Test Bioelectrics team:

December 15, 2017

1 Introduction:

This exercice is proposed by Bioelectrics team. The goal here is to see how the candidate is able to construct a reasoning, justify the choices he takes in each step and analyze the results. Kindly send back your answers: report + code to mohcine.heddi@bioserenity.com.

2 Epileptic Seizure Detection:

In this section, we will try to implement a basic patient specific epileptic seizure detection algorithm using the data from patient 1 of the CHB MIT database. You will find enclosed to this report csv files containing 8 recordings of this patient.
Patient 1 is an 11 years old female patient. The brain activity of the patient has been acquired using the international 10-20 system of scalp EEG electrode positions (as the one described in figure 1) mounted as bipolar. The bipolar montage means that adjacent electrodes are linked along longitudinal or transverse lines. Hence we have two electrodes per one channel, so we have a reference electrode for each channel in contrast with the referential montage that uses a common reference electrode for all the channels.

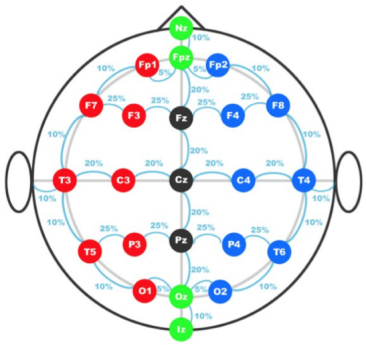

Figure 1: 10/20 system electrode distances.

2.1 Question 1: Database construction

Every rec_x.csv file represents a record signal. Column 'label' gives you the labels for each timestamp. label 1 means that is it s a seizure event and label 0 means none-seizure events. Describe how you would construct your training and test set.

2.2 Question 2: Feature extraction

Here we propose a feature extraction based on the power spectral density. Given one record, how would you perform such feature generation (you can calculate the power spectral density over 5 different frequency bands : 0.5-4Hz, 4-8Hz, 8-16Hz, 16-32Hz and 32-50Hz). Can you propose any other method/approach to generate relevant features?

2.3 Question 3: Classification task

Describe how you would use the extracted features to perform a classification task. Make sure to describe precisely which classifier you choose, and how you evaluate the performance of your classification.

2.4 Question 4: Going further

Propose any other approach/method for epileptic seizure detection.

3 Understanding machine learning algorithms:

Machine learning studies the algorithms that can learn and make predictions. These algorithms can be either interpretable or not. Interpretable classifiers are really shallow: a decision tree for instance, but once we try to go deeper in the feature generation process (to increase the performance) it becomes more difficult to understand the classifier's behaviour. In particular, Deep Learning approaches are famously "black box" algorithms and are used in a wide range of applications: computer vision, speech recognition, medicine, finance and others.
Please present an approach that you could use to make a Deep Learning algorithm more humanly interpretable.