1.14110788 -0.67974864    -0.8586448   -0.01229328 -0.181423013
## 410 -0.84433482  1.65301831    -0.3626394    2.26270356  5.074237085
## 411  0.63953049 -0.64689277     1.4560472    1.12520514 -0.181423013
## 419 -0.84433482 -1.27115435    -0.3626394   -0.01229328 -0.181423013
## 439 -0.84433482 -0.81117213    -0.1973042   -1.60479106 -0.181423013
## 441 -1.14110788  2.21156814     2.6133932   -0.46729264 -0.181423013
## 443  0.04598437 -0.15405468    -0.6933097   -0.23979296 -0.239304733
## 444  1.23307662 -0.44975754    -0.1973042   -0.01229328 -0.181423013
## 452 -0.54756176  0.40449515    -0.1973042   -0.01229328 -0.181423013
## 453 -1.14110788 -1.00830737    -0.3626394    0.32895625  0.802566212
## 469  1.23307662 -0.05548707    -0.0319691   -0.01229328 -0.181423013
## 471 -0.84433482  0.73305388     0.7947066    1.23895498 -0.181423013
## 474  0.93630355  0.47020689     1.4560472   -0.01229328 -0.181423013
## 485 -1.14110788  0.76590975    -0.0319691   -0.01229328 -0.181423013
## 493  0.04598437 -0.74546039    -0.3626394    1.01145530 -0.181423013
## 495 -0.25078869 -1.36972197    -0.0319691   -0.01229328 -0.181423013
## 496  0.63953049  1.45588307     0.1333660   -0.01229328 -0.181423013
## 506  1.82662274 -1.53400133     0.7947066   -0.01229328 -0.181423013
## 510  1.23307662 -0.05548707     0.4640363   -0.01229328 -0.181423013
## 511  2.42016887 -1.23829848    -0.0319691    0.21520641 -0.181423013
## 512 -1.14110788  0.56877451    -0.8586448   -1.37729138  0.802566212
## 524  1.52984968  0.27307166    -0.1973042   -0.01229328 -0.181423013
## 530 -1.14110788 -0.35118992    -0.6106421   -0.01229328 -0.181423013
## 531 -0.54756176  0.01022468    -1.0239800   -1.26354154 -0.401373546
## 535 -0.84433482 -1.46828959    -1.3546503    0.10145656 -0.980190738
## 541  1.23307662 -0.71260452     0.1333660    1.23895498  0.860447931
## 561  0.63953049  0.10879230     0.2987012   -0.01229328 -0.181423013
## 565 -1.14110788 -1.00830737     0.6293715   -0.01229328 -0.181423013
## 568  0.63953049 -0.97545150    -0.8586448    0.32895625 -0.169846670
## 569  0.04598437  1.06161260    -0.0319691   -0.01229328 -0.169846670
## 570 -1.14110788 -0.02263119    -0.5279745    0.10145656  0.281630740
## 584  1.23307662 -0.71260452     0.2987012   -0.01229328 -0.181423013
## 586 -0.84433482 -0.94259562    -1.3546503   -2.05979043 -0.181423013
## 587  1.23307662  0.70019800    -0.5279745   -0.01229328 -0.181423013
## 592 -0.54756176 -0.31833405     0.4640363    2.37645340 -0.007777856
## 601 -0.84433482 -0.44975754     1.2907120   -1.14979169 -0.181423013
## 605  0.04598437  2.01443290    -0.0319691   -0.01229328 -0.181423013
## 608 -0.84433482 -0.97545150    -0.8586448   -0.46729264 -1.153835895
## 613  0.93630355  1.52159482     1.2907120    1.46645467  2.087540377
## 616 -0.25078869 -0.51546928    -0.0319691   -0.01229328 -0.181423013
```

```
## 618 -0.54756176 -1.76399244    -0.8586448   -1.83229074 -1.454820835
## 623  0.63953049  2.01443290     1.7867175   -0.01229328 -0.181423013
## 624 -1.14110788 -0.90973975    -0.1973042   -0.23979296 -0.297186452
## 626  0.04598437 -1.04116324     1.2907120    2.03520387 -1.003343425
## 630  0.04598437 -0.90973975    -0.6106421   -0.80854217 -0.181423013
## 634 -0.84433482  0.20735991     0.7947066   -1.37729138  0.490004929
## 639  0.93630355 -0.81117213     0.2987012    0.32895625 -0.575018704
## 642  0.04598437  0.20735991    -0.1973042   -0.01229328 -0.181423013
## 644  0.04598437 -1.04116324    -0.0319691   -0.01229328 -0.181423013
## 647 -0.84433482  1.48873894     0.1333660   -1.37729138  0.038527519
## 651 -0.84433482 -1.00830737    -1.5199854   -0.46729264 -0.470831609
## 655 -0.84433482 -0.51546928    -0.1973042   -0.12604312 -0.065659575
## 660 -0.25078869 -1.36972197     0.7947066    0.21520641 -0.818121924
## 676  0.63953049  2.40870338    -0.1973042   -0.01229328 -0.181423013
## 677  1.52984968  1.12732435     1.1253769   -0.01229328 -0.181423013
## 680 -0.54756176 -0.67974864    -1.1893151   -1.37729138  1.439265123
## 692  2.71694193  1.19303609     3.4400689   -0.01229328 -0.181423013
## 703 -0.84433482  1.52159482     1.2907120   -0.01229328 -0.181423013
## 705  0.04598437 -0.38404579     0.2987012   -1.03604185 -0.470831609
## 715 -0.25078869 -0.64689277     0.1333660   -0.01229328 -0.181423013
## 718  1.82662274 -0.90973975    -0.0319691   -1.26354154 -0.181423013
## 720  0.34275743 -0.81117213     0.2987012   -0.23979296 -0.181423013
## 724  0.34275743 -0.15405468     1.1253769    0.10145656 -0.412949890
## 726  0.04598437 -0.31833405     0.4640363    1.23895498 -0.181423013
## 730 -0.54756176 -0.97545150    -1.6853205   -0.01229328 -0.181423013
## 732  1.23307662 -0.05548707     1.1253769   -0.01229328 -0.181423013
## 737 -1.14110788  0.14164817     1.1253769   -0.23979296 -0.239304733
## 740 -0.84433482 -0.64689277     0.1333660   -0.01229328 -0.181423013
## 742 -0.25078869 -0.64689277    -2.3466611   -1.03604185 -0.540289672
## 756 -0.84433482  0.20735991     1.2907120    1.12520514 -0.355068171
## 757  0.93630355  0.50306277     1.4560472    1.35270482 -0.181423013
## 765 -0.54756176  0.01022468    -0.1973042   -0.23979296 -0.181423013
## 766  0.34275743 -0.02263119    -0.0319691   -0.69479233 -0.331915483
##              BMI DiabetesPedigreeFunction         Age
## 1    0.167131243             0.4681868702  1.42506672
## 3   -1.330970720             0.6040037019 -0.10551539
## 9   -0.283753814            -0.9473263304  1.68016374
## 17   1.941582111             0.2388073324 -0.19054773
## 22   0.428935469            -0.2531514133  1.42506672
## 27   1.010722639            -0.6485293009  0.82984034
## 28  -1.345515399             0.0456456163 -0.95583878
## 32  -0.123762342             1.1442528765 -0.44564475
## 42   1.127080073             0.6764393454  0.31964631
## 43  -1.418238795            -0.7149286408  1.25500204
## 44   1.883403394             0.7518931407  1.76519608
## 58   2.087028903             1.4792677279 -0.19054773
## 60   1.316160903            -0.9020540532 -0.95583878
## 62   0.065318488            -0.6092933273  0.48971099
## 63  -1.083711172             0.3474607977  0.23461397
## 70  -0.516468682            -0.8537636242 -0.53067709
## 77   0.021684450            -0.2440969578  0.65977566
## 82  -0.065583625            -1.1163428320 -0.95583878
## 86  -0.007404908             0.6824756490 -0.53067709
## 92  -0.065583625            -0.0871530635  0.06454929
```

```
## 93   2.072484224          -0.6364566936  0.74480800
## 97  -0.123762342          -1.0318345812 -0.78577411
## 99  -0.545558040          -0.3497322713 -0.87080644
## 102 -0.923719701          -0.8839451424 -0.95583878
## 107 -1.461872833          -0.7994368916 -0.53067709
## 109  0.268943997          -0.4100953076 -0.70074177
## 123  0.167131243          -0.2048609842 -0.87080644
## 126  3.279692601           0.0728089826 -0.61570943
## 140  0.647105658          -0.9443081786 -0.44564475
## 142  1.025267318          -0.5610028983  0.40467865
## 144 -0.007404908          -0.6032570237  0.74480800
## 145  0.050773809          -0.7088923372 -0.87080644
## 146 -0.065583625           0.3021885205 -1.04087112
## 147  0.050773809          -1.1344517429  0.65977566
## 149  0.181675922          -0.7662372216  2.70055181
## 150 -0.749183550          -1.1676514128 -0.95583878
## 154  1.185258790           0.6492759791 -0.87080644
## 157 -1.141889889           0.4983683884 -1.04087112
## 182  0.356212073           0.7639657480 -0.87080644
## 183 -0.691004833          -0.5217669247 -1.04087112
## 192  0.094407846          -0.2954055387  0.57474333
## 194  2.886986262           0.3202974314  0.57474333
## 208  0.763463092          -0.9684533931  1.59513140
## 216  1.359794941           0.8152743288  0.40467865
## 245  0.836186488          -0.4312223703 -0.36061241
## 249  0.428935469          -0.5730755055  0.06454929
## 253 -1.170979248          -0.6726745154 -0.78577411
## 254  0.487114186          -0.7058741853 -0.70074177
## 256  0.167131243           0.2146621179 -1.04087112
## 264 -0.007404908          -0.8205639543  2.53048713
## 271  1.912492752           2.0044261435  0.40467865
## 274  0.108952526          -0.1505342516 -1.04087112
## 275  0.254399318          -0.6666382118  1.59513140
## 293  1.577965129           2.2700235031 -0.19054773
## 295 -1.534596229          -0.6575837563  2.70055181
## 300 -1.287336682           1.1110532066  2.10532543
## 312  1.010722639           0.4017875303 -0.95583878
## 314 -0.429200606           0.4651687184 -0.70074177
## 318 -0.283753814          -0.3829319413 -0.36061241
## 320 -1.301881361          -1.0348527330  2.19035777
## 322 -0.123762342          -0.8296184097 -0.70074177
## 324 -0.821906946           0.7820746589  0.82984034
## 325  0.472569507          -0.9775078486 -1.04087112
## 327  0.385301431           0.6643667381 -0.27558007
## 328  0.385301431          -0.8205639543  0.31964631
## 329  1.897948073          -1.0408890367 -0.87080644
## 336  2.247020375          -0.6424929972 -0.61570943
## 341 -0.952809059           0.0003733391 -0.95583878
## 351  1.417973658          -0.7088923372 -0.36061241
## 354 -0.763728229           0.3263337350 -0.78577411
## 356 -0.298298493          -0.5127124693  1.34003438
## 359  0.414390790          -0.2833329314  1.25500204
## 360  0.588926941           1.2166885201 -0.36061241
## 365  0.356212073          -0.2622058687 -0.27558007
```

```
## 368 -1.665498342          -0.6636200599 -1.04087112
## 369 -0.720094191          -0.5006398620 -0.95583878
## 370  0.050773809          -0.7179467926  0.99990502
## 383 -1.025532455           1.4339954506 -1.04087112
## 387 -0.021949588           0.5677858801  0.14958163
## 388  1.577965129          -0.7028560335  0.99990502
## 394 -1.505506871          -0.0267900272  0.31964631
## 408 -1.534596229          -0.4100953076 -0.70074177
## 410  1.447063016           0.6945482563 -0.44564475
## 411  0.472569507           0.6100400055 -0.44564475
## 419 -2.072749361           0.4591324148 -0.53067709
## 439 -2.072749361          -0.9805260004 -1.04087112
## 441  0.268943997          -0.1112982780  0.65977566
## 443  0.108952526          -0.7300193998 -0.78577411
## 444 -0.283753814           1.4581406652 -0.02048305
## 452 -0.516468682           0.2116439661 -0.87080644
## 453  1.083446035          -0.2742784760 -0.70074177
## 469 -0.356477210          -0.8718725351  0.40467865
## 471  1.287071545           0.4078238340 -0.44564475
## 474 -0.371021889          -0.7903824361  1.42506672
## 485  1.708867243           0.4772413257 -0.19054773
## 493  0.050773809          -0.9865623040 -0.02048305
## 495 -0.065583625          -0.8990359014 -0.95583878
## 496 -0.850996305          -0.5066761656  2.78558415
## 506  0.123497205          -0.6304203900  0.40467865
## 510 -1.083711172          -0.1897702252  2.61551947
## 511 -0.400111248          -0.5278032283  1.08493736
## 512 -1.505506871          -0.7994368916 -1.04087112
## 524  0.254399318           0.5436406656  0.99990502
## 530 -1.141889889           0.5677858801 -0.19054773
## 531 -0.385566569           0.7398205335 -0.95583878
## 535  0.123497205           2.3515136020 -0.78577411
## 541  1.010722639           0.5708040319  0.82984034
## 561  0.196220601          -1.0589979476  1.76519608
## 565 -0.007404908           0.3897149231 -0.53067709
## 568 -0.065583625          -1.1676514128  1.08493736
## 569 -0.167396380          -0.4040590040  0.31964631
## 570  0.268943997          -0.8115094988 -0.02048305
## 584  0.908909884          -0.8507454724  0.74480800
## 586 -1.447328154          -0.1656250107 -0.95583878
## 587  0.356212073          -1.0348527330  0.65977566
## 592  1.010722639          -0.8960177496 -0.78577411
## 601 -0.778272908          -0.2169335915 -0.78577411
## 605 -0.589192078          -0.7843461325  0.23461397
## 608 -1.883668531           0.0305548572 -0.70074177
## 613  0.836186488           0.9510911604  0.57474333
## 616 -0.967353739          -0.7994368916 -0.53067709
## 618 -1.796400455          -0.6485293009 -0.87080644
## 623  1.214348148           2.9853254829  0.99990502
## 624  1.607054488          -0.3768956376 -1.04087112
## 626  0.763463092          -0.3316233604 -0.36061241
## 630 -1.127345210          -0.9775078486 -1.04087112
## 634 -0.720094191          -1.0771068584 -0.95583878
## 639  1.228892828           1.2046159128 -0.10551539
```

```
## 642  0.268943997           -0.5096943174 -0.78577411
## 644 -0.647370795            0.4168782894 -0.19054773
## 647 -1.316426040           -0.0750804563 -0.02048305
## 651 -1.054621814           -0.7179467926 -0.87080644
## 655  0.254399318           -0.9956167595 -0.95583878
## 660  0.254399318            2.4752578264 -0.53067709
## 676 -0.225575097           -0.4342405221 -0.19054773
## 677 -1.112800531           -0.7300193998  1.68016374
## 680 -1.200068606            0.4289508967 -0.87080644
## 692  1.432518337           -0.6485293009  0.91487268
## 703  0.370756752            1.3072330745  1.59513140
## 705 -0.589192078           -1.0680524030 -0.53067709
## 715 -0.429200606           -1.0589979476 -0.10551539
## 718 -1.360060078            0.3716060122  1.93526076
## 720  0.458024828           -0.2833329314  1.59513140
## 724  0.967088601           -0.6666382118  0.74480800
## 726  1.010722639           -0.7119104890  0.40467865
## 730 -0.341932531           -0.9986349113 -0.95583878
## 732 -0.589192078           -0.6424929972 -0.95583878
## 737 -0.734638871            0.1301538671 -1.04087112
## 740  1.025267318           -0.5398758356  0.74480800
## 742 -0.240119776           -0.2169335915 -0.61570943
## 756  0.588926941            1.7659921502  0.31964631
## 757 -0.065583625           -0.2440969578  0.48971099
## 765  0.632560978           -0.3980227003 -0.53067709
## 766 -0.909175022           -0.6847471226 -0.27558007
```

```
library(class)

predictions <- knn(train = data_train,
                   test = data_test,
                   cl = train_labels,
                   k= 9)
length(predictions)
```

```
## [1] 154
```

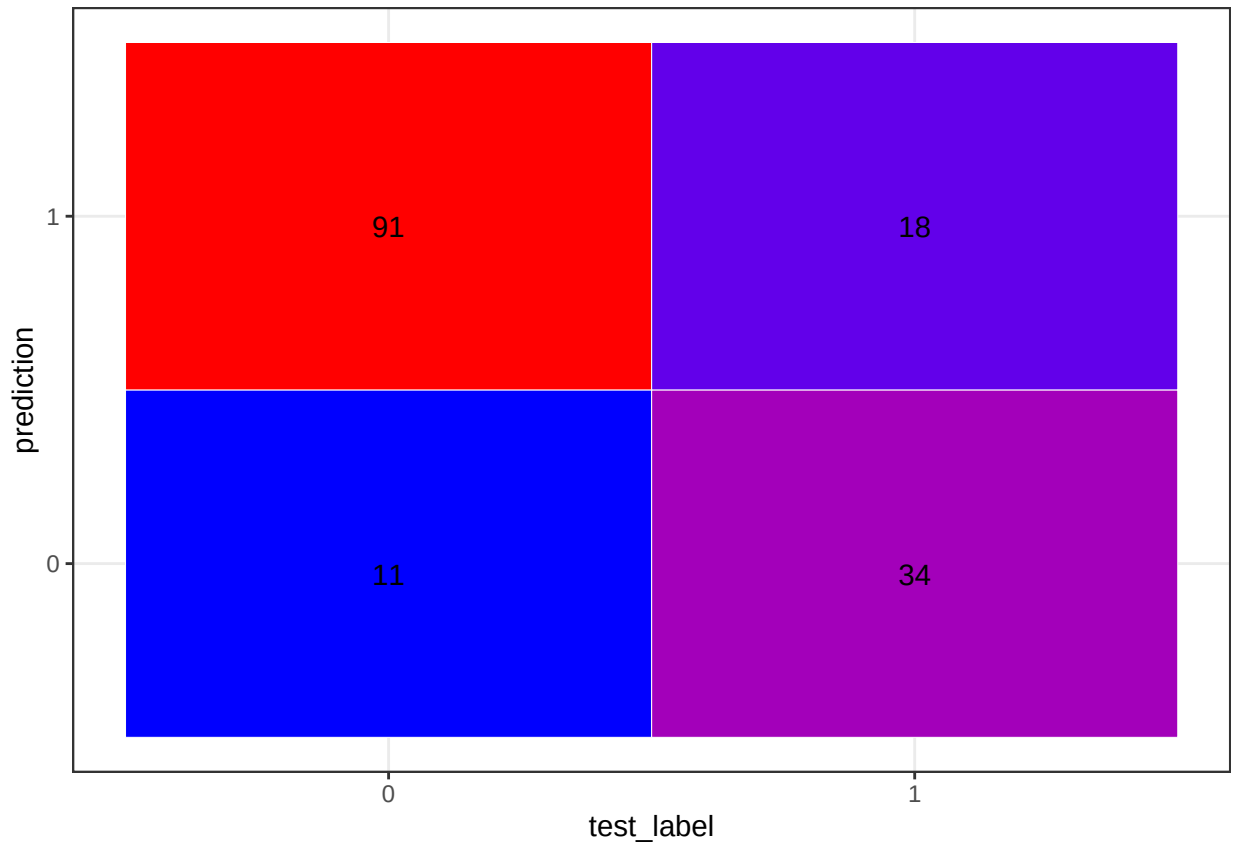
Confusion Matrix

```
##create confusion matrix
tab <- table( predictions, test_labels )
tab
```

```
##             test_labels
## predictions  0  1
##           0 91 18
##           1 11 34
```

```
prediction <- factor(c(0, 0, 1, 1))
test_label <- factor(c(0, 1, 0, 1))
Y      <- c(11, 34, 91, 18)
df <- data.frame(prediction, test_label, Y)
```

```
library(ggplot2)
ggplot(data =  df, mapping = aes(x = test_label, y = prediction)) +
  geom_tile(aes(fill = Y), colour = "white") +
  geom_text(aes(label = sprintf("%1.0f", Y)), vjust = 1) +
  scale_fill_gradient(low = "blue", high = "red") +
  theme_bw() + theme(legend.position = "none")
```



Accuracy

```
##check the accuracy
accuracy <-    function( matriz ){
        sum( diag( x = matriz ) / sum( rowSums( x = matriz )) ) * 100.0
}



print( paste('accuracy ' , round( accuracy( tab ) , digits = 3 )  ) )
```

```
## [1] "accuracy  81.169"
```

```
data_test
```

```
##     Pregnancies     Glucose BloodPressure SkinThickness      Insulin
## 1    0.63953049  0.86447737    -0.0319691    0.67020577 -0.181423013
```

```
## 3    1.23307662  2.01443290    -0.6933097   -0.01229328 -0.181423013
## 9   -0.54756176  2.47441512    -0.1973042    1.80770419  4.657488707
## 17  -1.14110788 -0.12119881     0.9600418    2.03520387  1.034093089
## 22   1.23307662 -0.74546039     0.9600418   -0.01229328 -0.181423013
## 27   0.93630355  0.83162149     0.2987012   -0.01229328 -0.181423013
## 28  -0.84433482 -0.81117213    -0.5279745   -1.60479106 -0.007777856
## 32  -0.25078869  1.19303609     0.2987012    0.78395561  1.207738246
## 42   0.93630355  0.37163928     0.9600418   -0.01229328 -0.181423013
## 43   0.93630355 -0.51546928     1.6213823   -1.26354154 -0.181423013
## 44   1.52984968  1.62016243     3.1093986   -0.58104249  1.149856527
## 58  -1.14110788 -0.71260452     1.2907120    3.51395182 -0.355068171
## 60  -1.14110788 -0.54832515    -0.6933097    1.35270482  0.015374832
## 62   1.23307662  0.37163928    -0.0319691   -0.01229328 -0.181423013
## 63   0.34275743 -2.55253338    -0.8586448   -0.01229328 -0.181423013
## 70   0.04598437  0.79876562     1.0427093   -0.23979296 -0.470831609
## 77   0.93630355 -1.96112767     0.4640363   -0.01229328 -0.181423013
## 82  -0.54756176 -1.56685720    -0.0319691   -0.01229328 -0.181423013
## 86  -0.54756176 -0.38404579     0.1333660   -0.01229328 -0.181423013
## 92   0.04598437  0.04308055     0.6293715   -1.60479106  0.408970522
## 93   0.93630355 -1.33686610     0.4640363    1.23895498 -1.072801488
## 97  -0.54756176 -0.97545150    -0.8586448   -0.12604312 -0.181423013
## 99   0.63953049 -0.94259562    -1.8506557    0.10145656 -0.887579987
## 102 -0.84433482  0.96304498    -1.0239800   -0.01229328 -0.181423013
## 107 -0.84433482 -0.84402801     4.1014095   -0.01229328 -0.181423013
## 109 -0.25078869 -1.27115435    -1.1893151    0.21520641 -1.420091803
## 123 -0.54756176 -0.48261341     0.1333660    0.10145656 -0.470831609
## 126 -0.84433482 -1.10687499    -3.5040071    1.46645467 -0.482407953
## 140  0.34275743 -0.54832515    -0.0319691   -0.01229328  2.133845752
## 142  0.34275743 -0.51546928     0.7947066    0.10145656 -0.181423013
## 144  1.82662274 -0.44975754    -0.5279745   -0.01229328 -0.181423013
## 145  0.04598437  1.06161260    -0.8586448    0.21520641  1.659215655
## 146 -1.14110788 -0.64689277     0.2160336   -0.69479233 -0.181423013
## 147  1.52984968 -2.12540704     0.6293715    0.89770546 -0.181423013
## 149  0.34275743  0.83162149     0.4640363   -0.01229328 -0.181423013
## 150 -0.54756176 -1.04116324    -0.1973042   -1.37729138 -0.181423013
## 154 -0.84433482  1.02875673     0.7947066    1.46645467  3.986060765
## 157 -0.54756176 -0.74546039    -1.6853205   -1.60479106 -0.540289672
## 182 -1.14110788 -0.08834294    -0.6933097   -1.26354154 -0.563442360
## 183 -0.84433482  0.01022468     0.1333660   -1.03604185 -1.362210084
## 192  1.52984968  0.04308055    -0.1973042    1.69395435 -0.540289672
## 194  2.12339580  0.43735102    -0.0319691   -0.01229328 -0.181423013
## 208  0.34275743  1.32445958     2.6133932   -0.01229328 -0.181423013
## 216  2.42016887  0.96304498    -0.1973042    1.23895498  1.508723186
## 245 -0.54756176  0.79876562     0.2987012    0.67020577  0.617344711
## 249  1.52984968  0.07593642    -0.1973042    0.44270609  3.025224227
## 253 -0.54756176 -1.04116324     0.6293715   -1.71854090 -0.991767081
## 254 -1.14110788 -1.17258673    -0.3626394    0.32895625 -0.181423013
## 256 -0.84433482 -0.28547817    -0.6933097    0.67020577 -0.181423013
## 264 -0.25078869  0.66734213     0.6293715   -1.60479106 -0.181423013
## 271  1.82662274 -0.67974864     1.1253769    0.89770546 -0.181423013
## 274 -0.84433482 -1.66542482     0.4640363    2.37645340 -1.107530520
## 275  2.71694193 -0.51546928    -0.1973042   -0.01229328 -0.181423013
## 293 -0.54756176  0.20735991     0.4640363    0.89770546  0.478428585
## 295 -1.14110788  1.29160371    -1.8506557   -0.01229328 -0.181423013
```

```
## 300  1.23307662 -0.31833405    -0.0319691   -0.01229328 -0.181423013
## 312 -1.14110788 -0.51546928    -0.1973042    0.89770546  0.084832895
## 314 -0.25078869 -0.28547817    -1.8506557   -2.17354027 -0.644476767
## 318 -0.25078869  1.98157703     0.1333660   -0.01229328 -0.181423013
## 320  0.63953049  2.37584750     0.4640363   -0.01229328 -0.181423013
## 322 -0.25078869 -0.31833405     0.1333660    0.10145656 -0.181423013
## 324  2.71694193  0.99590086     1.4560472    0.44270609 -1.292752021
## 325 -0.54756176 -0.31833405     0.2160336    0.32895625 -0.181423013
## 327 -0.84433482  0.01022468    -0.6933097    0.32895625  0.177443645
## 328  1.82662274  1.88300941    -0.1973042   -0.01229328 -0.181423013
## 329 -0.54756176 -0.64689277     1.1253769    0.78395561 -0.239304733
## 336 -1.14110788  1.42302720     0.2987012    1.58020451  1.323501684
## 341 -0.84433482  0.27307166    -0.1973042   -1.83229074 -0.412949890
## 351  0.04598437 -0.97545150     0.6293715   -0.01229328 -0.181423013
## 354 -0.84433482 -1.04116324    -0.8586448   -1.94604059 -1.130683207
## 356  1.52984968  1.42302720     1.2907120   -0.01229328 -0.181423013
## 359  2.42016887 -1.10687499     0.1333660    1.23895498 -1.003343425
## 360 -0.84433482  2.44155925     0.2987012    0.78395561  1.254043621
## 365  0.04598437  0.83162149     0.1333660   -0.46729264  1.763402750
## 368 -1.14110788 -0.67974864    -0.6933097   -1.37729138 -0.181423013
## 369 -0.25078869 -1.33686610     1.1253769   -1.49104122 -0.864427299
## 370 -0.84433482  0.37163928     2.4480581   -0.12604312 -0.007777856
## 383 -0.84433482 -0.41690166    -1.0239800   -2.40103995  0.478428585
## 387  0.34275743 -0.18691056     0.1333660   -0.01229328 -0.181423013
## 388  1.23307662 -0.54832515     2.2827229    0.78395561 -0.181423013
## 394  0.04598437 -0.18691056    -0.0319691   -1.94604059 -0.621324079
## 408 -1.14110788 -0.67974864    -0.8586448   -0.01229328 -0.181423013
## 410 -0.84433482  1.65301831    -0.3626394    2.26270356  5.074237085
## 411  0.63953049 -0.64689277     1.4560472    1.12520514 -0.181423013
## 419 -0.84433482 -1.27115435    -0.3626394   -0.01229328 -0.181423013
## 439 -0.84433482 -0.81117213    -0.1973042   -1.60479106 -0.181423013
## 441 -1.14110788  2.21156814     2.6133932   -0.46729264 -0.181423013
## 443  0.04598437 -0.15405468    -0.6933097   -0.23979296 -0.239304733
## 444  1.23307662 -0.44975754    -0.1973042   -0.01229328 -0.181423013
## 452 -0.54756176  0.40449515    -0.1973042   -0.01229328 -0.181423013
## 453 -1.14110788 -1.00830737    -0.3626394    0.32895625  0.802566212
## 469  1.23307662 -0.05548707    -0.0319691   -0.01229328 -0.181423013
## 471 -0.84433482  0.73305388     0.7947066    1.23895498 -0.181423013
## 474  0.93630355  0.47020689     1.4560472   -0.01229328 -0.181423013
## 485 -1.14110788  0.76590975    -0.0319691   -0.01229328 -0.181423013
## 493  0.04598437 -0.74546039    -0.3626394    1.01145530 -0.181423013
## 495 -0.25078869 -1.36972197    -0.0319691   -0.01229328 -0.181423013
## 496  0.63953049  1.45588307     0.1333660   -0.01229328 -0.181423013
## 506  1.82662274 -1.53400133     0.7947066   -0.01229328 -0.181423013
## 510  1.23307662 -0.05548707     0.4640363   -0.01229328 -0.181423013
## 511  2.42016887 -1.23829848    -0.0319691    0.21520641 -0.181423013
## 512 -1.14110788  0.56877451    -0.8586448   -1.37729138  0.802566212
## 524  1.52984968  0.27307166    -0.1973042   -0.01229328 -0.181423013
## 530 -1.14110788 -0.35118992    -0.6106421   -0.01229328 -0.181423013
## 531 -0.54756176  0.01022468    -1.0239800   -1.26354154 -0.401373546
## 535 -0.84433482 -1.46828959    -1.3546503    0.10145656 -0.980190738
## 541  1.23307662 -0.71260452     0.1333660    1.23895498  0.860447931
## 561  0.63953049  0.10879230     0.2987012   -0.01229328 -0.181423013
## 565 -1.14110788 -1.00830737     0.6293715   -0.01229328 -0.181423013
```

```
## 568  0.63953049 -0.97545150    -0.8586448    0.32895625 -0.169846670
## 569  0.04598437  1.06161260    -0.0319691   -0.01229328 -0.169846670
## 570 -1.14110788 -0.02263119    -0.5279745    0.10145656  0.281630740
## 584  1.23307662 -0.71260452     0.2987012   -0.01229328 -0.181423013
## 586 -0.84433482 -0.94259562    -1.3546503   -2.05979043 -0.181423013
## 587  1.23307662  0.70019800    -0.5279745   -0.01229328 -0.181423013
## 592 -0.54756176 -0.31833405     0.4640363    2.37645340 -0.007777856
## 601 -0.84433482 -0.44975754     1.2907120   -1.14979169 -0.181423013
## 605  0.04598437  2.01443290    -0.0319691   -0.01229328 -0.181423013
## 608 -0.84433482 -0.97545150    -0.8586448   -0.46729264 -1.153835895
## 613  0.93630355  1.52159482     1.2907120    1.46645467  2.087540377
## 616 -0.25078869 -0.51546928    -0.0319691   -0.01229328 -0.181423013
## 618 -0.54756176 -1.76399244    -0.8586448   -1.83229074 -1.454820835
## 623  0.63953049  2.01443290     1.7867175   -0.01229328 -0.181423013
## 624 -1.14110788 -0.90973975    -0.1973042   -0.23979296 -0.297186452
## 626  0.04598437 -1.04116324     1.2907120    2.03520387 -1.003343425
## 630  0.04598437 -0.90973975    -0.6106421   -0.80854217 -0.181423013
## 634 -0.84433482  0.20735991     0.7947066   -1.37729138  0.490004929
## 639  0.93630355 -0.81117213     0.2987012    0.32895625 -0.575018704
## 642  0.04598437  0.20735991    -0.1973042   -0.01229328 -0.181423013
## 644  0.04598437 -1.04116324    -0.0319691   -0.01229328 -0.181423013
## 647 -0.84433482  1.48873894     0.1333660   -1.37729138  0.038527519
## 651 -0.84433482 -1.00830737    -1.5199854   -0.46729264 -0.470831609
## 655 -0.84433482 -0.51546928    -0.1973042   -0.12604312 -0.065659575
## 660 -0.25078869 -1.36972197     0.7947066    0.21520641 -0.818121924
## 676  0.63953049  2.40870338    -0.1973042   -0.01229328 -0.181423013
## 677  1.52984968  1.12732435     1.1253769   -0.01229328 -0.181423013
## 680 -0.54756176 -0.67974864    -1.1893151   -1.37729138  1.439265123
## 692  2.71694193  1.19303609     3.4400689   -0.01229328 -0.181423013
## 703 -0.84433482  1.52159482     1.2907120   -0.01229328 -0.181423013
## 705  0.04598437 -0.38404579     0.2987012   -1.03604185 -0.470831609
## 715 -0.25078869 -0.64689277     0.1333660   -0.01229328 -0.181423013
## 718  1.82662274 -0.90973975    -0.0319691   -1.26354154 -0.181423013
## 720  0.34275743 -0.81117213     0.2987012   -0.23979296 -0.181423013
## 724  0.34275743 -0.15405468     1.1253769    0.10145656 -0.412949890
## 726  0.04598437 -0.31833405     0.4640363    1.23895498 -0.181423013
## 730 -0.54756176 -0.97545150    -1.6853205   -0.01229328 -0.181423013
## 732  1.23307662 -0.05548707     1.1253769   -0.01229328 -0.181423013
## 737 -1.14110788  0.14164817     1.1253769   -0.23979296 -0.239304733
## 740 -0.84433482 -0.64689277     0.1333660   -0.01229328 -0.181423013
## 742 -0.25078869 -0.64689277    -2.3466611   -1.03604185 -0.540289672
## 756 -0.84433482  0.20735991     1.2907120    1.12520514 -0.355068171
## 757  0.93630355  0.50306277     1.4560472    1.35270482 -0.181423013
## 765 -0.54756176  0.01022468    -0.1973042   -0.23979296 -0.181423013
## 766  0.34275743 -0.02263119    -0.0319691   -0.69479233 -0.331915483
##              BMI DiabetesPedigreeFunction         Age
## 1    0.167131243             0.4681868702  1.42506672
## 3   -1.330970720             0.6040037019 -0.10551539
## 9   -0.283753814            -0.9473263304  1.68016374
## 17   1.941582111             0.2388073324 -0.19054773
## 22   0.428935469            -0.2531514133  1.42506672
## 27   1.010722639            -0.6485293009  0.82984034
## 28  -1.345515399             0.0456456163 -0.95583878
## 32  -0.123762342             1.1442528765 -0.44564475
```

```
## 42   1.127080073            0.6764393454  0.31964631
## 43  -1.418238795           -0.7149286408  1.25500204
## 44   1.883403394            0.7518931407  1.76519608
## 58   2.087028903            1.4792677279 -0.19054773
## 60   1.316160903           -0.9020540532 -0.95583878
## 62   0.065318488           -0.6092933273  0.48971099
## 63  -1.083711172            0.3474607977  0.23461397
## 70  -0.516468682           -0.8537636242 -0.53067709
## 77   0.021684450           -0.2440969578  0.65977566
## 82  -0.065583625           -1.1163428320 -0.95583878
## 86  -0.007404908            0.6824756490 -0.53067709
## 92  -0.065583625           -0.0871530635  0.06454929
## 93   2.072484224           -0.6364566936  0.74480800
## 97  -0.123762342           -1.0318345812 -0.78577411
## 99  -0.545558040           -0.3497322713 -0.87080644
## 102 -0.923719701           -0.8839451424 -0.95583878
## 107 -1.461872833           -0.7994368916 -0.53067709
## 109  0.268943997           -0.4100953076 -0.70074177
## 123  0.167131243           -0.2048609842 -0.87080644
## 126  3.279692601            0.0728089826 -0.61570943
## 140  0.647105658           -0.9443081786 -0.44564475
## 142  1.025267318           -0.5610028983  0.40467865
## 144 -0.007404908           -0.6032570237  0.74480800
## 145  0.050773809           -0.7088923372 -0.87080644
## 146 -0.065583625            0.3021885205 -1.04087112
## 147  0.050773809           -1.1344517429  0.65977566
## 149  0.181675922           -0.7662372216  2.70055181
## 150 -0.749183550           -1.1676514128 -0.95583878
## 154  1.185258790            0.6492759791 -0.87080644
## 157 -1.141889889            0.4983683884 -1.04087112
## 182  0.356212073            0.7639657480 -0.87080644
## 183 -0.691004833           -0.5217669247 -1.04087112
## 192  0.094407846           -0.2954055387  0.57474333
## 194  2.886986262            0.3202974314  0.57474333
## 208  0.763463092           -0.9684533931  1.59513140
## 216  1.359794941            0.8152743288  0.40467865
## 245  0.836186488           -0.4312223703 -0.36061241
## 249  0.428935469           -0.5730755055  0.06454929
## 253 -1.170979248           -0.6726745154 -0.78577411
## 254  0.487114186           -0.7058741853 -0.70074177
## 256  0.167131243            0.2146621179 -1.04087112
## 264 -0.007404908           -0.8205639543  2.53048713
## 271  1.912492752            2.0044261435  0.40467865
## 274  0.108952526           -0.1505342516 -1.04087112
## 275  0.254399318           -0.6666382118  1.59513140
## 293  1.577965129            2.2700235031 -0.19054773
## 295 -1.534596229           -0.6575837563  2.70055181
## 300 -1.287336682            1.1110532066  2.10532543
## 312  1.010722639            0.4017875303 -0.95583878
## 314 -0.429200606            0.4651687184 -0.70074177
## 318 -0.283753814           -0.3829319413 -0.36061241
## 320 -1.301881361           -1.0348527330  2.19035777
## 322 -0.123762342           -0.8296184097 -0.70074177
## 324 -0.821906946            0.7820746589  0.82984034
```

```
## 325  0.472569507          -0.9775078486 -1.04087112
## 327  0.385301431           0.6643667381 -0.27558007
## 328  0.385301431          -0.8205639543  0.31964631
## 329  1.897948073          -1.0408890367 -0.87080644
## 336  2.247020375          -0.6424929972 -0.61570943
## 341 -0.952809059           0.0003733391 -0.95583878
## 351  1.417973658          -0.7088923372 -0.36061241
## 354 -0.763728229           0.3263337350 -0.78577411
## 356 -0.298298493          -0.5127124693  1.34003438
## 359  0.414390790          -0.2833329314  1.25500204
## 360  0.588926941           1.2166885201 -0.36061241
## 365  0.356212073          -0.2622058687 -0.27558007
## 368 -1.665498342          -0.6636200599 -1.04087112
## 369 -0.720094191          -0.5006398620 -0.95583878
## 370  0.050773809          -0.7179467926  0.99990502
## 383 -1.025532455           1.4339954506 -1.04087112
## 387 -0.021949588           0.5677858801  0.14958163
## 388  1.577965129          -0.7028560335  0.99990502
## 394 -1.505506871          -0.0267900272  0.31964631
## 408 -1.534596229          -0.4100953076 -0.70074177
## 410  1.447063016           0.6945482563 -0.44564475
## 411  0.472569507           0.6100400055 -0.44564475
## 419 -2.072749361           0.4591324148 -0.53067709
## 439 -2.072749361          -0.9805260004 -1.04087112
## 441  0.268943997          -0.1112982780  0.65977566
## 443  0.108952526          -0.7300193998 -0.78577411
## 444 -0.283753814           1.4581406652 -0.02048305
## 452 -0.516468682           0.2116439661 -0.87080644
## 453  1.083446035          -0.2742784760 -0.70074177
## 469 -0.356477210          -0.8718725351  0.40467865
## 471  1.287071545           0.4078238340 -0.44564475
## 474 -0.371021889          -0.7903824361  1.42506672
## 485  1.708867243           0.4772413257 -0.19054773
## 493  0.050773809          -0.9865623040 -0.02048305
## 495 -0.065583625          -0.8990359014 -0.95583878
## 496 -0.850996305          -0.5066761656  2.78558415
## 506  0.123497205          -0.6304203900  0.40467865
## 510 -1.083711172          -0.1897702252  2.61551947
## 511 -0.400111248          -0.5278032283  1.08493736
## 512 -1.505506871          -0.7994368916 -1.04087112
## 524  0.254399318           0.5436406656  0.99990502
## 530 -1.141889889           0.5677858801 -0.19054773
## 531 -0.385566569           0.7398205335 -0.95583878
## 535  0.123497205           2.3515136020 -0.78577411
## 541  1.010722639           0.5708040319  0.82984034
## 561  0.196220601          -1.0589979476  1.76519608
## 565 -0.007404908           0.3897149231 -0.53067709
## 568 -0.065583625          -1.1676514128  1.08493736
## 569 -0.167396380          -0.4040590040  0.31964631
## 570  0.268943997          -0.8115094988 -0.02048305
## 584  0.908909884          -0.8507454724  0.74480800
## 586 -1.447328154          -0.1656250107 -0.95583878
## 587  0.356212073          -1.0348527330  0.65977566
## 592  1.010722639          -0.8960177496 -0.78577411
```

```
## 601 -0.778272908           -0.2169335915 -0.78577411
## 605 -0.589192078           -0.7843461325  0.23461397
## 608 -1.883668531            0.0305548572 -0.70074177
## 613  0.836186488            0.9510911604  0.57474333
## 616 -0.967353739           -0.7994368916 -0.53067709
## 618 -1.796400455           -0.6485293009 -0.87080644
## 623  1.214348148            2.9853254829  0.99990502
## 624  1.607054488           -0.3768956376 -1.04087112
## 626  0.763463092           -0.3316233604 -0.36061241
## 630 -1.127345210           -0.9775078486 -1.04087112
## 634 -0.720094191           -1.0771068584 -0.95583878
## 639  1.228892828            1.2046159128 -0.10551539
## 642  0.268943997           -0.5096943174 -0.78577411
## 644 -0.647370795            0.4168782894 -0.19054773
## 647 -1.316426040           -0.0750804563 -0.02048305
## 651 -1.054621814           -0.7179467926 -0.87080644
## 655  0.254399318           -0.9956167595 -0.95583878
## 660  0.254399318            2.4752578264 -0.53067709
## 676 -0.225575097           -0.4342405221 -0.19054773
## 677 -1.112800531           -0.7300193998  1.68016374
## 680 -1.200068606            0.4289508967 -0.87080644
## 692  1.432518337           -0.6485293009  0.91487268
## 703  0.370756752            1.3072330745  1.59513140
## 705 -0.589192078           -1.0680524030 -0.53067709
## 715 -0.429200606           -1.0589979476 -0.10551539
## 718 -1.360060078            0.3716060122  1.93526076
## 720  0.458024828           -0.2833329314  1.59513140
## 724  0.967088601           -0.6666382118  0.74480800
## 726  1.010722639           -0.7119104890  0.40467865
## 730 -0.341932531           -0.9986349113 -0.95583878
## 732 -0.589192078           -0.6424929972 -0.95583878
## 737 -0.734638871            0.1301538671 -1.04087112
## 740  1.025267318           -0.5398758356  0.74480800
## 742 -0.240119776           -0.2169335915 -0.61570943
## 756  0.588926941            1.7659921502  0.31964631
## 757 -0.065583625           -0.2440969578  0.48971099
## 765  0.632560978           -0.3980227003 -0.53067709
## 766 -0.909175022           -0.6847471226 -0.27558007
```

```
plot_predictions <- data.frame(
  data_test$Pregnancies,
  data_test$Glucose,
  data_test$BloodPressure,
  data_test$SkinThickness,
  data_test$Insulin,
  data_test$BMI,
  data_test$DiabetesPedigreeFunction,
  data_test$Age,

  predicted = predictions)

colnames(plot_predictions) <- c("data_test$Pregnancies",
                                "data_test$Glucose",
                                "data_test$BloodPressure",
```

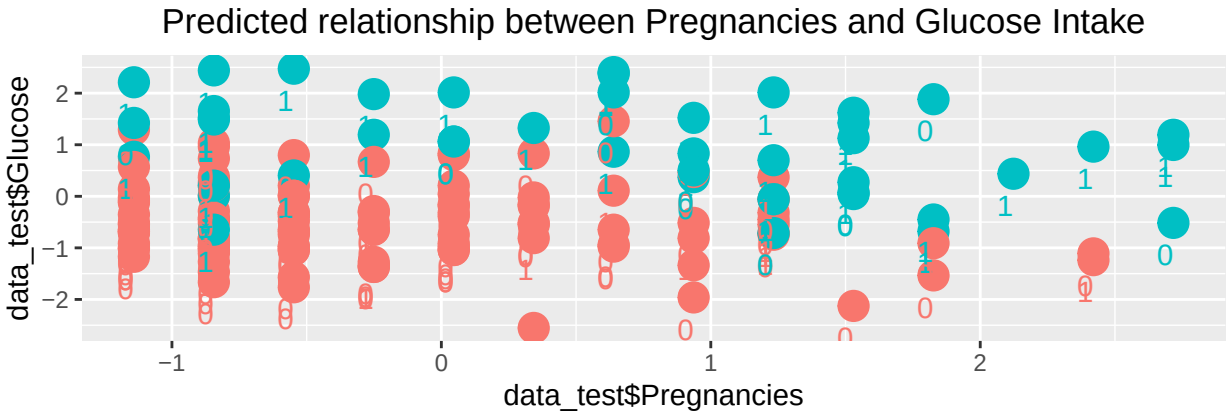
```
                                "data_test$SkinThickness",
                                "data_test$Insulin",
                                "data_test$BMI",
                                "data_test$DiabetesPedigreeFunction",
                                "data_test$Age",
                                "predicted")
# Visualize the KNN algorithm results.
library(ggplot2)
library(plyr)
```

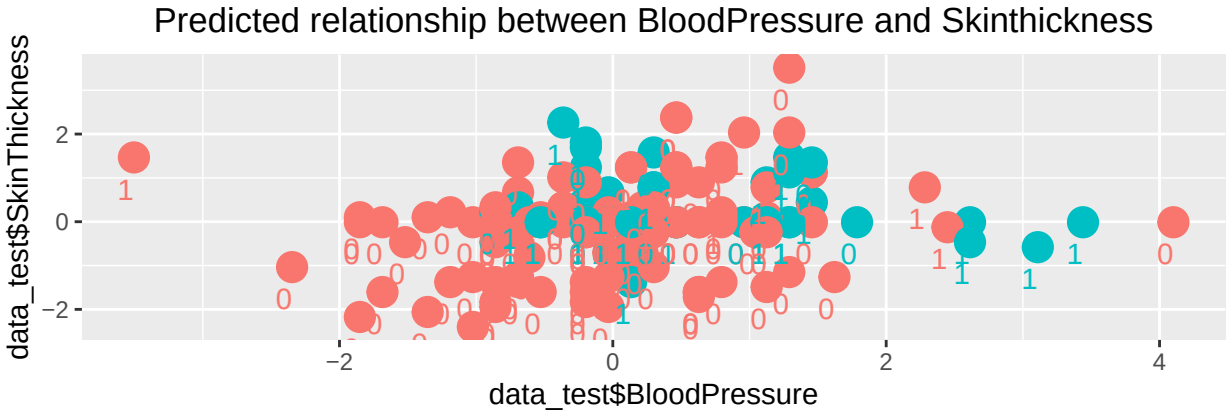
```
## ------------------------------------------------------------------------------

## You have loaded plyr after dplyr - this is likely to cause problems.
## If you need functions from both plyr and dplyr, please load plyr first, then dplyr:
## library(plyr); library(dplyr)

## ------------------------------------------------------------------------------

##
## Attaching package: 'plyr'

## The following objects are masked from 'package:dplyr':
##
##     arrange, count, desc, failwith, id, mutate, rename, summarise,
##     summarize
```

```
require(gridExtra)
```

```
## Loading required package: gridExtra

##
## Attaching package: 'gridExtra'

## The following object is masked from 'package:dplyr':
##
##     combine
```

```
p1 <- ggplot(plot_predictions, aes(data_test$Pregnancies,data_test$Glucose, color = predicted, fill = p
  geom_point(size = 5) +
  geom_text(aes(label=test_labels),hjust=1, vjust=2) +
  ggtitle("Predicted relationship between Pregnancies and Glucose Intake") +
  theme(plot.title = element_text(hjust = 0.5)) +
  theme(legend.position = "none")


p2 <- ggplot(plot_predictions, aes(data_test$BloodPressure, data_test$SkinThickness, color = predicted,
  geom_point(size = 5) +
  geom_text(aes(label=test_labels),hjust=1, vjust=2) +
  ggtitle("Predicted relationship between BloodPressure and Skinthickness") +
  theme(plot.title = element_text(hjust = 0.5)) +
  theme(legend.position = "none")

grid.arrange(p1, p2, ncol=1)
```


Predicted relationship between Pregnancies and Glucose Intake
data_test$Glucose
data_test$Pregnancies


Predicted relationship between BloodPressure and Skinthickness
data_test$SkinThickness
data_test$BloodPressure