Pattern recognition system
Exercise Project

Report Assignment n°4

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I Code verification

I.1 Errors in the forward algorithm

To correct the code of the forward algorithm, we first tried to run it with the inputs provided page 240. We were able to correct a few systax mistakes afterwards.
Then, we went throught it with the textbook to figure out which lines correspond to which step. By doing this we found out mistakes like b(t,j) instead of b(j,t) ; Useless computation of a variable c_z ;
The first test that passed consisted in finding the same vector c than the textbook page 240. Then, we tried the forward algorithm with our own database and figure out that the computation of c_{T+1} was set up to work with the example in the textbook.
The next test consisted in using the algorithm on our entire database. No unlikely values appeared so we can reasonably assume that the forward algorithm is working.

I.2 Consequences

Run time errors

These errors can cause a dramatic drop in the performance of our song recognition system. But the biggest problem of computing useless calculations is that it is slightly impossible to find after a couple of weeks and the algorithm will be desperatly slow.

Syntax errors

It is not the biggest problem in an algorithm since the compiler is capable of finding and locating them. Running the code on any data is enough to correct the mistakes. Thus, they doesn't have a long living time.

Logical flows

This can cause calculation issues in recursive algorithms. If a sequence (u_n) such that $u_{n+1} = f(u_n)$ starts with the wrong value u_0 the final result is wrong. In our case the algorithm uses different variables inter correlated for each recursive step so if the variable are not computed in the right order, the final result will be wrong. This kind of errors had been found by reading the code and the textbook in parallel. In some particular cases, the result cas be good and the code can be validated with the error if the tests are not chose carefuly.

II Song Database

For this assignment we have constituted a song database on which try and train our HMM. As our feature extractor is based on the pitch of the note, we have choosen to hum the songs of the database. Also, our feature extractor uses an offset of semitons so we have tried to focus on songs which have a well defined melody. The songs we have chosen are :

- Au Clair de la Lune
- Highway to hell - ACDC
- House of the rising sun - Animals
- Concerning Hobbits - The lord of the ring
- Satisfaction - Rolling stones
- California Dreaming - The Mamas and the Papas
- La Marseillaise - French National Anthem
- I get around - Beach Boys
- Hit the road jack - Ray Charles
- Horse with no name - America
- Smoke on the water - Deep purple
- Trio n°2 in E-flat major - Schubert

Each one of these songs have been recorded by both members of the project groupe, 8 times each. The recordings were done on a computer, in a quiet environment and we chose a sample rate of 44100Hz [1]. We have tried to vary significantly the way we were humming the songs in the different recordings so that our HMM is more robust. For example, we have transposed the song in different ways along the recordings. We want our song recognizer to adapt at every people tone. In each folder, you will find a .mat file containing the hmm trained on the database that we have so far.

As we are one male and one female in the project group, we assume that our HMM should be able to recognize a song sang by both a man and a woman.

1. The textbook mentions 22050Hz. If the computing time become a problem we will undersample the files.