Project: Beat Detection Algorithm Implementation

In this project you are allowed to group up as 2. You are expected to implement a rather detailed (compared to homeworks) DSP application.

You are expected to implement two different beat detection algorithms and use them on given songs to predict the BPM of the music. You can assume the given songs will only contain a single BPM, meaning you can assume the BPM will not vary throughout the song.

List of song information:
sevdacicegi.wav sample rate 44100 Hz, stereo, 114.5 BPM
dudu.wav sample rate 44100 Hz, stereo, 91.0 BPM
beat.wav sample rate 44100 Hz, stereo, 60.0 BPM
aleph.wav sample rate 44100 Hz, stereo, 81.0 BPM

Song files download link:
https://drive.google.com/drive/folders/1hdU4vXO6GNXLpZnjhze3lEzCms5hJlPe?usp=drive_link

We will call the two algorithms algorithm 1 and algorithm 2 for convenience. Links for the descriptions of these algorithms:

Algorithm 1:
https://archive.gamedev.net/archive/reference/programming/features/beatdetection/default.html

Algorithm 2:
https://archive.gamedev.net/archive/reference/programming/features/beatdetection/page2.html

- You can use any of the MATLAB functions as long as you are implementing the two algorithms.
- You can also use external sources for information (as long as you give a reference).
- You are also encouraged to discuss these algorithms with other people, as long as your report and your code belongs to you.
- Since these algorithms are prone to error, if your code fails to predict correct bpm or fails by a small mistake, it's okay as long as the algorithm is implemented properly.
- Descriptions of algorithms might be using stereo or mono audio. However, you should be able to adapt the algorithms if you want to use one or the other. We will give you stereo audio files, however, it should be easy to convert them to mono if you prefer to do it that way.
- Reporting half or twice the bpm is okay. Since they both can be considered the bpm of the music

In both of the pages, you will see some optimizations on algorithms. Therefore you might be asking which one you should actually implement:

<u>For algorithm 1 (pick only one of the following)</u>
- If you implement **Simple sound energy algorithm #1**, you will get 40 points.
- If you implement **Frequency selected sound energy algorithm #1**, you will get 50 points

<u>For algorithm 2 (pick only one of the following)</u>
- If you implement **Derivation and Combfilter algorithm #1**, you will get 40 points.
- If you implement **Frequency selected processing combfilters algorithm #1:**, you will get 50 points

In your report, please clarify which one of these variants you are implementing.

In your submissions:

- Provide a pdf report that contains:
  - Your name, your student id (if you are a group of 2, both of your names and ids).
  - A section (for both algorithms) where you briefly discuss and explain your code segments, explain important parts of the code by referring to the algorithm at hand.
  - A results section where you share your results for each of the given songs and each of the algorithms. Explain how you are reaching a prediction (selecting the correct bpm). If you implemented both of them, compare the performance of the two algorithms for given songs. Does the accuracy of your results differ depending on the song type? You are also free to try your algorithm on other songs of your choosing, aside from the given songs.
  - A brief conclusion section where you provide some feedback to yourself. Comment on shortcomings, potential bugs, ideas on improvement and exciting points etc.
  - Cite your resources if you've used external resources.
- Provide your code as two files, named *algorithm1.m* and *algorithm2.m*.
  - Each code file should produce a single prediction for a single input audio file using the corresponding algorithm.
  - Structure your code so that I can easily change the name and path of the input file in the beginning of your code. You don't need to make a console interface or GUI.
  - I will expect your code to output the predicted bpm in the MATLAB command window (format is not very important as long as output is readable since I will manually check it).
  - If, due to some reason, you are unable to make a single prediction but have made some progress, please explain this situation in your report.
- You don't need to reupload given audio files. We already have them.
- If your project file exceeds Moodle upload limit, you can provide a download link in a txt file. (I should be able to see the "Last Modified" information on this link, due to the deadline.)
- If you are a group of two, only one submission is sufficient.