# Health Informatics Practical #3

## Instructions:

This group assignment is expected to **require 5-8 hours to complete.** Please plan accordingly.

**Due Date:** **Nov. 21st (Thursday) by 11:59pm EST**.
**Submission Files:** the **signed HONOR CODE page** (see HONOR CODE page), and **one zipped program folder file** (i.e., containing all code files)

**Submission Protocol:**
Upload the zipped file to your home directory on knn.bme.gatech.edu, and then send an email to 8813grading@lists.gatech.edu to inform us that you have submitted your assignment. For your email subject line, please use: BMED8813 last name 1, last name 2, group #, PRACTICAL #3.

**Submission 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: < last name 1>_<last name 2>_..._<group #>
(3) In your folder, code files should be named as: <last name 1>_<last name 2>_..._<group #>_<code name>.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 instructors at 8813grading@lists.gatech.edu with the proper email subject line as instructed in the syllabus.

# HONOR CODE

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

I pledge that the work in this assignment, including all written code, represents the original work of BMED8813 BHI Group ____ [write group #]. I have NOT communicated with anyone (other than my group members) about the contents of this assignment, nor participated in or observed any conduct prohibited by the Honor Code.

Student Signature _____

Student Signature _____

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:

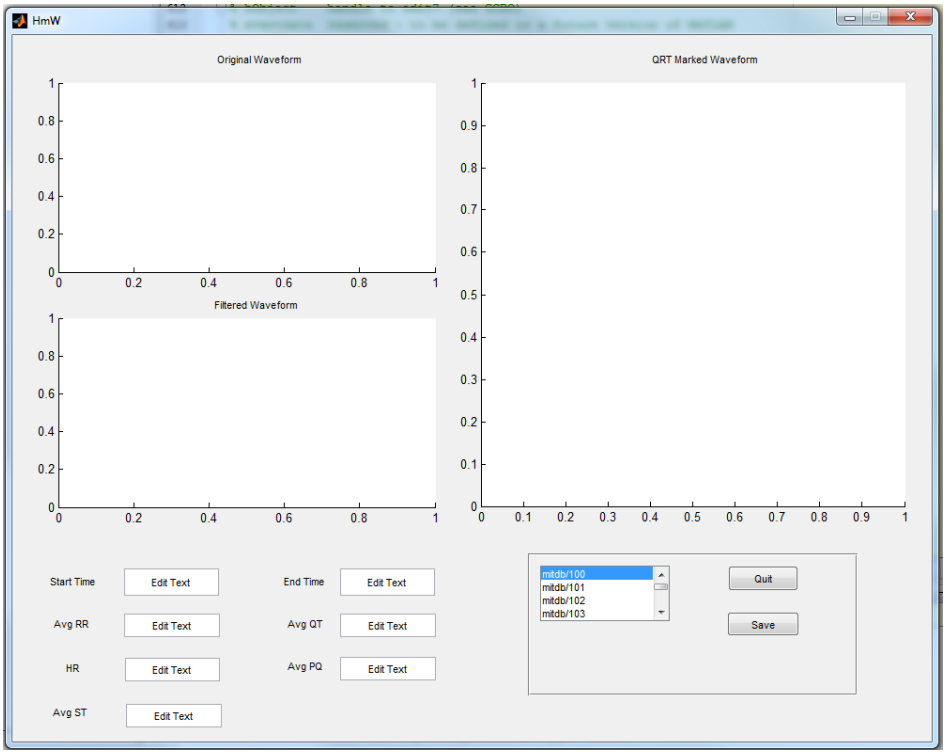
The health informatics practical will require students to be familiar with the MIT-BIH Arrythmia database. The MIT-BIH Arrhythmia Database contains 48 half-hour excerpts of two-channel ambulatory ECG recordings, obtained from 47 subjects. The recordings were digitized at 360 samples per second per channel. 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

Familiarization with different ECG waveforms:
http://www.ijsrp.org/research-paper-1212/ijsrp-p1276.pdf

**1. (10 Points) In the first part of this assignment, modify the previous GUI to display the average PQ, ST segments as shown below.**



**2. (20 Points) In the second part of this assignment, add the P wave extraction code to your previous assignment. Extract the P wave from the ECG signals mitdb/100-mitdb/109 using the following steps:**

Extract the P wave from the ECG using the R wave positions obtained in the previous practical. Use the hints given below.or the algorithm outlined in:
*Cuiwei Li; Chongxun Zheng; Changfeng Tai, "Detection of ECG characteristic points using wavelet transforms," Biomedical Engineering, IEEE Transactions on , vol.42, no.1, pp.21,28, Jan. 1995*

Hints:

- The P wave is found between 30-300ms before the R peak position.
- The P wave is the maximum position in the range given.
- The algorithm would involve (1) searching for the maximum point between 30 to 300 ms before the R wave (this would indicate the position of the P peak), and (2) finding the amplitude of the P peak.

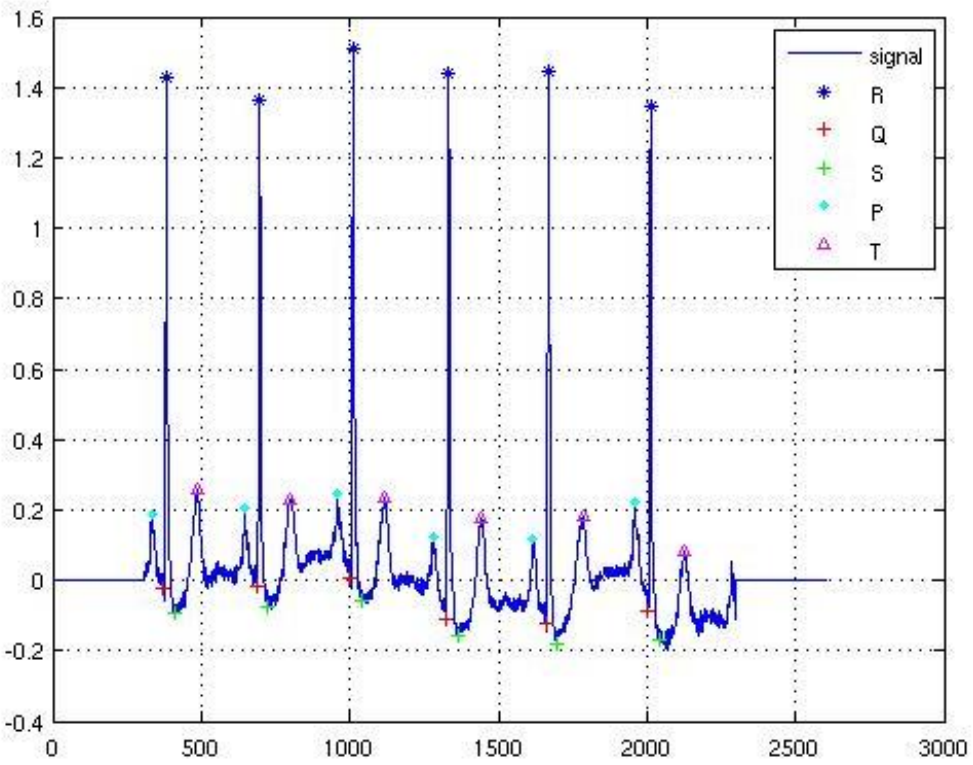
**3. (20 Points) In the third part of this assignment, perform the extraction of the S wave from the ECG signals mitdb/100-mitdb/109.**

Use the same R position values extracted in the previous assignment. Use the hints given below.or implement the algorithm outlined in:
*Cuiwei Li; Chongxun Zheng; Changfeng Tai, "Detection of ECG characteristic points using wavelet transforms," Biomedical Engineering, IEEE Transactions on , vol.42, no.1, pp.21,28, Jan. 1995.*

Hints:

- The S wave is found between 15-150 ms after the R peak position.
- It denotes the end of the QRS complex and marks the end of ventricular depolarization.
- The algorithm would involve (1) searching for the minimum point between 15 to 150 ms after the R wave (this would indicate the position of the S peak) and (2) finding the start and end of the S wave.
- To find the start of the S wave, perform a local search about 15 ms before the minimum point. If the amplitude of the signal changes from a positive value to zero or a negative in consecutive samples, it denotes the S wave beginning. If not, then the maximum value in the 55 ms range prior to the minimum point denotes the S wave beginning. If more than one such value is found, then the point closest to the R wave denotes the beginning.
- The end of S wave is found using a similar search 55 ms after the maximum position. If the amplitude changes from positive to negative, then it denotes the end of S wave. In the event no such point is found, then the end of the S wave end corresponds to the maximum value in the range. If more than one such point is found, then the point closest to the S wave is chosen.

4. **(20 Points) Following the extraction of these points, plot the peak locations and the start and end of each peak on the GUI. Also provide the average PQ and ST intervals given by the distance between the S wave and T wave onsets locations.**




5. **(30 Points) Following the extraction of these points, take the mean and SD of each of these interval values, and amplitudes for the 10 ECG signals mitdb/100-mitdb/109 for [0-5s]. Perform feature selection using principal component analysis and determine the top 5 features that preserve maximum energy content.**

Information about PCA can be found in the following tutorial:
Jonathon Shlens, "A Tutorial on Principal Component Analysis"
URL: http://www.cs.cmu.edu/~elaw/papers/pca.pdf