Human Activity Recognition Data Analysis Using Samsung Galaxy S II Smartphone

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Abstract: using "Human Activity Recognition Using Smartphones Dataset Version 1.0" from the UC Irvine Machine Learning Repository that includes triaxial acceleration from the accelerometer (total acceleration) and the estimated body acceleration, triaxial Angular velocity from the gyroscope, 561 variables with time and frequency domain data, activity labels, and identifiers of the subject who carried out the experiment.

Data Set Characteristics:	Multivariate	**Number of Instances:**	180	**Area:**	Machine Learning
Attribute Characteristics:	N/A	**Number of Attributes:**	88	**Missing Values?**	N/A

Source:

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

Data Set Information:

The experiments have been carried out with a group of 30 volunteers within an age bracket of 19-48 years. Each person performed six activities (WALKING, WALKING_UPSTAIRS, WALKING_DOWNSTAIRS, SITTING, STANDING, LAYING) wearing a smartphone (Samsung Galaxy S II) on the waist. Using its embedded accelerometer and gyroscope, we captured 3-axial linear acceleration and 3-axial angular velocity at a constant rate of 50Hz. The experiments have been video-recorded to label the data manually. The obtained dataset has been randomly partitioned into two sets, where 70% of the volunteers was selected for generating the training data and 30% the test data.

The sensor signals (accelerometer and gyroscope) were pre-processed by applying noise filters and then sampled in fixed-width sliding windows of 2.56 sec and 50% overlap (128 readings/window). The sensor acceleration signal, which has gravitational and body motion components, was separated using a Butterworth low-pass filter into body acceleration and gravity. The gravitational force is assumed to have only low frequency components, therefore a filter

with 0.3 Hz cutoff frequency was used. From each window, a vector of features was obtained by calculating variables from the time and frequency domain. See 'features_info.txt' for more details.[1]

Data variables include:

Label	**Data Type**	**Explanation**
subject	Factor	identifies the subject who performed the activity
activities	Factor	Activity performed
X1.tBodyAcc.mean...X	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X2.tBodyAcc.mean...Y	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X3.tBodyAcc.mean...Z	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X41.tGravityAcc.mean...X	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X42.tGravityAcc.mean...Y	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X43.tGravityAcc.mean...Z	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X81.tBodyAccJerk.mean...X	Numeric	Feature vector: body linear acceleration and angular velocity
X82.tBodyAccJerk.mean...Y	Numeric	Feature vector: body linear acceleration and angular velocity
X83.tBodyAccJerk.mean...Z	Numeric	Feature vector: body linear acceleration and angular velocity
X121.tBodyGyro.mean...X	Numeric	Feature vector: angular velocity vector measured by the gyroscope
X122.tBodyGyro.mean...Y	Numeric	Feature vector: angular velocity vector measured by the gyroscope
X123.tBodyGyro.mean...Z	Numeric	Feature vector: angular velocity vector measured by the gyroscope
X161.tBodyGyroJerk.mean...X	Numeric	Feature vector: body linear acceleration and angular velocity

[1] http://archive.ics.uci.edu/ml/datasets/Human+Activity+Recognition+Using+Smartphones

X162.tBodyGyroJerk.mean...Y	Numeric	Feature vector: body linear acceleration and angular velocity
X163.tBodyGyroJerk.mean...Z	Numeric	Feature vector: body linear acceleration and angular velocity
X201.tBodyAccMag.mean..	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X214.tGravityAccMag.mean..	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X227.tBodyAccJerkMag.mean..	Numeric	Feature vector: body linear acceleration and angular velocity
X240.tBodyGyroMag.mean..	Numeric	Feature vector: angular velocity vector measured by the gyroscope
X253.tBodyGyroJerkMag.mean..	Numeric	Feature vector: body linear acceleration and angular velocity
X266.fBodyAcc.mean...X	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X267.fBodyAcc.mean...Y	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X268.fBodyAcc.mean...Z	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X294.fBodyAcc.meanFreq...X	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X295.fBodyAcc.meanFreq...Y	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X296.fBodyAcc.meanFreq...Z	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X345.fBodyAccJerk.mean...X	Numeric	Feature vector: body linear acceleration and angular velocity
X346.fBodyAccJerk.mean...Y	Numeric	Feature vector: body linear acceleration and angular velocity
X347.fBodyAccJerk.mean...Z	Numeric	Feature vector: body linear acceleration and angular velocity
X373.fBodyAccJerk.meanFreq...X	Numeric	Feature vector: body linear acceleration and angular velocity
X374.fBodyAccJerk.meanFreq...Y	Numeric	Feature vector: body linear acceleration and angular velocity

X375.fBodyAccJerk.meanFreq...Z	Numeric	Feature vector: body linear acceleration and angular velocity
X424.fBodyGyro.mean...X	Numeric	Feature vector: angular velocity vector measured by the gyroscope
X425.fBodyGyro.mean...Y	Numeric	Feature vector: angular velocity vector measured by the gyroscope
X426.fBodyGyro.mean...Z	Numeric	Feature vector: angular velocity vector measured by the gyroscope
X452.fBodyGyro.meanFreq...X	Numeric	Feature vector: angular velocity vector measured by the gyroscope
X453.fBodyGyro.meanFreq...Y	Numeric	Feature vector: angular velocity vector measured by the gyroscope
X454.fBodyGyro.meanFreq...Z	Numeric	Feature vector: angular velocity vector measured by the gyroscope
X503.fBodyAccMag.mean..	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X513.fBodyAccMag.meanFreq..	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X516.fBodyBodyAccJerkMag.mean..	Numeric	Feature vector: body linear acceleration and angular velocity
X526.fBodyBodyAccJerkMag.meanFreq..	Numeric	Feature vector: body linear acceleration and angular velocity
X529.fBodyBodyGyroMag.mean..	Numeric	Feature vector: angular velocity vector measured by the gyroscope
X539.fBodyBodyGyroMag.meanFreq..	Numeric	Feature vector: angular velocity vector measured by the gyroscope
X542.fBodyBodyGyroJerkMag.mean..	Numeric	Feature vector: body linear acceleration and angular velocity
X552.fBodyBodyGyroJerkMag.meanFreq..	Numeric	Feature vector: body linear acceleration and angular velocity
X555.angle.tBodyAccMean.gravity.	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X556.angle.tBodyAccJerkMean..gravityMean.	Numeric	Feature vector: body linear acceleration and angular velocity
X557.angle.tBodyGyroMean.gravityMean.	Numeric	Feature vector: angular velocity vector measured by the gyroscope

X558.angle.tBodyGyroJerkMean.gravityMean.	Numeric	Feature vector: angular velocity vector measured by the gyroscope
X559.angle.X.gravityMean.	Numeric	Feature vector: gravity acceleration
X560.angle.Y.gravityMean.	Numeric	Feature vector: gravity acceleration
X561.angle.Z.gravityMean.	Numeric	Feature vector: gravity acceleration
X4.tBodyAcc.std...X	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X5.tBodyAcc.std...Y	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X6.tBodyAcc.std...Z	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X44.tGravityAcc.std...X	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X45.tGravityAcc.std...Y	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X46.tGravityAcc.std...Z	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X84.tBodyAccJerk.std...X	Numeric	Feature vector: body linear acceleration and angular velocity
X85.tBodyAccJerk.std...Y	Numeric	Feature vector: body linear acceleration and angular velocity
X86.tBodyAccJerk.std...Z	Numeric	Feature vector: body linear acceleration and angular velocity
X124.tBodyGyro.std...X	Numeric	Feature vector: angular velocity vector measured by the gyroscope
X125.tBodyGyro.std...Y	Numeric	Feature vector: angular velocity vector measured by the gyroscope
X126.tBodyGyro.std...Z	Numeric	Feature vector: angular velocity vector measured by the gyroscope
X164.tBodyGyroJerk.std...X	Numeric	Feature vector: body linear acceleration and angular velocity
X165.tBodyGyroJerk.std...Y	Numeric	Feature vector: body linear acceleration and angular velocity
X166.tBodyGyroJerk.std...Z	Numeric	Feature vector: body linear acceleration and angular velocity

X202.tBodyAccMag.std..	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X215.tGravityAccMag.std..	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X228.tBodyAccJerkMag.std..	Numeric	Feature vector: body linear acceleration and angular velocity
X241.tBodyGyroMag.std..	Numeric	Feature vector: angular velocity vector measured by the gyroscope
X254.tBodyGyroJerkMag.std..	Numeric	Feature vector: body linear acceleration and angular velocity
X269.fBodyAcc.std...X	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X270.fBodyAcc.std...Y	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X271.fBodyAcc.std...Z	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X348.fBodyAccJerk.std...X	Numeric	Feature vector: body linear acceleration and angular velocity
X349.fBodyAccJerk.std...Y	Numeric	Feature vector: body linear acceleration and angular velocity
X350.fBodyAccJerk.std...Z	Numeric	Feature vector: body linear acceleration and angular velocity
X427.fBodyGyro.std...X	Numeric	Feature vector: angular velocity vector measured by the gyroscope
X428.fBodyGyro.std...Y	Numeric	Feature vector: angular velocity vector measured by the gyroscope
X429.fBodyGyro.std...Z	Numeric	Feature vector: angular velocity vector measured by the gyroscope
X504.fBodyAccMag.std..	Numeric	Feature vector: acceleration signal from the smartphone accelerometer
X517.fBodyBodyAccJerkMag.std..	Numeric	Feature vector: body linear acceleration and angular velocity
X530.fBodyBodyGyroMag.std..	Numeric	Feature vector: angular velocity vector measured by the gyroscope
X543.fBodyBodyGyroJerkMag.std..	Numeric	Feature vector: body linear acceleration and angular velocity

Data Summaries Calculated:

- Mean

Units for Data Summaries and Variables:

- All units are standard Gravity Units (g)

Data Transformations:

- Data was downloaded from https://d396qusza40orc.cloudfront.net/getdata%2Fprojectfiles%2FUCI%20HAR%20Dataset.zip
- Files "features", "activity_labels", train files: "subject_train", "X_train", "y_train", test files: "subject_test", "X_test", "y_test" were imported into R studio.
- Factor labels were created and bound to "features", "activity_labels", "subject_test", and "subject_train" files.
- Columns were renamed for human readability.
- "train" and "test" data sets were merged together to create a final data set.
- The final data set was subset for variables representing the mean and standard deviation of the features.
- Barplots were created for each subject's activity showing the mean for features variables.