German University in Cairo
Faculty of Media Engineering and Technology
Spring 2020

CSEN 1099 – Introduction to Biomedical Engineering

Assignment #1

(Due on: March 23, 2020 at mid-night)

(This assignment can be done in teams of maximum 2 students – Please include a text files with your names and IDs in the submission)

Problem 1

Implement the QRS detection method given in Lecture 5. Your function should take as inputs the ECG signal to process and the moving average window size *N* mentioned on slide 22. The function should return a vector that contains the timestamps of the R wave and a vector that contains the corresponding RR intervals (Slide 24). Apply your function to the ECG signal provided in the file "DataN.txt". The sampling rate of this ECG signal is 256 Hz. You will need to suggest a method to compute the threshold needed for detection.

Deliverables:

- Your code
- A figure showing the first 2000 samples of the ECG signal before and after noise filtering. Name the figure "Before_After_Filter.jpg".
- A figure showing the first 2000 samples of the ECG signal with an "*" marking the detected R waves for *N* = 5. Name the figure "DetectedR_5.jpg"
- A figure showing the first 2000 samples of the ECG signal with an "*" marking the detected R waves for *N* = 15. Name the figure "DetectedR_15.jpg"
- A figure showing the first 2000 samples of the ECG signal with an "*" marking the detected R waves for *N* = 25. Name the figure "DetectedR_25.jpg"
- What can you conclude about the optimal setting of *N*? Explain your answer.
- A figure showing the first 2000 samples of the ECG signal with an "*" marking the detected R waves for N = 25 but without noise filtering. Name the figure "Unfiltered_25.jpg".
- A plot of the RR intervals with Beat number on the x-axis and RR interval in msec on the y-axis in the case of *N* = 25. Name the figure "RR.jpg"

Problem 2

The ECG of a patient with Sinus Arrest is provided in the file "Data2.txt". Implement a function that you can use to find the timestamps at which a beat should have been recorded (missing beats). The function should take as inputs the ECG signal to process and the moving average window size *N*. Your function could make use of the function you implemented in Problem 1. The function should return the timestamps of missing beats. Apply your function to the ECG signal provided in the file "Data2.txt" with the best *N* obtained from Problem 1. The sampling rate is 256 Hz.

Deliverables:

- Your code
- A text file that shows the timestamps of missing beat(s) (the sample number at which the R wave should have been present). Name your file "MissingBeats.txt"