PracticalMachineLearningReport

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 (see the section on the Weight Lifting Exercise Dataset).

The training data for this project are available here: https://d396qusza40orc.cloudfront.net/predmachlearn/pml-training.csv

The test data are available here: 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. 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.

Data preparatation

Download test and training data if not already existing and load the downloaded csv files.

```
url_training_data <- "https://d396qusza40orc.cloudfront.net/predmachlearn/pml-training.csv"
url_testing_data <- "https://d396qusza40orc.cloudfront.net/predmachlearn/pml-testing.csv"

path_training_data <- "./data/pml-training.csv"
path_testing_data <- "./data/pml-testing.csv"

if(!file.exists(path_training_data)){
        download.file(url_training_data, path_training_data)
}
if(!file.exists(path_training_data)){
        download.file(url_testing_data, path_testing_data)
}

training <- read.csv(path_training_data)
testing <- read.csv(path_testing_data)
```

Perform some simple exploratory analysis on the data set

```
dim(training)
```

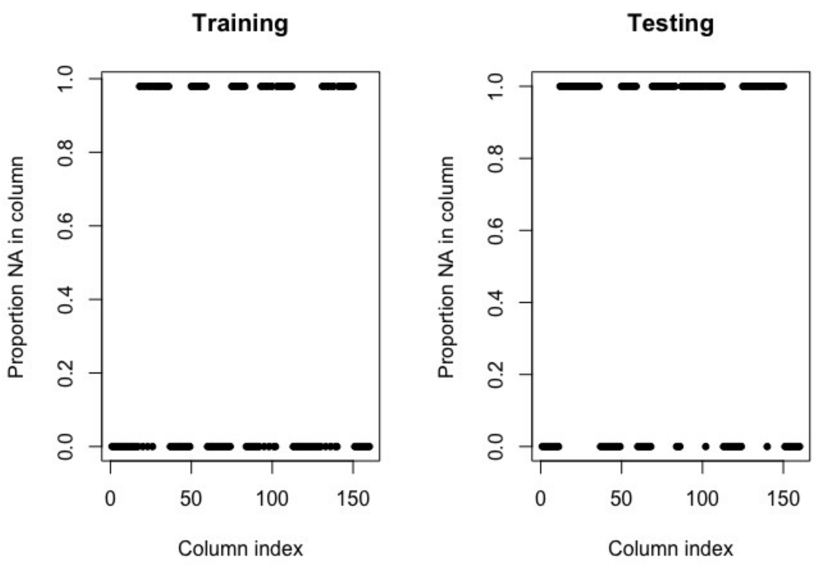
```
## [1] 19622   160
```

```
dim(testing)
```

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

There are NA values in both training and testing data. Investigate how often a column in training and testing is NA.

```
par(mfrow=c(1,2))
plot(sapply(training, function(y) sum(is.na(y))/length(y)), pch = 20, xlab = "Column index", ylab = "Proportion NA in co
plot(sapply(testing, function(y) sum(is.na(y))/length(y)), pch = 20, xlab = "Column index", ylab = "Proportion NA in col
```



A column in training and test is either fully complete or only NAs. We can therefore exclude any columns that have NAs in either training or test.

```
features_no_na_training <- sapply(training, function(y) !any(is.na(y)))
features_no_na_testing <- sapply(testing, function(y) !any(is.na(y)))
features_no_na <- features_no_na_training & features_no_na_testing

training <- training[, features_no_na]
testing <- testing[, features_no_na]
```

Remove columns not applicable, name of user, timestamps related variables and window.

```
training <- training[, -(1:7)]
testing <- testing[, -(1:7)]
dim(training)
```

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

```
dim(testing)
```

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

The final data frame contains 52 predictors and 1 outcome (classe).

Data analysis

Load required library and set seed for reproducability. Split the training in a 75% training set and a 25% valiation set.

```
library(ggplot2)
library(lattice)
library(caret)
set.seed(32123)
```

```r
inTrain = createDataPartition(training$classe, p = 3/4)[[1]]
training = training[ inTrain,]
validating = training[-inTrain,]
```

Use a 3 folded cross valiation and train a random forest with default parameters.

```r
fitControl <- trainControl(method = "cv", number = 3)
mdl_rf <- train(classe ~ ., data = training, method = "rf", trControl = fitControl)
```

Verify random forest model on valiadtion data

```r
pred_validating <- predict(mdl_rf, newdata = validating)
confusionMatrix(pred_validating, validating$classe)
```

```
## Confusion Matrix and Statistics
## 
##           Reference
## Prediction    A    B    C    D    E
##          A 1059    0    0    0    0
##          B    0  698    0    0    0
##          C    0    0  636    0    0
##          D    0    0    0  598    0
##          E    0    0    0    0  680
## 
## Overall Statistics
## 
##                Accuracy : 1
##                  95% CI : (0.999, 1)
##     No Information Rate : 0.2885
##     P-Value [Acc > NIR] : < 2.2e-16
## 
##                   Kappa : 1
## 
##  Mcnemar's Test P-Value : NA
## 
## Statistics by Class:
## 
##                      Class: A Class: B Class: C Class: D Class: E
## Sensitivity            1.0000   1.0000   1.0000   1.0000   1.0000
## Specificity            1.0000   1.0000   1.0000   1.0000   1.0000
## Pos Pred Value         1.0000   1.0000   1.0000   1.0000   1.0000
## Neg Pred Value         1.0000   1.0000   1.0000   1.0000   1.0000
## Prevalence             0.2885   0.1901   0.1732   0.1629   0.1852
## Detection Rate         0.2885   0.1901   0.1732   0.1629   0.1852
## Detection Prevalence   0.2885   0.1901   0.1732   0.1629   0.1852
## Balanced Accuracy      1.0000   1.0000   1.0000   1.0000   1.0000
```

The model is performing well on the validation data. Let's use the trained random forest model on the testing data.

```r
predict(mdl_rf, newdata = testing)
```

```
##  [1] 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
```