Technische Universität Braunschweig
Institut für Informationssysteme
http://www.ifis.cs.tu-bs.de

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Exercises for Multimedia Databases

Sheet 4 (by 27.06.2013)

Exercises have to be turned in by **Thursday** before the next lecture and should be completed in teams of two students each. Write both names and "Matrikelnummer" on each page. If you have multiple pages, staple them together! Please hand in your solutions on **paper** into the mailbox at the IFIS floor or to our secretary (Mühlenpfordtstraße 23, 2nd floor). You may answer in either German or English.

Exercise 1: Audio Low level Features (15P)

a) Please enumerate 4 typical audio low level features, and describe them shortly. (2P)
b) What is a spectrogram and how can we use it besides searching for cat images in songs? (1P)
c) How can we differentiate between music and speech? (2P)
d) Use the "Lu Hankinson" algorithm provided in the lecture to classify the sounds provided in the "audio.zip" archive, linked in the exercise section. Explain the classification. (Read the note section). (10P)

Exercise 2: Pitch recognition (5P)

a) What is pitch, what is a harmonic and how are they connected? (2P)
b) How can we determine the pitch of a sound? (1P)
c) What is Auto Correlation Function and why does it work for pitch tracking? (2P)

Exercise 3: Representation (10P)

Parsons code:

d) What is the Parsons code representation method? (1P)
e) How is matching with Parsons code performed and why can't we do note to note matching? (2P)
f) What is the cost matrix and why do we need it? (1P)
g) Why should it be cheaper to replace R with U or D than replacing U with D or D with U? (2P)
h) On which assumption can we optimize the minimum cost path finding algorithm, and how do we do that? (2P)

Frame based representation:

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a) What are the advantages of frame based representation? (1P)
b) What is Dynamic Time Warping and why do we need it? (1P)

Exercise 4: Hidden Markov Models (7P)

Considering the 5 elements of HMM, presented in lecture 8 in slides 72 and 73 and further discussed in lecture 9, draw a HMM (together with the ADSR representation of a note and corresponding observations), and explain each of these 5 elements.

NOTE for exercise 1.d): You can use the starter kit provided in the exercise section. For the bandwidth and brightness provide the plotted figures for the wave and frequency of all 3 figures. For the silence feature, provide a histogram of each of the 3, each with 100 bins. The silence in the histogram will be represented by the first bin (representing the smallest amplitudes). For the zero crossing features provide the value calculated for each of the 3 sounds. Classify according to the algorithm, but provide on paper also the above mentioned intermediate results, even if the algorithm would indicate a stop.