CodeBook for Week 3 Project

Getting and Cleaning Data Course Coursera

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Project summary Given a set of raw data files comprising of Samsung Galaxy S measurements, in two data sets (training and test) combine them and process them to a tidy dataset.

Then select the columns comprising mean or standard deviation data and average them by subject and group.

Further information on the data is at [http://archive.ics.uci.edu/ml/datasets/Human+Activity+Recognition+Using+Smartphones]

Raw Data Files The raw data is downloaded from the following url [http://archive.ics.uci.edu/ml/datasets/Human+Activity+Recognition+Using+Smartphones]

After unzipping it created a directory 'UCI HAR Dataset'

Task details The following is from the project task website

> You should create one R script called run_analysis.R that does the following.
>
> 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.

Code

My code is broken into steps as above plus step 0. However my steps are in a slightly different order from the task as I felt it was more logical (but for consistency I kept the original task step numbers).

Step 0 - Downloading raw data, unzipping and loading into R This is fairly self-explanatory from the code. I use the following variables:

activity_labels -this provides the label variables we will need later

features -this is the vector which contains the column labels for the X datasets

Steps 1,3,4 - Merge training and test sets, use descriptive activity names and label with descriptive variable names The two subdirectories (test and training) each contain 3 critical files - subject, X and Y These are loaded to *subject_test*, *x_test*, *y_test* or *subject_training*, *x_training* and *y_training* accordingly.

It is important to recognise that the final dataframe we want comprises a cbind of subject, y, x after the test and training datasets have gone through rbind. However the values in y need to be replaced with the values in *activity_labels*. (By *x*, *y* and *subject* I mean *x_test* and *x_training* etc)

The *features* vector contains the labels of the *x* datasets.

For step 4 I chose to use CamelCases. Furthermore I convert the leading 'f' to Freq, and the leading 'T' to Time. For further tidiness and to ensure that the column names are acceptable syntax in R we convert '-std()' to 'Std' and '-mean()' to 'Mean'. The exact code is here: (experimenting re inserting code!)

```
col_names <- names(data)
col_names <- gsub("^t","Time", col_names)
col_names <- gsub("^f","Freq", col_names)
col_names <- gsub("-std\\(\\)-|-std\\(\\)","Std",col_names)
col_names <- gsub("-mean\\(\\)-|-mean\\(\\)","Mean", col_names)

colnames(data) <- col_names
```

Step 2 - Extract only the measurements on the mean and the standard deviation for each measurement I chose to do this step relatively late in my code as it helped me understand what was going on by labelling the dataset first.

There is some discussion in the forums about whether this means we extract every occurrance of mean and standard deviation or only those where the label is mean() or std(). Based on the discussion in the forum I chose to chose only the latter option. See [https://class.coursera.org/getdata-011/forum/thread?thread_id=19]

My key decision is reflected in these line:

```
cols_to_select <- grep("[Mm]ean\\(\\)|-std\\(\\)", colnames(data))
data <- data[,c(1:2,cols_to_select)]
```

By changing the first of these two lines we could change the number of columns the code returns.

By using the above options I get 68 columns - of which 66 are the data from the X dataframes and the other two are subject (= the previous subject dataset) and activity (= the previous Y dataset). Others, by using more permissive searches for 'mean' and 'std' have obtained upto 79 columns (which I did before I looked at the data columns and decided to exclude columns such as 'angle(tBodyGyroJerkMean,gravityMean)')

Step 5 - Independent tidy data set with the average of each varible for each activity and each subject My interpretation of this is that this requires applying the mean function on a dataset that is grouped by both activity and subject. Hence given that there are 30 subjects, each of whom does 6 activities we will get 180 values which indeed the output dataset delivers.

The key lines of code are:

```
newdata <- group_by(data, Subject,Activity)
data_output <- summarise_each(newdata,funs(mean))
```

The dataset *data_output* is written to a file using write.table. I believe it is a tidy dataset as it has 180 rows (ie 30 subjects x 6 activities). There are 68 columns with each column representing the mean of a measured variable.

Code Book

Summary of input The input file files are explained in my text up. The mappings from eg tBodyAcc-mean()-z to TimeBodyAccMeanZ should be fairly obvious from the context. Nevertheless for completeness I list the input fields from the *features* file (at the end of this document) as they give the body of variables for the X data sets. The subject and y datasets are self explanatory from my explanations above.

(See end of document for input fields - put there to make it look tidier and more readable)

Summary of output The list below provides the variables that the code writes to 'tidy_data.txt'. The first variable *Subject* is the id for the subject. The second varible *Activity* describes the activity ("WALKING","WALKING_UPSTAIR","WALKING_DOWNSTAIRS","SITTING","STANDING","LAYING").

For all the other variables the data is the means of the Time or Freq based data from the accelerometer or gyroscope within the phone.

The following is the complete list of the variables (the variable number is for convenience only and not part of the variable name):

1 Subject

2 Activity

3 TimeBodyAccMeanX

4 TimeBodyAccMeanY

5 TimeBodyAccMeanZ

6 TimeBodyAccStdX

7 TimeBodyAccStdY

8 TimeBodyAccStdZ

9 TimeGravityAccMeanX

10 TimeGravityAccMeanY

11 TimeGravityAccMeanZ

12 TimeGravityAccStdX

13 TimeGravityAccStdY

14 TimeGravityAccStdZ

15 TimeBodyAccJerkMeanX

16 TimeBodyAccJerkMeanY

17 TimeBodyAccJerkMeanZ

18 TimeBodyAccJerkStdX

19 TimeBodyAccJerkStdY

20 TimeBodyAccJerkStdZ

21 TimeBodyGyroMeanX

22 TimeBodyGyroMeanY

23 TimeBodyGyroMeanZ

24 TimeBodyGyroStdX

25 TimeBodyGyroStdY

26 TimeBodyGyroStdZ
27 TimeBodyGyroJerkMeanX
28 TimeBodyGyroJerkMeanY
29 TimeBodyGyroJerkMeanZ
30 TimeBodyGyroJerkStdX
31 TimeBodyGyroJerkStdY
32 TimeBodyGyroJerkStdZ
33 TimeBodyAccMagMean
34 TimeBodyAccMagStd
35 TimeGravityAccMagMean
36 TimeGravityAccMagStd
37 TimeBodyAccJerkMagMean
38 TimeBodyAccJerkMagStd
39 TimeBodyGyroMagMean
40 TimeBodyGyroMagStd
41 TimeBodyGyroJerkMagMean
42 TimeBodyGyroJerkMagStd
43 FreqBodyAccMeanX
44 FreqBodyAccMeanY
45 FreqBodyAccMeanZ
46 FreqBodyAccStdX
47 FreqBodyAccStdY
48 FreqBodyAccStdZ
49 FreqBodyAccJerkMeanX
50 FreqBodyAccJerkMeanY
51 FreqBodyAccJerkMeanZ
52 FreqBodyAccJerkStdX
53 FreqBodyAccJerkStdY
54 FreqBodyAccJerkStdZ
55 FreqBodyGyroMeanX
56 FreqBodyGyroMeanY
57 FreqBodyGyroMeanZ
58 FreqBodyGyroStdX
59 FreqBodyGyroStdY
60 FreqBodyGyroStdZ
61 FreqBodyAccMagMean

62 FreqBodyAccMagStd

63 FreqBodyBodyAccJerkMagMean

64 FreqBodyBodyAccJerkMagStd

65 FreqBodyBodyGyroMagMean

66 FreqBodyBodyGyroMagStd

67 FreqBodyBodyGyroJerkMagMean

68 FreqBodyBodyGyroJerkMagStd

Listing of original input variables The original input features list (which gives the variable names for X) is below: (In order to save space not very neat)

```
V1                                    V2
```

1 1 tBodyAcc-mean()-X 2 2 tBodyAcc-mean()-Y 3 3 tBodyAcc-mean()-Z 4 4 tBodyAcc-std()-X 5 5 tBodyAcc-std()-Y 6 6 tBodyAcc-std()-Z 7 7 tBodyAcc-mad()-X 8 8 tBodyAcc-mad()-Y 9 9 tBodyAcc-mad()-Z 10 10 tBodyAcc-max()-X 11 11 tBodyAcc-max()-Y 12 12 tBodyAcc-max()-Z 13 13 tBodyAcc-min()-X 14 14 tBodyAcc-min()-Y 15 15 tBodyAcc-min()-Z 16 16 tBodyAcc-sma() 17 17 tBodyAcc-energy()-X 18 18 tBodyAcc-energy()-Y 19 19 tBodyAcc-energy()-Z 20 20 tBodyAcc-iqr()-X 21 21 tBodyAcc-iqr()-Y 22 22 tBodyAcc-iqr()-Z 23 23 tBodyAcc-entropy()-X 24 24 tBodyAcc-entropy()-Y 25 25 tBodyAcc-entropy()-Z 26 26 tBodyAcc-arCoeff()-X,1 27 27 tBodyAcc-arCoeff()-X,2 28 28 tBodyAcc-arCoeff()-X,3 29 29 tBodyAcc-arCoeff()-X,4 30 30 tBodyAcc-arCoeff()-Y,1 31 31 tBodyAcc-arCoeff()-Y,2 32 32 tBodyAcc-arCoeff()-Y,3 33 33 tBodyAcc-arCoeff()-Y,4 34 34 tBodyAcc-arCoeff()-Z,1 35 35 tBodyAcc-arCoeff()-Z,2 36 36 tBodyAcc-arCoeff()-Z,3 37 37 tBodyAcc-arCoeff()-Z,4 38 38 tBodyAcc-correlation()-X,Y 39 39 tBodyAcc-correlation()-X,Z 40 40 tBodyAcc-correlation()-Y,Z 41 41 tGravityAcc-mean()-X 42 42 tGravityAcc-mean()-Y 43 43 tGravityAcc-mean()-Z 44 44 tGravityAcc-std()-X 45 45 tGravityAcc-std()-Y 46 46 tGravityAcc-std()-Z 47 47 tGravityAcc-mad()-X 48 48 tGravityAcc-mad()-Y 49 49 tGravityAcc-mad()-Z 50 50 tGravityAcc-max()-X 51 51 tGravityAcc-max()-Y 52 52 tGravityAcc-max()-Z 53 53 tGravityAcc-min()-X 54 54 tGravityAcc-min()-Y 55 55 tGravityAcc-min()-Z 56 56 tGravityAcc-sma() 57 57 tGravityAcc-energy()-X 58 58 tGravityAcc-energy()-Y 59 59 tGravityAcc-energy()-Z 60 60 tGravityAcc-iqr()-X 61 61 tGravityAcc-iqr()-Y 62 62 tGravityAcc-iqr()-Z 63 63 tGravityAcc-entropy()-X 64 64 tGravityAcc-entropy()-Y 65 65 tGravityAcc-entropy()-Z 66 66 tGravityAcc-arCoeff()-X,1 67 67 tGravityAcc-arCoeff()-X,2 68 68 tGravityAcc-arCoeff()-X,3 69 69 tGravityAcc-arCoeff()-X,4 70 70 tGravityAcc-arCoeff()-Y,1 71 71 tGravityAcc-arCoeff()-Y,2 72 72 tGravityAcc-arCoeff()-Y,3 73 73 tGravityAcc-arCoeff()-Y,4 74 74 tGravityAcc-arCoeff()-Z,1 75 75 tGravityAcc-arCoeff()-Z,2 76 76 tGravityAcc-arCoeff()-Z,3 77 77 tGravityAcc-arCoeff()-Z,4 78 78 tGravityAcc-correlation()-X,Y 79 79 tGravityAcc-correlation()-X,Z 80 80 tGravityAcc-correlation()-Y,Z 81 81 tBodyAccJerk-mean()-X 82 82 tBodyAccJerk-mean()-Y 83 83 tBodyAccJerk-mean()-Z 84 84 tBodyAccJerk-std()-X 85 85 tBodyAccJerk-std()-Y 86 86 tBodyAccJerk-std()-Z 87 87 tBodyAccJerk-mad()-X 88 88 tBodyAccJerk-mad()-Y 89 89 tBodyAccJerk-mad()-Z 90 90 tBodyAccJerk-max()-X 91 91 tBodyAccJerk-max()-Y 92 92 tBodyAccJerk-max()-Z 93 93 tBodyAccJerk-min()-X 94 94 tBodyAccJerk-min()-Y 95 95 tBodyAccJerk-min()-Z 96 96 tBodyAccJerk-sma() 97 97 tBodyAccJerk-energy()-X 98 98 tBodyAccJerk-energy()-Y 99 99 tBodyAccJerk-energy()-Z 100 100 tBodyAccJerk-iqr()-X 101 101 tBodyAccJerk-iqr()-Y 102 102 tBodyAccJerk-iqr()-Z 103 103 tBodyAccJerk-entropy()-X 104 104 tBodyAccJerk-entropy()-Y 105 105 tBodyAccJerk-entropy()-Z 106 106 tBodyAccJerk-arCoeff()-X,1 107 107 tBodyAccJerk-arCoeff()-X,2 108 108 tBodyAccJerk-arCoeff()-X,3 109 109 tBodyAccJerk-arCoeff()-X,4 110 110 tBodyAccJerk-arCoeff()-Y,1 111 111 tBodyAccJerk-arCoeff()-Y,2 112 112 tBodyAccJerk-arCoeff()-Y,3 113 113 tBodyAccJerk-arCoeff()-Y,4 114 114 tBodyAccJerk-arCoeff()-Z,1 115 115 tBodyAccJerk-arCoeff()-Z,2 116 116 tBodyAccJerk-arCoeff()-Z,3 117 117 tBodyAccJerk-arCoeff()-Z,4 118 118 tBodyAccJerk-correlation()-X,Y 119 119 tBodyAccJerk-correlation()-X,Z 120 120 tBodyAccJerk-correlation()-Y,Z 121 121 tBodyGyro-mean()-X 122 122 tBodyGyro-mean()-Y 123 123 tBodyGyro-mean()-Z 124 124 tBodyGyro-std()-X 125 125 tBodyGyro-std()-Y

126 126 tBodyGyro-std()-Z 127 127 tBodyGyro-mad()-X 128 128 tBodyGyro-mad()-Y 129 129 tBodyGyro-mad()-Z 130 130 tBodyGyro-max()-X 131 131 tBodyGyro-max()-Y 132 132 tBodyGyro-max()-Z 133 133 tBodyGyro-min()-X 134 134 tBodyGyro-min()-Y 135 135 tBodyGyro-min()-Z 136 136 tBodyGyro-sma() 137 137 tBodyGyro-energy()-X 138 138 tBodyGyro-energy()-Y 139 139 tBodyGyro-energy()-Z 140 140 tBodyGyro-iqr()-X 141 141 tBodyGyro-iqr()-Y 142 142 tBodyGyro-iqr()-Z 143 143 tBodyGyro-entropy()-X 144 144 tBodyGyro-entropy()-Y 145 145 tBodyGyro-entropy()-Z 146 146 tBodyGyro-arCoeff()-X,1 147 147 tBodyGyro-arCoeff()-X,2 148 148 tBodyGyro-arCoeff()-X,3 149 149 tBodyGyro-arCoeff()-X,4 150 150 tBodyGyro-arCoeff()-Y,1 151 151 tBodyGyro-arCoeff()-Y,2 152 152 tBodyGyro-arCoeff()-Y,3 153 153 tBodyGyro-arCoeff()-Y,4 154 154 tBodyGyro-arCoeff()-Z,1 155 155 tBodyGyro-arCoeff()-Z,2 156 156 tBodyGyro-arCoeff()-Z,3 157 157 tBodyGyro-arCoeff()-Z,4 158 158 tBodyGyro-correlation()-X,Y 159 159 tBodyGyro-correlation()-X,Z 160 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meanFreq()-Z 297 297 fBodyAcc-skewness()-X 298 298 fBodyAcc-kurtosis()-X 299 299 fBodyAcc-skewness()-Y 300 300 fBodyAcc-kurtosis()-Y 301 301 fBodyAcc-skewness()-Z 302 302 fBodyAcc-kurtosis()-Z 303 303 fBodyAcc-bandsEnergy()-1,8 304 304 fBodyAcc-bandsEnergy()-9,16 305 305 fBodyAcc-bandsEnergy()-17,24 306 306 fBodyAcc-bandsEnergy()-25,32 307 307 fBodyAcc-bandsEnergy()-33,40 308 308 fBodyAcc-bandsEnergy()-41,48 309 309 fBodyAcc-bandsEnergy()-49,56 310 310 fBodyAcc-bandsEnergy()-57,64 311 311 fBodyAcc-bandsEnergy()-1,16 312 312 fBodyAcc-bandsEnergy()-17,32 313 313 fBodyAcc-bandsEnergy()-33,48 314 314 fBodyAcc-bandsEnergy()-49,64 315 315 fBodyAcc-bandsEnergy()-1,24 316 316 fBodyAcc-bandsEnergy()-25,48 317 317 fBodyAcc-bandsEnergy()-1,8 318 318 fBodyAcc-bandsEnergy()-9,16 319 319 fBodyAcc-bandsEnergy()-17,24 320 320 fBodyAcc-bandsEnergy()-25,32 321 321 fBodyAcc-bandsEnergy()-33,40 322 322 fBodyAcc-bandsEnergy()-41,48 323 323 fBodyAcc-bandsEnergy()-49,56 324 324 fBodyAcc-bandsEnergy()-57,64 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