

Programming 1 - M1S1 - 2020

Project 03: Analyse and understand

Read Audio Files, analyse them by plotting the data and classify

In the git folder used for all our classes, you can now find and download a folder named “project03-01”.

Data Description:

The audio files are of varying lengths, most of them between 5 second and 10 seconds.

If you listen to all of them you will realize easily that they correspond to heart sound. Most information in heart sounds is contained in the low frequency components, with noise in the higher frequencies. It is common to apply a low-pass filter at 195 Hz. Fast Fourier transforms are also likely to provide useful information about volume and frequency over time. Precision about the difference between the categories of sounds is:

Normal Category: normal, healthy heart sounds. A normal heart sound has a clear “lub dub, lub dub” pattern, with the time from “lub” to “dub” shorter than the time from “dub” to the next “lub” (when the heart rate is less than 140 beats per minute). Note the temporal description of “lub” and “dub” locations over time in the following illustration:

```
###lub#####dub##### lub#####dub##### lub#####dub#####
```

Murmur Category: Heart murmurs sound as though there is a “whooshing, roaring, rumbling, or turbulent fluid” noise in one of two temporal locations. There will still be a “lub” and a “dub”. One of the things that confuses non-medically trained people is that murmurs happen *between* lub and dub or *between* dub and lub; not *on* lub and not *on* dub. illustration:

```
###lub ***** dub##### lub*****dub##### lub*****dub#####
or
###lub#####dub***** lub#####dub***** lub#####dub*****
```

Extra Heart Sound Category: Extra heart sounds can be identified because there is an additional sound, e.g. a “lub-lub dub” or a “lub dub-dub”.

```
###lub lub#####dub##### lub lub#####dub##### lub lub#####dub#####
or
###lub##### dub dub##### lub##### dub dub##### lub#####dub dub ##
```

Artifact Category: Wide range of different sounds, including feedback squeals and echoes, speech, music and noise. There are usually no discernable heart sounds, and thus little or no temporal periodicity at frequencies below 195 Hz. This category is the most different from the others. It is important to be able to distinguish this category from the other three categories, so that someone gathering the data can be instructed to try again.

Extrasystole Category: Extrasystole sounds may appear occasionally and can be identified because there is a heart sound that is out of rhythm involving extra or skipped heartbeats, e.g. a “lub-lub dub” or a “lub dub-dub”. (This is not the same as an extra heart sound as the event is not regularly occurring.)

###lub#####dub##### lub#####dub##### lub lub#####dub#####

or

###lub#####dub##### lub#####dub dub ##### lub #####dub#####

This Challenge will be divided into many parts before the phase of data science :

You have now 12 audio WAV files, and 6 categories (the 6th category is not described above is the unlabelled audio file) because cannot be one of the above categories.

Part 1:

You need to build a notebook that,

Read the audio files,

Extract the data (you may need to filter the different audio or not is up to you to decide)

Plot the data and analyse them (describe the data)

Classify Visually/Manually and after the description of the plot the different files.

Part 2:

Create a new version of your notebook that can read a set of audio files and classify them automatically.