**CODE BOOK**

One of the most exciting areas in all of data science right now is wearable computing - see for example [this article](http://www.insideactivitytracking.com/data-science-activity-tracking-and-the-battle-for-the-worlds-top-sports-brand/). Companies like Fitbit, Nike, and Jawbone Up are racing to develop the most advanced algorithms to attract new users. The data linked to from the course website represent data collected from the accelerometers from the Samsung Galaxy S smartphone. A full description is available at the site where the data was obtained:

<http://archive.ics.uci.edu/ml/datasets/Human+Activity+Recognition+Using+Smartphones>

Here are the data for the project:

<https://d396qusza40orc.cloudfront.net/getdata%2Fprojectfiles%2FUCI%20HAR%20Dataset.zip>

Variables is the final dataset-

[1] "activity"

[2] "subject"

[3] "timeBodyAccelerometer-mean-X"

[4] "timeBodyAccelerometer-mean-Y"

[5] "timeBodyAccelerometer-mean-Z"

[6] "timeGravityAccelerometer-mean-X"

[7] "timeGravityAccelerometer-mean-Y"

[8] "timeGravityAccelerometer-mean-Z"

[9] "timeBodyAccelerometerJerk-mean-X"

[10] "timeBodyAccelerometerJerk-mean-Y"

[11] "timeBodyAccelerometerJerk-mean-Z"

[12] "timeBodyGyro-sensor-mean-X"

[13] "timeBodyGyro-sensor-mean-Y"

[14] "timeBodyGyro-sensor-mean-Z"

[15] "timeBodyGyro-sensorJerk-mean-X"

[16] "timeBodyGyro-sensorJerk-mean-Y"

[17] "timeBodyGyro-sensorJerk-mean-Z"

[18] "timeBodyAccelerometerMag-mean"

[19] "timeGravityAccelerometerMag-mean"

[20] "timeBodyAccelerometerJerkMag-mean"

[21] "timeBodyGyro-sensorMag-mean"

[22] "timeBodyGyro-sensorJerkMag-mean"

[23] "frequencyBodyAccelerometer-mean-X"

[24] "frequencyBodyAccelerometer-mean-Y"

[25] "frequencyBodyAccelerometer-mean-Z"

[26] "frequencyBodyAccelerometer-meanFreq-X"

[27] "frequencyBodyAccelerometer-meanFreq-Y"

[28] "frequencyBodyAccelerometer-meanFreq-Z"

[29] "frequencyBodyAccelerometerJerk-mean-X"

[30] "frequencyBodyAccelerometerJerk-mean-Y"

[31] "frequencyBodyAccelerometerJerk-mean-Z"

[32] "frequencyBodyAccelerometerJerk-meanFreq-X"

[33] "frequencyBodyAccelerometerJerk-meanFreq-Y"

[34] "frequencyBodyAccelerometerJerk-meanFreq-Z"

[35] "frequencyBodyGyro-sensor-mean-X"

[36] "frequencyBodyGyro-sensor-mean-Y"

[37] "frequencyBodyGyro-sensor-mean-Z"

[38] "frequencyBodyGyro-sensor-meanFreq-X"

[39] "frequencyBodyGyro-sensor-meanFreq-Y"

[40] "frequencyBodyGyro-sensor-meanFreq-Z"

[41] "frequencyBodyAccelerometerMag-mean"

[42] "frequencyBodyAccelerometerMag-meanFreq"

[43] "frequencyBodyBodyAccelerometerJerkMag-mean"

[44] "frequencyBodyBodyAccelerometerJerkMag-meanFreq"

[45] "frequencyBodyBodyGyro-sensorMag-mean"

[46] "frequencyBodyBodyGyro-sensorMag-meanFreq"

[47] "frequencyBodyBodyGyro-sensorJerkMag-mean"

[48] "frequencyBodyBodyGyro-sensorJerkMag-meanFreq"

[49] "timeBodyAccelerometer-std-X"

[50] "timeBodyAccelerometer-std-Y"

[51] "timeBodyAccelerometer-std-Z"

[52] "timeGravityAccelerometer-std-X"

[53] "timeGravityAccelerometer-std-Y"

[54] "timeGravityAccelerometer-std-Z"

[55] "timeBodyAccelerometerJerk-std-X"

[56] "timeBodyAccelerometerJerk-std-Y"

[57] "timeBodyAccelerometerJerk-std-Z"

[58] "timeBodyGyro-sensor-std-X"

[59] "timeBodyGyro-sensor-std-Y"

[60] "timeBodyGyro-sensor-std-Z"

[61] "timeBodyGyro-sensorJerk-std-X"

[62] "timeBodyGyro-sensorJerk-std-Y"

[63] "timeBodyGyro-sensorJerk-std-Z"

[64] "timeBodyAccelerometerMag-std"

[65] "timeGravityAccelerometerMag-std"

[66] "timeBodyAccelerometerJerkMag-std"

[67] "timeBodyGyro-sensorMag-std"

[68] "timeBodyGyro-sensorJerkMag-std"

[69] "frequencyBodyAccelerometer-std-X"

[70] "frequencyBodyAccelerometer-std-Y"

[71] "frequencyBodyAccelerometer-std-Z"

[72] "frequencyBodyAccelerometerJerk-std-X"

[73] "frequencyBodyAccelerometerJerk-std-Y"

[74] "frequencyBodyAccelerometerJerk-std-Z"

[75] "frequencyBodyGyro-sensor-std-X"

[76] "frequencyBodyGyro-sensor-std-Y"

[77] "frequencyBodyGyro-sensor-std-Z"

[78] "frequencyBodyAccelerometerMag-std"

[79] "frequencyBodyBodyAccelerometerJerkMag-std"

[80] "frequencyBodyBodyGyro-sensorMag-std"

[81] "frequencyBodyBodyGyro-sensorJerkMag-std"

“activity”- this is taken from the y\_train.txt and y\_test.txt

“subject” - this the id of the subject, taken from subject\_train.txt and subject\_test.txt

All the data was grouped by “activity” and “subject” in that ordered and then other variables were averaged on the bases of the groupings. Also I have extracts only the measurements on the mean and standard deviation for each measurement.

Details of the variables are given below.

Feature Selection

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The features selected for this database come from the accelerometer and gyroscope 3-axial raw signals tAcc-XYZ and tGyro-XYZ. These time domain signals (prefix 't' to denote time) were captured at a constant rate of 50 Hz. Then they were filtered using a median filter and a 3rd order low pass Butterworth filter with a corner frequency of 20 Hz to remove noise. Similarly, the acceleration signal was then separated into body and gravity acceleration signals (tBodyAcc-XYZ and tGravityAcc-XYZ) using another low pass Butterworth filter with a corner frequency of 0.3 Hz.

Subsequently, the body linear acceleration and angular velocity were derived in time to obtain Jerk signals (tBodyAccJerk-XYZ and tBodyGyroJerk-XYZ). Also the magnitude of these three-dimensional signals were calculated using the Euclidean norm (tBodyAccMag, tGravityAccMag, tBodyAccJerkMag, tBodyGyroMag, tBodyGyroJerkMag).

Finally a Fast Fourier Transform (FFT) was applied to some of these signals producing fBodyAcc-XYZ, fBodyAccJerk-XYZ, fBodyGyro-XYZ, fBodyAccJerkMag, fBodyGyroMag, fBodyGyroJerkMag. (Note the 'f' to indicate frequency domain signals).

These signals were used to estimate variables of the feature vector for each pattern:

'-XYZ' is used to denote 3-axial signals in the X, Y and Z directions.

tBodyAcc-XYZ

tGravityAcc-XYZ

tBodyAccJerk-XYZ

tBodyGyro-XYZ

tBodyGyroJerk-XYZ

tBodyAccMag

tGravityAccMag

tBodyAccJerkMag

tBodyGyroMag

tBodyGyroJerkMag

fBodyAcc-XYZ

fBodyAccJerk-XYZ

fBodyGyro-XYZ

fBodyAccMag

fBodyAccJerkMag

fBodyGyroMag

fBodyGyroJerkMag

The set of variables that were estimated from these signals are:

mean(): Mean value

std(): Standard deviation

mad(): Median absolute deviation

max(): Largest value in array

min(): Smallest value in array

sma(): Signal magnitude area

energy(): Energy measure. Sum of the squares divided by the number of values.

iqr(): Interquartile range

entropy(): Signal entropy

arCoeff(): Autorregresion coefficients with Burg order equal to 4

correlation(): correlation coefficient between two signals

maxInds(): index of the frequency component with largest magnitude

meanFreq(): Weighted average of the frequency components to obtain a mean frequency

skewness(): skewness of the frequency domain signal

kurtosis(): kurtosis of the frequency domain signal

bandsEnergy(): Energy of a frequency interval within the 64 bins of the FFT of each window.

angle(): Angle between to vectors.

Additional vectors obtained by averaging the signals in a signal window sample. These are used on the angle() variable:

gravityMean

tBodyAccMean

tBodyAccJerkMean

tBodyGyroMean

tBodyGyroJerkMean

The complete list of variables of each feature vector is available in 'features.txt'