Ain Shams University
Faculty of Engineering
Computer & Systems Eng. Dept.
1st Term 2018-2019

CSE 462 – Biomedical Engineering

Assignment #1

(Due on: Sunday, November 25 at mid-night)

Problem 1

One method that can be used to find the heart rate from ECG signals is to use Autocorrelation of the processed ECG signals. The steps of the method are as follows:

1 – Find the derivative of the ECG signal using the 5-point difference equation provided in Slide 20 of Lecture 5.pdf

2 – Square the derivative similar to what is explained in Slide 21 of Lecture 5.pdf

3 – Smooth the squared signal using a moving average window of size 31 samples as explained in Slide 22 of Lecture 5.pdf

4 – Compute the Autocorrelation of the obtained signal using the following expression:

$$A(m) = \sum_{i=1}^{n} x(i)x(i-m)$$

where n is the number of samples in the ECG signal and m is the lag. The average time between beats can be obtained as the time at which the autocorrelation achieves its first peak after the peak at 0 lag.

Apply your code to the provided file "Data1.txt". The sampling rate of this ECG signal is 512Hz.

Deliverables:

- Your code
- A figure showing the first 2000 samples of the ECG signal after step 3 above. Name the figure "Squared.jpg"
- A plot of the autocorrelation showing the lag on the x-axis and the autocorrelation value on the y-axis. Name the figure "AutoCorr1.jpg"
- A text file that shows the average heart rate as computed from the autocorrelation.

Problem 2

The ECG of a patient with Atrial Fibrillation is provided in the file "Data2.txt". Apply the function you implemented in Problem 1 to this dataset with a moving average window of size 31 samples.

Deliverables:

- A plot of the autocorrelation showing the lag on the x-axis and the autocorrelation value on the y-axis. Name the figure "AutoCorr2.jpg"
- A text file that contains your observation about the autocorrelation of this dataset compared to that of the normal ECG of Problem 1. Suggest a measure that can be computed from the autocorrelation that increases as the amount of Atrial Fibrillation increases.
- The code you wrote to test the measure you suggested
- A text file that shows the value of the suggested measure for the dataset of this problem and that of Problem 1