The American University in Cairo
Computer Science and Engineering Department
Fall 2022

CSCE 363/3611 – Digital Signal Processing

Project

(Due on: December 11, 2022 at mid-night)
(Submit on Blackboard as one .zip file)

Project Title: Finding Heart Rate from ECG Signals and Identifying Missing Beats for Sinus Arrest Patients

This project consists of two parts as follows:

Part 1: Detecting ECG R-waves

Implement the QRS detection method given in the attached File (ECG Processing.pdf). Your function should take as inputs the ECG signal to process and the moving average window size *N* mentioned on slide 12. The function should return a vector that contains the timestamps of the R wave and a vector that contains the corresponding RR intervals (Slide 14). 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 1500 samples of the ECG signal before and after noise filtering.
- A figure showing the first 1500 samples of the ECG signal with an "*" marking the detected R waves for N = 10.
- A figure showing the first 1500 samples of the ECG signal with an "*" marking the detected R waves for N = 15.
- A figure showing the first 1500 samples of the ECG signal with an "*" marking the detected R waves for N = 25.
- What can you conclude about the optimal setting of N? Explain your answer.
- A figure showing the first 1500 samples of the ECG signal with an "*" marking the detected R waves for N = 25 but without noise filtering.
- 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.

Part 2: Sinus Arrest Missing Beats Detection

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

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N. Your function could make use of the function you implemented in Part 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 Part 1. The sampling rate is 256 Hz.

Deliverables:

- Your code
- The timestamps of missing beat(s) (the sample number at which the R wave should have been present).

Submission:

- Your MATLAB or Python code to be submitted on Blackboard on **December 11 at mid-night**
- A report (to be submitted on Blackboard on **December 11 at mid-night**) that includes the following:
  - Description of the approach used
  - Output figures as described in Part 1
  - Timestamp of missing beats in Part 2
- Submission of the above items should be done as one .zip file by the deadline

Guidelines:

- This is a group project. A maximum of 3 students per group is allowed.
- Each team must send an e-mail by **Sunday, November 20 at mid-night** specifying the members of the team.
- **Changing teams will not be allowed**.
- Project evaluation will occur in the class of **December 12.**
- Project grading will be as follows (out of 15):
  - 5 points on the code submitted
  - 5 points on the submitted report
  - 5 points on the evaluation and discussion