Prediction Assignment Writeup

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Information

Background

Using devices such as Jawbone Up, Nike FuelBand, and Fitbit it is now possible to collect a large amount of data about personal activity relatively inexpensively. These type of devices are part of the quantified self movement - a group of enthusiasts who take measurements about themselves regularly to improve their health, to find patterns in their behavior, or because they are tech geeks. One thing that people regularly do is quantify how much of a particular activity they do, but they rarely quantify how well they do it. In this project, your goal will be to use data from accelerometers on the belt, forearm, arm, and dumbell of 6 participants. They were asked to perform barbell lifts correctly and incorrectly in 5 different ways. More information is available from the website here: http://web.archive.org/web/20161224072740/http:/groupware.les.inf.puc-rio.br/har (http://web.archive.org/web/20161224072740/http:/groupware.les.inf.puc-rio.br/har) (see the section on the Weight Lifting Exercise Dataset).

Data

The training data for this project are available here:

https://d396qusza40orc.cloudfront.net/predmachlearn/pml-training.csv (https://d396qusza40orc.cloudfront.net/predmachlearn/pml-training.csv)

The test data are available here:

https://d396qusza40orc.cloudfront.net/predmachlearn/pml-testing.csv (https://d396qusza40orc.cloudfront.net/predmachlearn/pml-testing.csv)

The data for this project come from this source: http://web.archive.org/web/20161224072740/http:/groupware.les.inf.puc-rio.br/har (http://web.archive.org/web/20161224072740/http:/groupware.les.inf.puc-rio.br/har). If you use the document you create for this class for any purpose please cite them as they have been very generous in allowing their data to be used for this kind of assignment.

Working area

```
# 1. library..
library(caret)
```

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

```
## Loading required package: ggplot2
```

```
library(randomForest)
```

```
## randomForest 4.6-14
```

```
## Type rfNews() to see new features/changes/bug fixes.
```

```
##
## Attaching package: 'randomForest'
```

```
## The following object is masked from 'package:ggplot2':
##
##     margin
```

```
library(rpart)
library(rpart.plot)
set.seed(1234)

#2.Loading Cleaning Data
trainingset<-read.csv("pml-training.csv" , na.strings=c("NA","#DIV/0!", ""))
testingset <- read.csv("pml-testing.csv", na.strings=c("NA","#DIV/0!", ""))
dim(trainingset)
```

```
## [1] 19622   160
```

```
dim(testingset)
```

```
## [1]  20 160
```

```
trainingset<-trainingset[,colSums(is.na(trainingset)) == 0]
testingset <-testingset[,colSums(is.na(testingset)) == 0]
trainingset   <-trainingset[,-c(1:7)]
testingset <-testingset[,-c(1:7)]
dim(trainingset)
```

```
## [1] 19622    53
```

```
dim(testingset)
```

```
## [1] 20 53
```

```
head(trainingset)
```

```
##   roll_belt pitch_belt yaw_belt total_accel_belt gyros_belt_x gyros_belt_y
## 1      1.41       8.07    -94.4               3         0.00         0.00
## 2      1.41       8.07    -94.4               3         0.02         0.00
## 3      1.42       8.07    -94.4               3         0.00         0.00
## 4      1.48       8.05    -94.4               3         0.02         0.00
## 5      1.48       8.07    -94.4               3         0.02         0.02
## 6      1.45       8.06    -94.4               3         0.02         0.00
##   gyros_belt_z accel_belt_x accel_belt_y accel_belt_z magnet_belt_x
## 1        -0.02          -21            4           22            -3
## 2        -0.02          -22            4           22            -7
## 3        -0.02          -20            5           23            -2
## 4        -0.03          -22            3           21            -6
## 5        -0.02          -21            2           24            -6
## 6        -0.02          -21            4           21             0
##   magnet_belt_y magnet_belt_z roll_arm pitch_arm yaw_arm total_accel_arm
## 1           599          -313     -128      22.5    -161              34
## 2           608          -311     -128      22.5    -161              34
## 3           600          -305     -128      22.5    -161              34
## 4           604          -310     -128      22.1    -161              34
## 5           600          -302     -128      22.1    -161              34
## 6           603          -312     -128      22.0    -161              34
##   gyros_arm_x gyros_arm_y gyros_arm_z accel_arm_x accel_arm_y accel_arm_z
## 1        0.00        0.00       -0.02        -288         109        -123
## 2        0.02       -0.02       -0.02        -290         110        -125
## 3        0.02       -0.02       -0.02        -289         110        -126
## 4        0.02       -0.03        0.02        -289         111        -123
## 5        0.00       -0.03        0.00        -289         111        -123
## 6        0.02       -0.03        0.00        -289         111        -122
##   magnet_arm_x magnet_arm_y magnet_arm_z roll_dumbbell pitch_dumbbell
## 1         -368          337          516      13.05217      -70.49400
## 2         -369          337          513      13.13074      -70.63751
## 3         -368          344          513      12.85075      -70.27812
## 4         -372          344          512      13.43120      -70.39379
## 5         -374          337          506      13.37872      -70.42856
## 6         -369          342          513      13.38246      -70.81759
##   yaw_dumbbell total_accel_dumbbell gyros_dumbbell_x gyros_dumbbell_y
## 1    -84.87394                  37                0            -0.02
## 2    -84.71065                  37                0            -0.02
## 3    -85.14078                  37                0            -0.02
## 4    -84.87363                  37                0            -0.02
## 5    -84.85306                  37                0            -0.02
## 6    -84.46500                  37                0            -0.02
##   gyros_dumbbell_z accel_dumbbell_x accel_dumbbell_y accel_dumbbell_z
## 1             0.00             -234               47             -271
## 2             0.00             -233               47             -269
## 3             0.00             -232               46             -270
## 4            -0.02             -232               48             -269
## 5             0.00             -233               48             -270
## 6             0.00             -234               48             -269
##   magnet_dumbbell_x magnet_dumbbell_y magnet_dumbbell_z roll_forearm
## 1              -559               293               -65         28.4
## 2              -555               296               -64         28.3
## 3              -561               298               -63         28.3
```

```
## 4              -552               303               -60         28.1
## 5              -554               292               -68         28.0
## 6              -558               294               -66         27.9
##   pitch_forearm yaw_forearm total_accel_forearm gyros_forearm_x
## 1         -63.9        -153                  36            0.03
## 2         -63.9        -153                  36            0.02
## 3         -63.9        -152                  36            0.03
## 4         -63.9        -152                  36            0.02
## 5         -63.9        -152                  36            0.02
## 6         -63.9        -152                  36            0.02
##   gyros_forearm_y gyros_forearm_z accel_forearm_x accel_forearm_y
## 1            0.00           -0.02             192             203
## 2            0.00           -0.02             192             203
## 3           -0.02            0.00             196             204
## 4           -0.02            0.00             189             206
## 5            0.00           -0.02             189             206
## 6           -0.02           -0.03             193             203
##   accel_forearm_z magnet_forearm_x magnet_forearm_y magnet_forearm_z
## 1            -215              -17              654              476
## 2            -216              -18              661              473
## 3            -213              -18              658              469
## 4            -214              -16              658              469
## 5            -214              -17              655              473
## 6            -215               -9              660              478
##   classe
## 1      A
## 2      A
## 3      A
## 4      A
## 5      A
## 6      A
```

```
head(testingset)
```

```
##   roll_belt pitch_belt yaw_belt total_accel_belt gyros_belt_x gyros_belt_y
## 1    123.00      27.00    -4.75               20        -0.50        -0.02
## 2      1.02       4.87   -88.90                4        -0.06        -0.02
## 3      0.87       1.82   -88.50                5         0.05         0.02
## 4    125.00     -41.60   162.00               17         0.11         0.11
## 5      1.35       3.33   -88.60                3         0.03         0.02
## 6     -5.92       1.59   -87.70                4         0.10         0.05
##   gyros_belt_z accel_belt_x accel_belt_y accel_belt_z magnet_belt_x
## 1        -0.46          -38           69         -179           -13
## 2        -0.07          -13           11           39            43
## 3         0.03            1           -1           49            29
## 4        -0.16           46           45         -156           169
## 5         0.00           -8            4           27            33
## 6        -0.13          -11          -16           38            31
##   magnet_belt_y magnet_belt_z roll_arm pitch_arm yaw_arm total_accel_arm
## 1           581          -382     40.7    -27.80     178              10
## 2           636          -309      0.0      0.00       0              38
## 3           631          -312      0.0      0.00       0              44
## 4           608          -304   -109.0     55.00    -142              25
## 5           566          -418     76.1      2.76     102              29
## 6           638          -291      0.0      0.00       0              14
##   gyros_arm_x gyros_arm_y gyros_arm_z accel_arm_x accel_arm_y accel_arm_z
## 1       -1.65        0.48       -0.18          16          38          93
## 2       -1.17        0.85       -0.43        -290         215         -90
## 3        2.10       -1.36        1.13        -341         245         -87
## 4        0.22       -0.51        0.92        -238         -57           6
## 5       -1.96        0.79       -0.54        -197         200         -30
## 6        0.02        0.05       -0.07         -26         130         -19
##   magnet_arm_x magnet_arm_y magnet_arm_z roll_dumbbell pitch_dumbbell
## 1         -326          385          481     -17.73748       24.96085
## 2         -325          447          434      54.47761      -53.69758
## 3         -264          474          413      57.07031      -51.37303
## 4         -173          257          633      43.10927      -30.04885
## 5         -170          275          617    -101.38396      -53.43952
## 6          396          176          516      62.18750      -50.55595
##   yaw_dumbbell total_accel_dumbbell gyros_dumbbell_x gyros_dumbbell_y
## 1    126.23596                   9             0.64             0.06
## 2    -75.51480                  31             0.34             0.05
## 3    -75.20287                  29             0.39             0.14
## 4   -103.32003                  18             0.10            -0.02
## 5    -14.19542                   4             0.29            -0.47
## 6    -71.12063                  29            -0.59             0.80
##   gyros_dumbbell_z accel_dumbbell_x accel_dumbbell_y accel_dumbbell_z
## 1            -0.61              21             -15              81
## 2            -0.71            -153             155            -205
## 3            -0.34            -141             155            -196
## 4             0.05             -51              72            -148
## 5            -0.46             -18             -30              -5
## 6             1.10            -138             166            -186
##   magnet_dumbbell_x magnet_dumbbell_y magnet_dumbbell_z roll_forearm
## 1               523              -528              -56          141
## 2              -502               388              -36          109
## 3              -506               349               41          131
```

```
## 4              -576               238                53            0
## 5              -424               252               312         -176
## 6              -543               262                96          150
##   pitch_forearm yaw_forearm total_accel_forearm gyros_forearm_x
## 1         49.30       156.0                  33            0.74
## 2        -17.60       106.0                  39            1.12
## 3        -32.60        93.0                  34            0.18
## 4          0.00         0.0                  43            1.38
## 5         -2.16       -47.9                  24           -0.75
## 6          1.46        89.7                  43           -0.88
##   gyros_forearm_y gyros_forearm_z accel_forearm_x accel_forearm_y
## 1           -3.34           -0.59            -110             267
## 2           -2.78           -0.18             212             297
## 3           -0.79            0.28             154             271
## 4            0.69            1.80             -92             406
## 5            3.10            0.80             131             -93
## 6            4.26            1.35             230             322
##   accel_forearm_z magnet_forearm_x magnet_forearm_y magnet_forearm_z
## 1            -149             -714              419              617
## 2            -118             -237              791              873
## 3            -129              -51              698              783
## 4             -39             -233              783              521
## 5             172              375             -787               91
## 6            -144             -300              800              884
##   problem_id
## 1          1
## 2          2
## 3          3
## 4          4
## 5          5
## 6          6
```

```
#3 cross-validation
#The training data set contains 53 variables and 19622 obs. The testing data set contains 53 var
iables and 20 obs.In order to perform cross-validation, the training data set is partionned into
 2 sets: subTraining (75%) and subTest (25%).This will be performed using random subsampling wit
hout replacement.

subsamples <- createDataPartition(y=trainingset$classe, p=0.75, list=FALSE)
subTraining <- trainingset[subsamples, ]
subTesting <- trainingset[-subsamples, ]
dim(subTraining)
```

```
## [1] 14718    53
```

```
dim(subTesting)
```

```
## [1] 4904   53
```

```
head(subTraining)
```

```
##   roll_belt pitch_belt yaw_belt total_accel_belt gyros_belt_x gyros_belt_y
## 2      1.41       8.07    -94.4               3         0.02         0.00
## 3      1.42       8.07    -94.4               3         0.00         0.00
## 4      1.48       8.05    -94.4               3         0.02         0.00
## 5      1.48       8.07    -94.4               3         0.02         0.02
## 6      1.45       8.06    -94.4               3         0.02         0.00
## 7      1.42       8.09    -94.4               3         0.02         0.00
##   gyros_belt_z accel_belt_x accel_belt_y accel_belt_z magnet_belt_x
## 2        -0.02          -22            4           22            -7
## 3        -0.02          -20            5           23            -2
## 4        -0.03          -22            3           21            -6
## 5        -0.02          -21            2           24            -6
## 6        -0.02          -21            4           21             0
## 7        -0.02          -22            3           21            -4
##   magnet_belt_y magnet_belt_z roll_arm pitch_arm yaw_arm total_accel_arm
## 2           608          -311     -128      22.5    -161              34
## 3           600          -305     -128      22.5    -161              34
## 4           604          -310     -128      22.1    -161              34
## 5           600          -302     -128      22.1    -161              34
## 6           603          -312     -128      22.0    -161              34
## 7           599          -311     -128      21.9    -161              34
##   gyros_arm_x gyros_arm_y gyros_arm_z accel_arm_x accel_arm_y accel_arm_z
## 2        0.02       -0.02       -0.02        -290         110        -125
## 3        0.02       -0.02       -0.02        -289         110        -126
## 4        0.02       -0.03        0.02        -289         111        -123
## 5        0.00       -0.03        0.00        -289         111        -123
## 6        0.02       -0.03        0.00        -289         111        -122
## 7        0.00       -0.03        0.00        -289         111        -125
##   magnet_arm_x magnet_arm_y magnet_arm_z roll_dumbbell pitch_dumbbell
## 2         -369          337          513      13.13074      -70.63751
## 3         -368          344          513      12.85075      -70.27812
## 4         -372          344          512      13.43120      -70.39379
## 5         -374          337          506      13.37872      -70.42856
## 6         -369          342          513      13.38246      -70.81759
## 7         -373          336          509      13.12695      -70.24757
##   yaw_dumbbell total_accel_dumbbell gyros_dumbbell_x gyros_dumbbell_y
## 2    -84.71065                  37               0            -0.02
## 3    -85.14078                  37               0            -0.02
## 4    -84.87363                  37               0            -0.02
## 5    -84.85306                  37               0            -0.02
## 6    -84.46500                  37               0            -0.02
## 7    -85.09961                  37               0            -0.02
##   gyros_dumbbell_z accel_dumbbell_x accel_dumbbell_y accel_dumbbell_z
## 2             0.00             -233               47             -269
## 3             0.00             -232               46             -270
## 4            -0.02             -232               48             -269
## 5             0.00             -233               48             -270
## 6             0.00             -234               48             -269
## 7             0.00             -232               47             -270
##   magnet_dumbbell_x magnet_dumbbell_y magnet_dumbbell_z roll_forearm
## 2              -555               296               -64         28.3
## 3              -561               298               -63         28.3
## 4              -552               303               -60         28.1
```

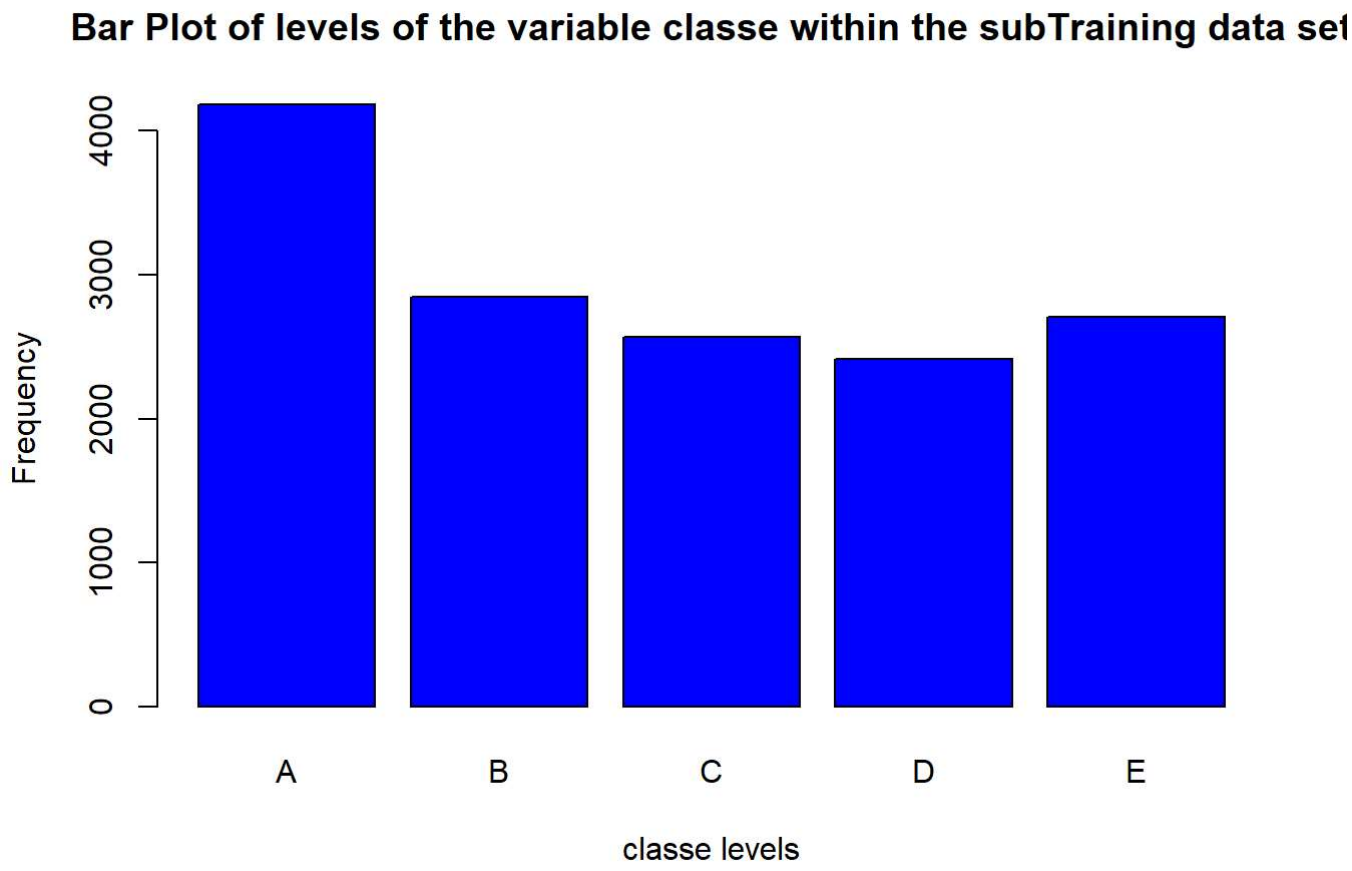
```
## 5              -554              292               -68         28.0
## 6              -558              294               -66         27.9
## 7              -551              295               -70         27.9
##   pitch_forearm yaw_forearm total_accel_forearm gyros_forearm_x
## 2         -63.9        -153                  36            0.02
## 3         -63.9        -152                  36            0.03
## 4         -63.9        -152                  36            0.02
## 5         -63.9        -152                  36            0.02
## 6         -63.9        -152                  36            0.02
## 7         -63.9        -152                  36            0.02
##   gyros_forearm_y gyros_forearm_z accel_forearm_x accel_forearm_y
## 2            0.00           -0.02             192             203
## 3           -0.02            0.00             196             204
## 4           -0.02            0.00             189             206
## 5            0.00           -0.02             189             206
## 6           -0.02           -0.03             193             203
## 7            0.00           -0.02             195             205
##   accel_forearm_z magnet_forearm_x magnet_forearm_y magnet_forearm_z
## 2            -216              -18              661              473
## 3            -213              -18              658              469
## 4            -214              -16              658              469
## 5            -214              -17              655              473
## 6            -215               -9              660              478
## 7            -215              -18              659              470
##   classe
## 2      A
## 3      A
## 4      A
## 5      A
## 6      A
## 7      A
```

```
head(subTesting)
```

```
##    roll_belt pitch_belt yaw_belt total_accel_belt gyros_belt_x
## 1       1.41       8.07    -94.4               3         0.00
## 21      1.60       8.10    -94.4               3         0.02
## 22      1.57       8.09    -94.4               3         0.02
## 23      1.56       8.10    -94.3               3         0.02
## 25      1.53       8.11    -94.4               3         0.03
## 26      1.55       8.09    -94.4               3         0.02
##    gyros_belt_y gyros_belt_z accel_belt_x accel_belt_y accel_belt_z
## 1          0.00        -0.02          -21            4           22
## 21         0.00        -0.02          -20            1           20
## 22         0.02        -0.02          -21            3           21
## 23         0.00        -0.02          -21            4           21
## 25         0.00         0.00          -19            4           21
## 26         0.00         0.00          -21            3           22
##    magnet_belt_x magnet_belt_y magnet_belt_z roll_arm pitch_arm yaw_arm
## 1             -3           599          -313     -128      22.5    -161
## 21           -10           607          -304     -129      20.9    -161
## 22            -2           604          -313     -129      20.8    -161
## 23            -4           606          -311     -129      20.7    -161
## 25            -8           605          -319     -129      20.7    -161
## 26           -10           601          -312     -129      20.7    -161
##    total_accel_arm gyros_arm_x gyros_arm_y gyros_arm_z accel_arm_x
## 1               34        0.00        0.00       -0.02        -288
## 21              34        0.03       -0.02       -0.02        -288
## 22              34        0.03       -0.02       -0.02        -289
## 23              34        0.02       -0.02       -0.02        -290
## 25              34       -0.02       -0.02        0.00        -289
## 26              34       -0.02       -0.02       -0.02        -290
##    accel_arm_y accel_arm_z magnet_arm_x magnet_arm_y magnet_arm_z
## 1          109        -123         -368          337          516
## 21         111        -124         -375          337          513
## 22         111        -123         -372          338          510
## 23         110        -123         -373          333          509
## 25         109        -123         -370          340          512
## 26         108        -123         -366          346          511
##    roll_dumbbell pitch_dumbbell yaw_dumbbell total_accel_dumbbell
## 1       13.05217      -70.49400    -84.87394                  37
## 21      13.38246      -70.81759    -84.46500                  37
## 22      13.37872      -70.42856    -84.85306                  37
## 23      13.35451      -70.63995    -84.64919                  37
## 25      13.05217      -70.49400    -84.87394                  37
## 26      12.80060      -70.31305    -85.11886                  37
##    gyros_dumbbell_x gyros_dumbbell_y gyros_dumbbell_z accel_dumbbell_x
## 1                 0            -0.02             0.00             -234
## 21                0            -0.02             0.00             -234
## 22                0            -0.02             0.00             -233
## 23                0            -0.02             0.00             -234
## 25                0            -0.02             0.00             -234
## 26                0            -0.02            -0.02             -233
##    accel_dumbbell_y accel_dumbbell_z magnet_dumbbell_x magnet_dumbbell_y
## 1                47             -271              -559               293
## 21               48             -269              -554               299
## 22               48             -270              -554               301
```

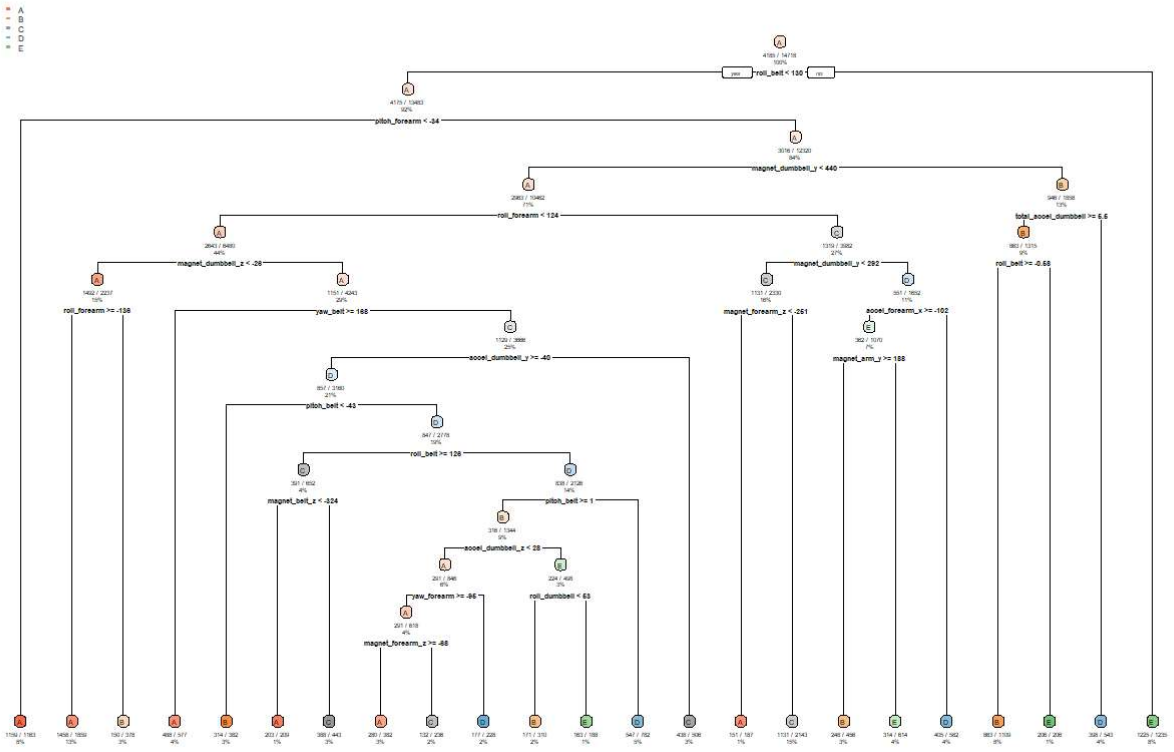
```
## 23               48             -270              -557               294
## 25               47             -271              -555               290
## 26               46             -271              -563               294
##    magnet_dumbbell_z roll_forearm pitch_forearm yaw_forearm
## 1                -65         28.4         -63.9        -153
## 21               -72         26.9         -63.9        -151
## 22               -65         27.0         -63.9        -151
## 23               -69         26.9         -63.8        -151
## 25               -68         27.1         -63.7        -151
## 26               -72         27.0         -63.7        -151
##    total_accel_forearm gyros_forearm_x gyros_forearm_y gyros_forearm_z
## 1                   36            0.03            0.00           -0.02
## 21                  36            0.03           -0.03           -0.02
## 22                  36            0.02           -0.03           -0.02
## 23                  36            0.02           -0.02           -0.02
## 25                  36            0.05           -0.03            0.00
## 26                  36            0.03            0.00            0.00
##    accel_forearm_x accel_forearm_y accel_forearm_z magnet_forearm_x
## 1              192             203            -215              -17
## 21             194             208            -214              -11
## 22             191             206            -213              -17
## 23             194             206            -214              -10
## 25             191             202            -214              -14
## 26             190             203            -216              -16
##    magnet_forearm_y magnet_forearm_z classe
## 1               654              476      A
## 21              654              469      A
## 22              654              478      A
## 23              653              467      A
## 25              667              470      A
## 26              658              462      A
```

```
#4 Data showing
#Class levels
plot(subTraining$classe, col="blue", main="Bar Plot of levels of the variable classe within the
 subTraining data set", xlab="classe levels", ylab="Frequency")
```




```
#Decision Tree
model1 <- rpart(classe ~ ., data=subTraining, method="class")
prediction1 <- predict(model1, subTesting, type = "class")
rpart.plot(model1, main="Classification Tree", extra=102, under=TRUE, faclen=0)
```

Classification Tree




```
confusionMatrix(prediction1, subTesting$classe)
```

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction    A    B    C    D    E
##          A 1235  157   16   50   20
##          B   55  568   73   80  102
##          C   44  125  690  118  116
##          D   41   64   50  508   38
##          E   20   35   26   48  625
##
## Overall Statistics
##
##                Accuracy : 0.7394
##                  95% CI : (0.7269, 0.7516)
##     No Information Rate : 0.2845
##     P-Value [Acc > NIR] : < 2.2e-16
##
##                   Kappa : 0.6697
##  Mcnemar's Test P-Value : < 2.2e-16
##
## Statistics by Class:
##
##                      Class: A Class: B Class: C Class: D Class: E
## Sensitivity            0.8853   0.5985   0.8070   0.6318   0.6937
## Specificity            0.9307   0.9216   0.9005   0.9529   0.9678
## Pos Pred Value         0.8356   0.6469   0.6313   0.7247   0.8289
## Neg Pred Value         0.9533   0.9054   0.9567   0.9296   0.9335
## Prevalence             0.2845   0.1935   0.1743   0.1639   0.1837
## Detection Rate         0.2518   0.1158   0.1407   0.1036   0.1274
## Detection Prevalence   0.3014   0.1790   0.2229   0.1429   0.1538
## Balanced Accuracy      0.9080   0.7601   0.8537   0.7924   0.8307
```

```
#Random Forest
model2 <- randomForest(classe ~. , data=subTraining, method="class")
prediction2 <- predict(model2, subTesting, type = "class")
confusionMatrix(prediction2, subTesting$classe)
```

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction    A    B    C    D    E
##          A 1395    3    0    0    0
##          B    0  943   10    0    0
##          C    0    3  844    5    0
##          D    0    0    1  799    0
##          E    0    0    0    0  901
##
## Overall Statistics
##
##                Accuracy : 0.9955
##                  95% CI : (0.9932, 0.9972)
##     No Information Rate : 0.2845
##     P-Value [Acc > NIR] : < 2.2e-16
##
##                   Kappa : 0.9943
##  Mcnemar's Test P-Value : NA
##
## Statistics by Class:
##
##                      Class: A Class: B Class: C Class: D Class: E
## Sensitivity            1.0000   0.9937   0.9871   0.9938   1.0000
## Specificity            0.9991   0.9975   0.9980   0.9998   1.0000
## Pos Pred Value         0.9979   0.9895   0.9906   0.9988   1.0000
## Neg Pred Value         1.0000   0.9985   0.9973   0.9988   1.0000
## Prevalence             0.2845   0.1935   0.1743   0.1639   0.1837
## Detection Rate         0.2845   0.1923   0.1721   0.1629   0.1837
## Detection Prevalence   0.2851   0.1943   0.1737   0.1631   0.1837
## Balanced Accuracy      0.9996   0.9956   0.9926   0.9968   1.0000
```

```
#outcome
# I will choose ##THE FOREST MODEL
#The accuracy of the model is 0.995. The expected out-of-sample error is estimated at 0.005, or
 0.5%. The expected out-of-sample error is calculated as 1 - accuracy for predictions made again
st the cross-validation set. Our Test data set comprises 20 cases. With an accuracy above 99% on
 our cross-validation data, we can expect that very few, or none, of the test samples will be mi
ssclassified.

predictfinal <- predict(model2, testingset, type="class")
predictfinal
```

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

```
pml_write_files = function(x){
  n = length(x)
  for(i in 1:n){
    filename = paste0("problem_id_",i,".txt")
    write.table(x[i],file=filename,quote=FALSE,row.names=FALSE,col.names=FALSE)
  }
}

pml_write_files(predictfinal)
```

References

#[1] Velloso, E.; Bulling, A.; Gellersen, H.; Ugulino, W.; Fuks, H. Qualitative Activity Recognition of Weight Lifting Exercises. Proceedings of 4th International Conference in Cooperation with SIGCHI (Augmented Human '13) . Stuttgart, Germany: ACM SIGCHI, 2013.

#[2] Krzysztof Gra??bczewski and Norbert Jankowski. Feature Selection with Decision Tree Criterion.