# An accessment : How do you know you exercise correctly ?

# 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://groupware.les.inf.puc-rio.br/har> (see the section on the Weight Lifting Exercise Dataset).

# 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://groupware.les.inf.puc-rio.br/har>.

Download both training dataset :-

curdir <-getwd()  
file.url<-'http://d396qusza40orc.cloudfront.net/predmachlearn/pml-training.csv'  
download.file(file.url,destfile=paste(curdir,'/pml-training.csv',sep=""))  
  
curdir <-getwd()  
file.url<-'http://d396qusza40orc.cloudfront.net/predmachlearn/pml-testing.csv'  
download.file(file.url,destfile=paste(curdir,'/pml-testing.csv',sep=""))

Load both dataset :-

train <- read.csv(paste(curdir,'/pml-training.csv',sep=""),na.strings=c("NA","#DIV/0!",""))  
test <-read.csv(paste(curdir,'/pml-testing.csv',sep=""),na.strings=c("NA","#DIV/0!",""))

Cheking the dimension of training and test dataset :-

dim(train)

## [1] 19622 160

dim(test)

## [1] 20 160

Checking the columns which have all missing values

train<-train[,colSums(is.na(train)) == 0]  
test <-test[,colSums(is.na(test)) == 0]

We remove 6 of the variables which is irrelevant like :-

1. user\_name
2. raw\_timestamp\_part\_1
3. raw\_timestamp\_part\_2
4. cvtd\_timestamp
5. new\_window
6. num\_window

which resides on the column 1-7.

train <-train[,-c(1:7)]  
test <-test[,-c(1:7)]

Check again the dimension

dim(train)

## [1] 19622 53

dim(test)

## [1] 20 53

Now we obtain the several rows to preview

head(train)

## 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(test)

## 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

# Reference

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. Read more: <http://groupware.les.inf.puc-rio.br/har#ixzz3lj0hACeI>