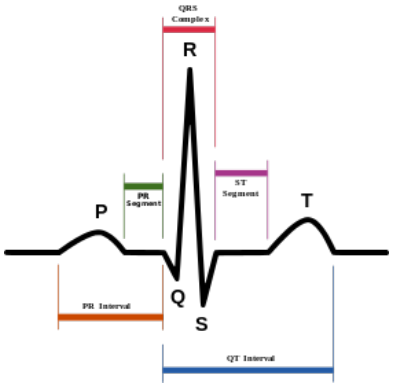
# ENGI-5631-FA Signal and Imaging Processing in Biomedical Applications

Mid-Term Assignment - October, 2017

The mid-term assignment is 15% of your mark. The assignment will be individual and will be strictly compared between students. Any plagiarized code will grant a zero to all students using the same code, regardless of the original author.

Create a Jupyter notebook that fulfils has the following specifications:

1. Has Markdowns for different sections
2. Provides appropriate bibliography for the material shown
3. Gives a brief introduction on ECG and ECG signals
4. Opens the provided ECG signal (*aami3a.dat*) and plots it. This file contains one ECG signal sampled at $720Hz$ with 12-bit resolution.
5. If a person at rest has an average heart rate between 60 and 100 beats per minute, how many samples should you plot to obtain 5 beats in the signal?
6. Plot a zoom-in of the signal where 5 cardiac cycles can be observed considering this person has a cardiac cycle of 60 beats/minute.
7. Considering that an ECG typical signal has the following shape:




   Was the heart rate lower or higher for this individual?
8. Estimate the heart rate of this individual in beats/minute
9. Obtain the DFT of the signal and plot the full spectrum
10. Obtain the frequency at which the maximum is observed
11. From the spectrum, what is your calculation for the heart rate in beats/minute
12. Discuss in the Markdown the peaks observed in the spectrum and what information they provide, in particular, explain how can you obtain from the frequency peaks the heart rate
13. Discuss in the markdown: if you needed to filter this signal (it is quite clean here), would it be a problem to affect the amplitude of the signal? Use references to justify your answer

14. Filter your signal using a digital low-pass Butterworth filter of order 4 that cuts frequencies above $100Hz$
15. Provide a plot with the frequency response of the filter
16. Obtain the DFT of the filtered signal and plot the full spectrum after filtering
17. Discuss in the markdown the effects that your filter may have on any interpretation of the heart rate, did it affect it? why? why not? Explain.

The criteria for evaluation will be as follows:
70% of the mark for completing each of the requested items
15% of the mark for formatting and the correct use of Markdowns
10% of the mark for complete and simple discussions and explanations in the Markdowns
5% of the mark for quality and completeness of the bibliography