Code Book-Getting & Cleaning Data

Programming Assignment 04

The assignment uses the Human Activity Recognition Using Smartphones Dataset 1.0 , described below as base on which a script is built to get a tidy data set with a refined number of fields obtained after average statistics analysis carried on groups.

Description of original data set

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Human Activity Recognition Using Smartphones Dataset

Version 1.0

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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.

For each record it is provided:

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- Triaxial acceleration from the accelerometer (total acceleration) and the estimated body acceleration.

- Triaxial Angular velocity from the gyroscope.

- A 561-feature vector with time and frequency domain variables.

- Its activity label.

- An identifier of the subject who carried out the experiment.

The dataset includes the following files:

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- 'README.txt'

- 'features_info.txt': Shows information about the variables used on the feature vector.

- 'features.txt': List of all features.

- 'activity_labels.txt': Links the class labels with their activity name.

- 'train/X_train.txt': Training set.

- 'train/y_train.txt': Training labels.

- 'test/X_test.txt': Test set.

- 'test/y_test.txt': Test labels.

The following files are available for the train and test data. Their descriptions are equivalent.

- 'train/subject_train.txt': Each row identifies the subject who performed the activity for each window sample. Its range is from 1 to 30.

- 'train/Inertial Signals/total_acc_x_train.txt': The acceleration signal from the smartphone accelerometer X axis in standard gravity units 'g'. Every row shows a 128 element vector. The same description applies for the 'total_acc_x_train.txt' and 'total_acc_z_train.txt' files for the Y and Z axis.

- 'train/Inertial Signals/body_acc_x_train.txt': The body acceleration signal obtained by subtracting the gravity from the total acceleration.

- 'train/Inertial Signals/body_gyro_x_train.txt': The angular velocity vector measured by the gyroscope for each window sample. The units are radians/second.

Notes:

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- Features are normalized and bounded within [-1,1].

- Each feature vector is a row on the text file.

For more information about this dataset contact: activityrecognition@smartlab.ws

License:

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Use of this dataset in publications must be acknowledged by referencing the following publication [1]

[1] Davide Anguita, Alessandro Ghio, Luca Oneto, Xavier Parra and Jorge L. Reyes-Ortiz. Human Activity Recognition on Smartphones using a Multiclass Hardware-Friendly Support Vector Machine. International Workshop of Ambient Assisted Living (IWAAL 2012). Vitoria-Gasteiz, Spain. Dec 2012

Jorge L. Reyes-Ortiz, Alessandro Ghio, Luca Oneto, Davide Anguita. November 2012.

Description about the features in original data set

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'

Description of Assignment

The R script run_analysis. R achieves the following modifications on the original dataset:

1. Merges the training and the test sets to create one data set.
2. Extracts only the measurements on the mean and standard deviation for each measurement.
3. Uses descriptive activity names to name the activities in the data set
4. Appropriately labels the data set with descriptive variable names.
5. From the data set in step 4, creates a second, independent tidy data set with the average of each variable for each activity and each subject.

The following new files have been created:

-codebook.pdf: Modified Codebook

-answer.txt: Contains the modified dataset after step 5

-run_analysis.R: the R script which achieves the modification

-Readme: describes the functioning of R script in detail

Variable Description:

The final dataset contains 88 variables and 180 columns. Out of 88, 86 variable names have been retained from the original data set. They however represent values averaged over Activity done by the subject and the subject identity.

The two new variables are:

Activity: Describes the activity being done by the subject for which the record has been recorded. Character data type among 6 categories of “"LAYING", "SITTING", "STANDING", "WALKING, "WALKING_DOWNSTAIRS", "WALKING_UPSTAIRS"

Subject: Numerical data type in range 1-30, indicating the 30 subjects on which experiment was conducted.