

Health Informatics Practical #1

Instructions:

This group assignment is expected to **require 2-6 hours to complete**. Please plan accordingly.

Due Date: TBD

Submission Files: the signed HONOR CODE page (see HONOR CODE page), and one zipped program folder file (i.e., containing all code files)

Email Address: 8813grading@lists.gatech.edu

Email Protocol: In your email subject line, please follow the following protocol
BMED8813 your last name, your first name, PRACTICAL #1

Programming File Protocol:

- (1) Your submission will be one zipped folder file. The folder should contain all of the necessary files (i.e., the main program file, possible additional function files, and necessary test data files) to run your code and show the results.
- (2) The folder should be named: **<your last name>_<your first name initial>**
For example, if your family name is Wang, and your first name initial is M, the zipped folder file will be: **Wang_M.zip**
- (3) In your folder, the main file should be named as: **<your last name>_<your first name initial>_main.m** (or .pl)
For example, if your family name is Wang, and your first name initial is M, the file should be named **Wang_M_Main.m (or .pl)**.
- (4) Please write well-commented code, and include any explanations you think will help the instructor understand your program. If your program does not work completely, comments might help you get partial credit. However, you will get **NO CREDIT** if your program generates errors, generates warnings, or outputs “junk”.

If you have problems, please contact the instructor at 8813grading@lists.gatech.edu with the proper email subject line as instructed in the syllabus.

HONOR CODE

The conditions of this examination are subject to the Georgia Institute of Technology Academic Honor Code.

I pledge that the work in this exam represents my own, original work. I have NOT communicated with anyone (other than my group members) about the contents of this exam, nor participated in or observed any conduct prohibited by the Honor Code.

Student Signature _____

NOTE: Please print out this page, sign the page, scan the signed page, and submit with your programming code.

If you have a problem finding a scanner to scan in the page, please type in the above HONOR CODE statement in your email message body and sign with your name.

Any assignment without the HONOR CODE PAGE will be void to ZERO grade by default.

Prerequisite Tutorials and Information:

MIT-BIH Arrhythmia Database:

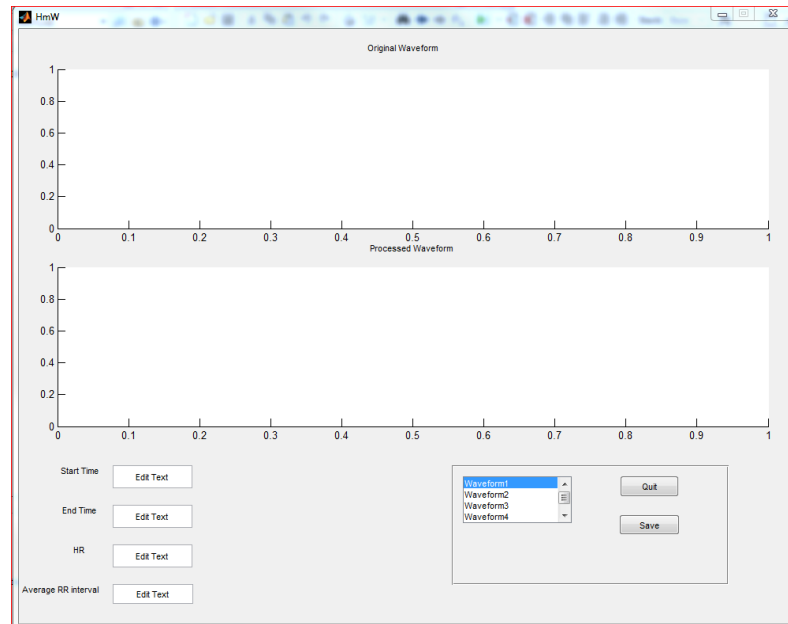
The health informatics practical will require students to be familiar with the MIT-BIH Arrhythmia database. The MIT-BIH Arrhythmia Database contains 48 half-hour excerpts of two-channel ambulatory ECG recordings, obtained from 47 subjects. The recordings were digitized at 360 samples per second per channel. The dataset also includes independent annotations from two or more cardiologists for each patient record in a computer-readable form (approximately 110,000 annotations in all).

The MIT-BIH Arrhythmia Database can be directly accessed at the following website:
<http://www.physionet.org/physiobank/database/mitdb/>.

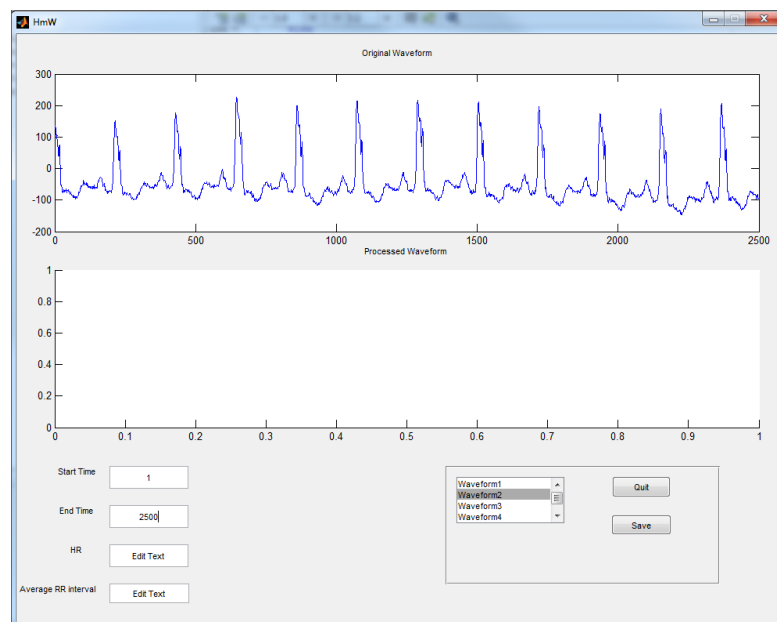
Students should use the PhysioNet MATLAB Toolbox to access the data directly from the website:

http://physionet.org/physiotools/matlab/wfdb-swig-matlab/new_version.shtml

1. **In the first part of this assignment, the students will install the WFDB toolbox for MATLAB, found at the link above. Then the students will familiarize themselves with the functions rdsamp, rdann, waveform data annotations, and methods needed to extract attributes of waveforms (e.g., sampling frequency of the signal).**
 - a. Plot both channels of the waveform with record name '`chfdb/chf01`'. Find and list the sampling frequency and annotations for the waveform using WFDB MATLAB Toolbox functions.
 - b. Plot the waveform with all annotations (overlaid on the plot) using methods outlined in the WFDB MATLAB Toolbox help: <http://physionet.org/physiotools/matlab/wfdb-app-matlab/>.
 - c. Understand the differences between different leads and channels in ECG waveforms and briefly describe the same. (1-2 sentences per lead/channel)
2. **Following setup and familiarization with the WFDB toolbox, students will develop a Graphical User Interface (GUI) for interactively measuring the RR interval and heart rate from an ECG recording.**
 - a. Create a GUI in MATLAB with 2 axes to plot original and processed waveforms, 2 text boxes or sliders to obtain time windows, a “Choose Waveform” list box, a “Quit” push button a textbox for average RR interval, and a “Save” push button. A screenshot of an example GUI is shown below. (Hint: students can use MATLAB GUIDE function for generating the GUI).



- b. The “Load Waveform” listbox, on execution, should open the selected waveform on the screen, using the time length from the text boxes (Hint: students can use the “rdsamp” function). The listbox should list 10 waveforms available in the MIT-BIH Arrhythmia Database.

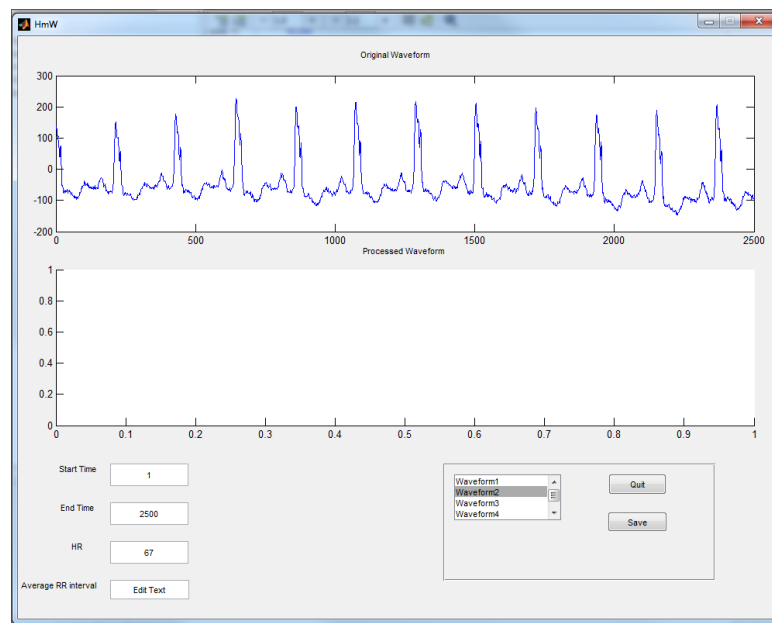


- c. Add functionality to the “Load Waveform” listbox by analyzing selected waveforms to calculate the heart rate (HR), and display it in the “HR” text box.

Hint: A basic process for this would be: (1) Filter the waveforms to remove noise, (2) Perform differentiation of the waveforms, (3) Filter the waveform

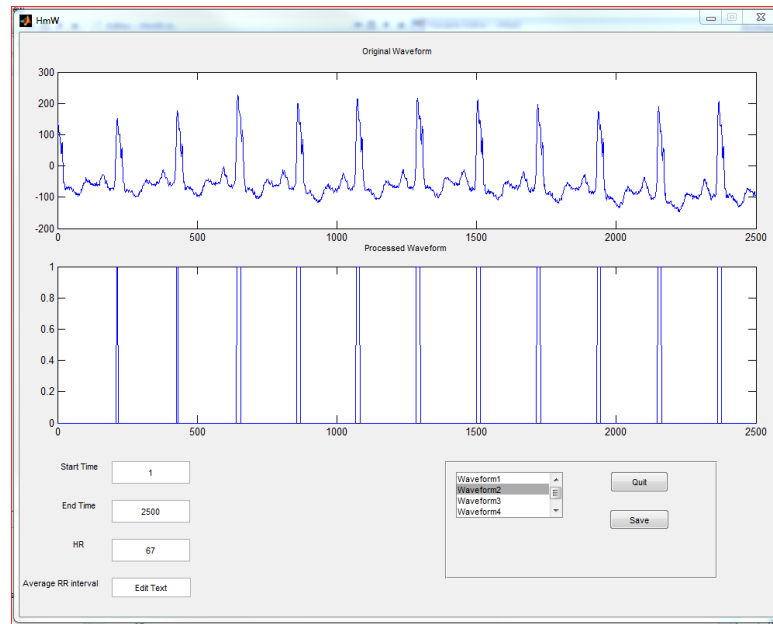
again, (4) Square the waveform, (5) Perform differentiation again, (6) Perform the following operation: $1.3*FDiff + 1.1*F2Diff$ (weighted average of first and second difference), (7) Find the thresholds that are given by half the maximum value of the results of step (6), (8) Count the number of peaks (values greater than the threshold) and scale it to peaks per min, which is the HR. Display the HR in the appropriate box. Alternatively, you may use the procedure outlined in the following paper:

Hamilton and Tompkins, "Quantitative Investigation of QRS Detection Rules Using the MIT/BIH Arrhythmia Database," IEEE Trans Biomed Eng, 33(12): 1157-65, 1986.

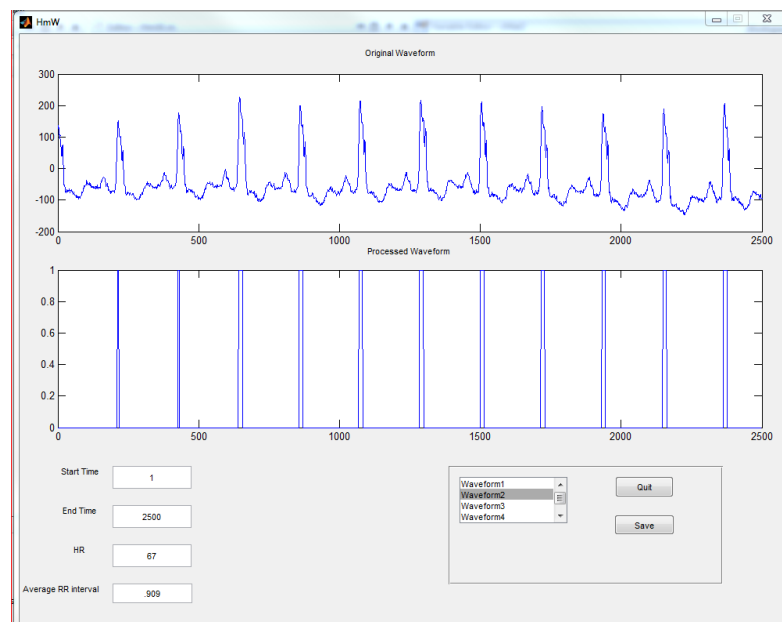


Sometimes, additional peaks are detected that occur very close to real peaks on the waveform. Formulate a method to remove these additional peaks and justify your solution.

Display the processed waveform showing the peaks in the "Processed Waveform" axis. A snapshot of GUI, is shown below.



- d. Calculate the average RR interval using the time duration between the peaks, as described in the Hamilton and Tomkins paper, and display it in the appropriate text box.



- e. The “Save” button, on execution, should save the processed waveform, RR interval, HR, and the start/end times into a *.mat file.