Codebook_TidyDataProject

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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:

- 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:

- '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:

- 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:

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.

Code Reference

Code for Types of Activity (Ref: "activity_labels.txt")

```
1 WALKING
2 WALKING_UPSTAIRS
3 WALKING_DOWNSTAIRS
4 SITTING
5 STANDING
6 LAYING
```

Types of activity performed for each observation in training and test data are recorded in 'y_train.txt' and 'y_test.txt' respectively.

Code for Individual Subject (Ref: "subject_train.txt" and "subject_test.txt")

The individual subject performing training/test activity is identified by code number ranging from 0 to 30.

Feature Selection (Ref: "features_info.txt")

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' section below.

List of complete features (Ref: "features.txt")

1 tBodyAcc-mean()-X 2 tBodyAcc-mean()-Y 3 tBodyAcc-mean()-Z 4 tBodyAcc-std()-X 5 tBodyAcc-std()-Y 6 tBodyAcc-std()-Z 7 tBodyAcc-mad()-X 8 tBodyAcc-mad()-Y 9 tBodyAcc-mad()-Z 10 tBodyAcc-max()-X 11 tBodyAcc-max()-Y 12 tBodyAcc-max()-Z 13 tBodyAcc-min()-X 14 tBodyAcc-min()-Y 15 tBodyAcc-min()-Z 16 tBodyAcc-sma() 17 tBodyAcc-energy()-X 18 tBodyAcc-energy()-Y 19 tBodyAcc-energy()-Z 20 tBodyAcc-iqr()-X 21 tBodyAcc-iqr()-Y 22 tBodyAcc-iqr()-Z 23 tBodyAcc-entropy()-X 24 tBodyAcc-entropy()-Y 25 tBodyAcc-entropy()-Z 26 tBodyAcc-arCoeff()-X,1 27 tBodyAcc-arCoeff()-X,2 28 tBodyAcc-arCoeff()-X,3 29 tBodyAcc-arCoeff()-X,4 30 tBodyAcc-arCoeff()-Y,1 31 tBodyAcc-arCoeff()-Y,2 32 tBodyAcc-arCoeff()-Y,3

33 tBodyAcc-arCoeff()-Y,4 34 tBodyAcc-arCoeff()-Z,1 35 tBodyAcc-arCoeff()-Z,2 36 tBodyAcc-arCoeff()-Z,3 37 tBodyAcc-arCoeff()-Z,4 38 tBodyAcc-correlation()-X,Y 39 tBodyAcc-correlation()-X,Z 40 tBodyAcc-correlation()-Y,Z 41 tGravityAcc-mean()-X 42 tGravityAcc-mean()-Y 43 tGravityAcc-mean()-Z 44 tGravityAcc-std()-X 45 tGravityAcc-std()-Y 46 tGravityAcc-std()-Z 47 tGravityAcc-mad()-X 48 tGravityAcc-mad()-Y 49 tGravityAcc-mad()-Z 50 tGravityAcc-max()-X 51 tGravityAcc-max()-Y 52 tGravityAcc-max()-Z 53 tGravityAcc-min()-X 54 tGravityAcc-min()-Y 55 tGravityAcc-min()-Z 56 tGravityAcc-sma() 57 tGravityAcc-energy()-X 58 tGravityAcc-energy()-Y 59 tGravityAcc-energy()-Z 60 tGravityAcc-iqr()-X 61 tGravityAcc-iqr()-Y 62 tGravityAcc-iqr()-Z 63 tGravityAcc-entropy()-X 64 tGravityAcc-entropy()-Y 65 tGravityAcc-entropy()-Z 66 tGravityAcc-arCoeff()-X,1 67 tGravityAcc-arCoeff()-X,2 68 tGravityAcc-arCoeff()-X,3 69 tGravityAcc-arCoeff()-X,4 70 tGravityAcc-arCoeff()-Y,1 71 tGravityAcc-arCoeff()-Y,2 72 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