

MSPR 9 Clustering Exercises (Due: 1.1.2015, 12 p.m. (noon))

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1. (Feedback) Please give us feedback on the last lecture and homework:
<http://goo.gl/forms/gdH0hxSsSR> Thanks!
2. Listen to the file `panos_beatboxing_1.wav`. How many different voice sounds can you hear? Load the matlab data `audiosegments.mat`, the result of an **music information retrieval analysis** of `panos_beatboxing_1.wav`. Onset detection has been applied to the sound file.¹ The resulting first 30 segments are cells in the cell array `sndseg` and can be played with `soundsc(sndseg{i},sr)`. The timbre of each segment is represented by a 13 dimensional vector² in the matlab 30×13 matrix `mfcc`. Apply clustering to detect the different sound classes automatically.³
 - (a) Perform linkage on the MFCCs and plot the dendrogram. Listen to the sound segments, in order to find out at which height to cut the dendrogram. How many clusters did you choose? In the function `dendrogram`, use the attribute `'colorthreshold'` to color the different branches of the dendrogram differently according the clusters you chose. (20 P)
 - (b) Apply the **variance ratio criterion** to determine the number of clusters automatically. Use `'linkage'` as an attribute in the respective Matlab function. How does the result of automatically detecting the number of clusters relate to the number of clusters you found previously? (15 bonus points)
 - (c) Perform k means with an appropriate number of clusters and plot the first two MFCC components in a scatter plot, coloring the points according to their classes. (15 P)
 - (d) Plot also the results from the agglomerative clustering in a different scatter plot. Compare the two clusterings. What problems do you encounter when comparing the two? (15 bonuspoints).

¹using the **MIRToolbox**,
<https://www.jyu.fi/hum/laitokset/musiikki/en/research/coe/materials/mirtoolbox>

²To be more precise: average mel frequency cepstrum coefficients (MFCCs) from a small window at the beginning of the segment. To be unprecise, MFCCs are sort of the eigenvalues to the most important eigenvectors of the frequency content of the sound, see e.g. <http://www.practicalcryptography.com/miscellaneous/machine-learning/guide-mel-frequency-cepstral-coefficients-mfccs/>.

³The details of the context of this task (not directly relevant to solve this assignment) you can find in Marchini and Purwins. An Unsupervised System for the Synthesis of Variations from Audio Percussion Patterns. In 7th International Symposium on Computer Music Modeling and Retrieval (CMMR), 27778, 2010. <http://www.mtg.upf.edu/node/3057>

3. Self Assessment: Check the exercises that you have seriously worked on.

2a	2b	2c	2d