Machine Learning

Inês L. Breda

8/10/2019

Summary:

This assignment aims to develop a model that can predict if a barbell lift is being well executed or not. The data includes sensor measurements located in the belt, the forearm, the arm and the dumbell of 6 individuals. Each of the 6 individuals performed barbell lifts in 5 different ways, 1 in a correct manner (class A), and 4 in an incorrect manner (class B, C, D and E). The training data includes 19622 observations of 159 variables, whereas the testing data includes 20 observations of 159 variables.

Packages and data

Cleaning and treating both training and test data

```
#import data
training <- read.csv(file = "pml-training.csv",header = T, sep = ",", row.names = 1, na.strings=
c("NA","#DIV/0!",""))
#format date and time
training$cvtd_timestamp <- parse_date_time(training$cvtd_timestamp , orders="dmy HMS")
#remove userID to aviod correlation between classe and user
training <- training[,-1]

#remove near zero variables
DataNZV <- nearZeroVar(training, saveMetrics=TRUE)
training <- training[,DataNZV$nzv  == "FALSE"]

#remove variables with > 50% NA values
NAColum <- colSums(is.na(training))/nrow(training) >0.5
training <- training[,NAColum == "FALSE"]
#repeat the same transformations on the testing data
test <- read.csv(file = "pml-testing.csv",header = T, sep = ",", row.names = 1, na.strings=c("N
A","#DIV/0!",""))
test$cvtd_timestamp <- parse_date_time(test$cvtd_timestamp , orders="dmy HMS")
test <- test[,-1]
test <- test[,DataNZV$nzv  == "FALSE"]
test <- test[,NAColum == "FALSE"]
#dimensions of training and test after dimensioning
training <- as.data.frame(training)
test <- as.data.frame(test)
dim(training); dim(test)
```

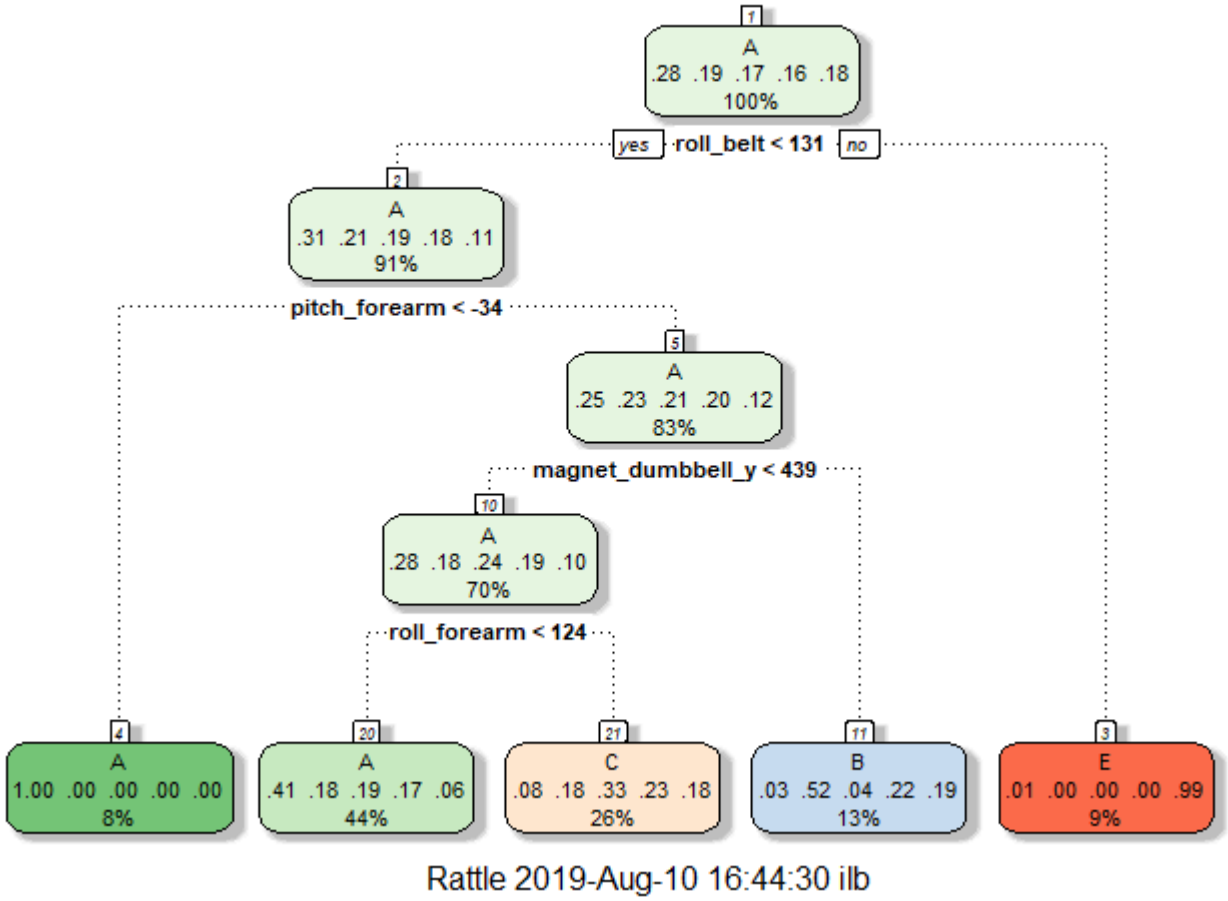
```
## [1] 19622    57
```

```
## [1] 20 57
```

#Model creation and evaluation

```
#creating traing and testing data
inTrain <- createDataPartition(y = training$classe, p = 0.7, list = F)
trainingData <- training[inTrain,]
testingData <- training[-inTrain,]

set.seed(1777)
#Model 1: Rpart
mod1 <- train(classe ~., data = trainingData, method = "rpart")
fancyRpartPlot(mod1$finalModel)
```




```
pred1 <- predict(mod1,testingData)
confusionMatrix(pred1, testingData$classe)
```

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction    A    B    C    D    E
##          A 1520  500  466  408  180
##          B   29  364   35  183  155
##          C  122  275  525  373  299
##          D    0    0    0    0    0
##          E    3    0    0    0  448
##
## Overall Statistics
##
##                Accuracy : 0.4855
##                  95% CI : (0.4726, 0.4983)
##     No Information Rate : 0.2845
##     P-Value [Acc > NIR] : < 2.2e-16
##
##                   Kappa : 0.3273
##
##  Mcnemar's Test P-Value : NA
##
## Statistics by Class:
##
##                      Class: A Class: B Class: C Class: D Class: E
## Sensitivity            0.9080  0.31958  0.51170   0.0000  0.41405
## Specificity            0.6310  0.91530  0.78000   1.0000  0.99938
## Pos Pred Value         0.4945  0.47520  0.32936      NaN  0.99335
## Neg Pred Value         0.9452  0.84860  0.88324   0.8362  0.88333
## Prevalence             0.2845  0.19354  0.17434   0.1638  0.18386
## Detection Rate         0.2583  0.06185  0.08921   0.0000  0.07613
## Detection Prevalence   0.5223  0.13016  0.27086   0.0000  0.07664
## Balanced Accuracy      0.7695  0.61744  0.64585   0.5000  0.70671
```

```
#Model 2: Boosters gbm
mod2 <- train(classe ~., data = trainingData, method = "gbm", verbose = FALSE)
pred2 <- predict(mod2, testingData)
confusionMatrix(pred2, testingData$classe)
```

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction    A    B    C    D    E
##          A 1673    2    0    0    0
##          B    1 1135    5    0    0
##          C    0    2 1018    5    0
##          D    0    0    3  957    4
##          E    0    0    0    2 1078
##
## Overall Statistics
##
##                Accuracy : 0.9959
##                  95% CI : (0.9939, 0.9974)
##     No Information Rate : 0.2845
##     P-Value [Acc > NIR] : < 2.2e-16
##
##                   Kappa : 0.9948
##
##  Mcnemar's Test P-Value : NA
##
## Statistics by Class:
##
##                      Class: A Class: B Class: C Class: D Class: E
## Sensitivity            0.9994   0.9965   0.9922   0.9927   0.9963
## Specificity            0.9995   0.9987   0.9986   0.9986   0.9996
## Pos Pred Value         0.9988   0.9947   0.9932   0.9927   0.9981
## Neg Pred Value         0.9998   0.9992   0.9984   0.9986   0.9992
## Prevalence             0.2845   0.1935   0.1743   0.1638   0.1839
## Detection Rate         0.2843   0.1929   0.1730   0.1626   0.1832
## Detection Prevalence   0.2846   0.1939   0.1742   0.1638   0.1835
## Balanced Accuracy      0.9995   0.9976   0.9954   0.9957   0.9979
```

Model 2 is the best with an accuracy of 0.99.

Quizz

```
predTest <- predict(mod2, test)
data.frame(test$problem_id, predTest)
```

```
##    test.problem_id predTest
## 1                1        B
## 2                2        A
## 3                3        B
## 4                4        A
## 5                5        A
## 6                6        E
## 7                7        D
## 8                8        B
## 9                9        A
## 10              10        A
## 11              11        B
## 12              12        C
## 13              13        B
## 14              14        A
## 15              15        E
## 16              16        E
## 17              17        A
## 18              18        B
## 19              19        B
## 20              20        B
```